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Alhacen's Theory of Visual Perception:

A Critical Edition, with English Translation
and Commentary, of the First Three Books
of Alhacen's *De aspectibus*, the Medieval
Latin Version of Ibn al-Haytham's
Kitab al-Manazir

VOLUME ONE

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CONTENTS

VOLUME I

| | |
|--|---------|
| Preface | ix |
| Notes | xiii |
| Introduction | xv |
| 1. Ibn al-Haytham: A Biobibliographic Sketch | xv |
| 2. From <i>Kitab al-Manazir</i> to <i>De aspectibus</i> | xix |
| The Evolution of the Latin Text | xix |
| A Structural Comparison of Texts | xxiii |
| 3. Ibn al-Haytham's Core Sources | xxv |
| The Problem of Sources | xxv |
| Aristotle's Theory of Visual Perception | xxvi |
| The Visual-Ray Theory | xxviii |
| The Galenic Model of Vision | xxxvii |
| Conclusion | xlili |
| 4. Ibn al-Haytham's Sources in Context | xliv |
| General Intellectual Background | xliv |
| Psychology and Epistemology | xlvi |
| Anatomy and Physiology | xlvi |
| Optics | xlix |
| Conclusion | lii |
| 5. Alhacen's Account of Visual Perception: An Overview | lii |
| Background Summary | lii |
| The Physical Grounds of Sight | liii |
| The Anatomical and Physiological Structure of the Eye | lvii |
| Sensation and the Selection of Visual Images | lx |
| Simple Perception | lxii |
| Certification and the Perception of Individuals and Types | lxviii |
| Visual Illusions | lxxiii |
| Conclusion | lxxviii |
| 6. Alhacen and the Latin West: Lines of Influence | lxxx |
| General Intellectual Background | lxxx |
| Alhacen and Perspectivist Optics | lxxxii |
| Alhacen and Scholastic Philosophy and Theology | xciv |
| Alhacen and Renaissance Art | civ |
| 7. Ibn al-Haytham: A Tentative Reappraisal | cxii |
| Notes | cxix |

| | |
|---|--------|
| Manuscripts and Editing | |
| The manuscripts | clv |
| Selection-Procedures | clxi |
| Afterthoughts on Manuscript-Selection | clxvii |
| The Critical Text | clxix |
| Summary of Results | clxxi |
| The Critical Apparatus | clxxii |
| The Translation | clxxiv |
| Notes | clxxix |

LATIN TEXT

| | |
|---------------------|-----|
| Book One | |
| Chapter 1 | 3 |
| Chapter 2 | 5 |
| Chapter 3 | 8 |
| Chapter 4 | 8 |
| Chapter 5 | 10 |
| Chapter 6 | 11 |
| Chapter 7 | 22 |
| Chapter 8 | 68 |
| Chapter 9 | 72 |
| Book Two | |
| Chapter 1 | 79 |
| Chapter 2 | 79 |
| Chapter 3 | 97 |
| Chapter 4 | 216 |
| Book Three | |
| Chapter 1 | 245 |
| Chapter 2 | 247 |
| Chapter 3 | 285 |
| Chapter 4 | 292 |
| Chapter 5 | 294 |
| Chapter 6 | 296 |
| Chapter 7 | 301 |

VOLUME II

ENGLISH TRANSLATION

| | |
|----------------------------|-----|
| Book One | |
| Topical Synopsis | 339 |
| Chapter 1 | 343 |

| | |
|------------------------------|-----|
| Chapter 2 | 344 |
| Chapter 3 | 346 |
| Chapter 4 | 346 |
| Chapter 5 | 347 |
| Chapter 6 | 348 |
| Chapter 7 | 355 |
| Chapter 8 | 387 |
| Chapter 9 | 390 |
| Notes | 395 |
| Book Two | |
| Topical Synopsis | 415 |
| Chapter 1 | 417 |
| Chapter 2 | 417 |
| Chapter 3 | 429 |
| Chapter 4 | 512 |
| Notes | 531 |
| Book Three | |
| Topical Synopsis | 559 |
| Chapter 1 | 561 |
| Chapter 2 | 562 |
| Chapter 3 | 588 |
| Chapter 4 | 593 |
| Chapter 5 | 595 |
| Chapter 6 | 597 |
| Chapter 7 | 600 |
| Notes | 629 |
| APPENDICES | |
| Appendix 1 | 642 |
| Appendix 2 | 653 |
| Appendix 3 | 667 |
| Appendix 4 | 677 |
| Latin-English Index | 681 |
| English-Latin Glossary | 747 |
| Bibliography | 785 |
| General Index | 799 |

PREFACE

Sometime between 1028 and 1038, Ibn al-Haytham completed his monumental optical synthesis, *Kitab al-Manazir* ("Book of Optics"). By no later than 1200, and perhaps somewhat earlier, this treatise appeared in Latin under the title *De aspectibus*. In that form it was attributed to a certain "Alhacen."¹ These differences in title and authorial designation are emblematic of the profound differences between the two versions of the treatise. In many ways, in fact, they can be regarded not simply as different versions of the same work, but as different works in their own right. The underlying point of this observation is so obvious that it can all-too-easily pass unremarked and thus unheeded: translation is not a straightforward conversion-process. To translate, as its Latin form *interpretare* suggests, is to interpret. Accordingly, the Arab author, Ibn al-Haytham, and his Latin incarnation, Alhacen, represent two distinct, sometimes even conflicting, interpretive voices. The same holds for their respective texts.

To complicate matters, "Alhacen" does not even represent a single interpretive voice. As we shall see in due course, there were at least two translators at work on the Latin text, one of them (Gerard of Cremona?) hewing as faithfully as possible to the Arabic original, the other content with distilling, even paraphrasing, the Arabic original.² Consequently, the Latin text presents not one, but at least two faces to the reader. The Latin text is also markedly different from its Arabic source in organization. To start with, in lacking the first three chapters of book 1 of the *Kitab al-Manazir*, the Latin text is missing almost half of that book in its original form. This turns out to be a significant omission in terms not only of amount, but also of content, for it is in those three chapters that Ibn al-Haytham sets forth key methodological principles for later discussion. Furthermore, the internal structure of the Latin text—according to chapters, subsections, and even paragraphs—is often at variance with that of the Arabic original.³ The analytic flow is therefore not precisely the same in the two texts, a fact that has a significant, albeit subtle, impact upon how the treatise is assimilated by the reader.

The two texts also differ according to lectorial perspective. The conceptual prism through which a medieval Arab scholar would have read the *Kitab al-Manazir* is fundamentally different from that through which his scholastic Latin counterpart would have read the *De aspectibus*. To

be sure, Arab and Latin were separated by language, but they were separated at an even more profound level by conceptual and cultural differences, some reflected by, some reflecting upon, language. Thus, for instance, the Arabic term *sura* ("form") might have been taken in a relatively concrete sense as "similitude" or "image" by a medieval Arab reader, whereas its Latin rendering, *forma*, might well have been taken in a more abstract sense as "intentional species" by his scholastic Latin counterpart.⁴ Suffice it to say, examples of this sort abound.

All of this is to affirm that in many critical respects the Latin text can be, and indeed should be, analyzed on its own, wholly independent of the Arabic original. I emphasize this point to underline the fact that much of the analysis that follows in this book is slanted specifically toward Alhacen's *De aspectibus*, not Ibn al-Haytham's *Kitab al-Manazir*. Much of what is said about the former no doubt extends to the latter, but such extension is often incidental rather than essential. Why restrict my analytic scope in this way? For one thing, I am not an Arabist. Any attempt on my part to speak for the Arabic text would thus be presumptuous. For another thing, even were I competent in Arabic, I doubt that I would have much, if anything, worth adding to what A. I. Sabra has already established in typically judicious fashion in his critical edition and English translation of the first three books of the *Kitab al-Manazir*.⁵

At this point one might question the very need for a critical edition and translation of the Latin text when we already have Sabra's Arabic edition and translation. We have already addressed this issue—at least partially—by pointing to the fundamentally different interpretive faces the two texts present. The Latin text, in short, is not just a replica, in different linguistic guise, of the Arabic. The same holds for my English translation. As an *interpretatio* of an *interpretatio*, it stands entirely apart from Sabra's. My English translation is thus intended as a complement, not an alternative, to his.

There is yet another possible objection to this critical edition. A perfectly serviceable Latin text is already available in the form of Friedrich Risner's *editio princeps* of 1572, a landmark of lateer Renaissance scholarship that has since been reprinted.⁶ What point is there, then, in publishing an essentially redundant modern edition? This objection is blunted in at least three ways. First, Risner's edition is not at all "critical," at least not in the proper sense of the term. His primary goal in publishing the *De aspectibus* was to create an up-to-date version that would appeal to contemporary readers interested in optics. To that end he not only modified terminology and phraseology according to humanist standards, but also restructured the text by subdividing the origi-

nal narrative into theorematic chunks. Second, although Risner did provide annotation, primarily by interpolating sources and citations into the Latin text, his purpose in doing so was not to place the work into proper historical context. On the contrary, it was to modernize it out of proper historical context. Third, as we will later see, the two manuscripts from which Risner drew his edition fall within the least authentic of three basic family-traditions.⁷

Furthermore, with a critical Arabic text of books 1-3 of the *Kitab al-Manazir* at last available, it is now possible to compare that text at every level against its Latin counterpart. But any comparison of Arabic and Latin texts on the basis of Risner's edition would be worse than useless; it would be downright misleading, because Risner transformed both terminology and phraseology in ways that do more to mask than to reveal proper textual links. In light of this consideration, the need for a new, critical edition of the *De aspectibus* is as obvious as is the insufficiency of Risner's text to fulfill it.

The need for such an edition gains added urgency from the fact that most of the key derivative works produced by Alhacen's Perspectivist disciples have come out in complete or partial form over the past three decades. The first to see print, John Pecham's *Perspectiva communis*, was published by David Lindberg in 1970.⁸ Since then Lindberg has produced editions of Roger Bacon's *De multiplicatione specierum* and *Perspectiva*.⁹ Meantime, critical editions of books 1-3 and 5 of Witelo's *Perspectiva* have appeared between 1977 and 1991, and an edition of book 4 is currently underway.¹⁰ Finally, at the divide between Perspectivist and modern optics, Johan Kepler's *Ad Vitellionem paralipomena* ("Emendations to Witelo") of 1604 has finally appeared in a critical English translation.¹¹ The time is thus ripe—indeed, overripe—for a critical edition of the work upon which all of these were ultimately based.

A final question that might be raised is why this edition is limited to the first three books of the *De aspectibus* rather than extending to all seven. There are two reasons. First, as I discuss later in the introduction (p. xviii), books 1-3 form a distinct and complete thematic unit. They therefore stand perfectly well on their own without any need of the remaining four books to provide context. The second reason has to do with the length of the *De aspectibus*, which runs to nearly 200,000 words. A proper edition of the remaining four books of the treatise, which can be subdivided into three thematic units, will be at least a decade in the making. I hope to have the next installment, a critical edition of books 4 and 5, ready for publication within the next three or four years.

This edition has been some fourteen years in the making. Over those years I have accrued a sizeable debt to individuals and institutions for their help and support. I therefore wish to take this opportunity to acknowledge those debts and express my gratitude to those who have allowed me to run them up. Let me start at the institutional level. First, and foremost, I wish to thank my home institution, the University of Missouri, for its generous support of this project, support that has come at both the Columbia campus level, through the MU Research Council (1987, 1990-91, 1993, and 1996), and the system level, through the University of Missouri Research Board (1995). I owe thanks, in addition, to the American Philosophical Society, the American Council of Learned Societies, and the National Endowment for the Humanities for their support during the summers of 1989 (APS, ACLS) and 1990 (NEH). Finally, I wish to express my deep gratitude to the National Science Foundation for supporting me during calendar year 1999, while I put the finishing touches on this edition and rendered it into publishable form.

Still at the institutional level, I am pleased to acknowledge the administration and staff of various libraries and manuscript-collections to whose holdings I needed continual access for this project. In particular, I owe a profound debt of gratitude to the staff of the following libraries for making me welcome at various reprises during the past twelve years. Foremost among these are the Trinity College Library, Cambridge; the Crawford Library of the Royal Observatory, Edinburgh (special thanks to Angus Macdonald for his kindness); the Wissenschaftliche Allgemeinbibliothek, Erfurt; the Royal College of Physicians, London; the Bibliothèque Nationale, Paris; and the Bibliothèque Municipale, St-Omer.

At the personal level, finally, I wish to thank the following: Matthew Shaw, not only for his invaluable editorial help, but also his yeoman labor in generating the Latin-English glossary and index; Melinda Lockwood, for her many services in formatting the text and rendering the diagrams importable into that text; Kristi Keuhn for her editorial contributions; Dallas Denery, Bruce Eastwood, David Lindberg, Robert Hatch, Norman Land, and Ann Stanton for their critical reading of various sections of this introduction. I would also like to thank the two referees, Noel Swerdlow and an anonymous reader, for providing me with several useful suggestions about both content and sources. Thanks, too, to Carole LeFaivre-Rochester, senior editor at the American Philosophical Society, for her encouragement and advice over the past year or so as this edition took final shape.

NOTES

¹For details on the dating and context of the *Kitab al-Manazir*, see "Introduction," pp. xix-xxi below. Although it has been traditional to Latinize Ibn al-Haytham's name according to the form "Alhazen," the proper form according to the actual manuscripts is "Alhacen." For elaboration on this point, see "Introduction," p. xxi below.

²For further discussion of the two Latin translators/translations, see "Manuscripts and Editing," pp. clxviii-clxix below.

³The content and import of the first three chapters of the Arabic version are briefly discussed in "Introduction," p. xxiii below. For a more extensive discussion of the structural differences between Arabic and Latin texts, see "Introduction," pp. xxiii-xxiv below.

⁴For a close examination of the use and intent of "form" in the *Kitab al-Manazir*, see A. I. Sabra, "Form in Ibn al-Haytham's Theory of Vision," *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* 5 (1980): 115-140. For a discussion of the meaning and intent of "intentional species," see "Introduction," pp. lxxxviii-lxxxix below.

⁵For the critical Arabic text, see A. I. Sabra, *Ibn al-Haytham, Al-Manazir I-II-III = Kitab al-Manazir. Books I-II-III: On Direct Vision* (Kuwait, 1983). For the English translation, which includes an extensive critical analysis of the treatise, see Sabra, *The Optics of Ibn al-Haytham: Books I-III on Direct Vision* (London: Warburg Institute, 1989).

⁶*Opticae thesaurus. Alhazeni arabis libri septem, nunc primum editi. Eiusdem liber De crepusculis et Nubium ascensionibus. Item Vitellonis thuringopoloni libri X* (Basel, 1572); reprinted with an introduction by David C. Lindberg (New York: Johnson Reprint, 1972). For a description of this edition, see "Introduction" and "Manuscripts and Editing," pp. xxii-xxiii and clx-clxi below.

⁷See "Manuscripts and Editing," pp. clxvi-clxix below, for details.

⁸David C. Lindberg, ed. and trans., *John Pecham and the Science of Optics* (Madison: University of Wisconsin Press, 1970).

⁹David C. Lindberg, ed. and trans., *Roger Bacon's Philosophy of Nature* (Oxford: Clarendon Press, 1983) and *Roger Bacon and the Origins of Perspectiva in the Middle Ages* (Oxford: Clarendon Press, 1996).

¹⁰Sabetai Unguru, ed. and trans., *Witelonis Perspectivae liber primus* (Wroclaw: Ossolineum Press, 1977) and *Witelonis Perspectivae liber secundus et liber tertius* (Wroclaw: Ossolineum Press, 1991). A. Mark Smith, ed. and trans., *Witelonis Perspectivae liber quintus* (Wroclaw: Ossolineum Press, 1983). Carl Kelso is

currently editing book 4 for his doctoral dissertation at the University of Missouri.

¹¹William H. Donahue, trans., *Johannes Kepler, Optics: Paralipomena to Witelo and Optical Part of Astronomy* (Santa Fe, NM: Green Lion Press, 2000).

INTRODUCTION

1. *Ibn al-Haytham: A Biobibliographic Sketch*

The two cardinal sources for Ibn al-Haytham's biography are Jamal al-Din ibn al-Qifti (d. c. 1248) and Ibn Abi Usaybi'a (d. 1270), both of whom lived a good two centuries after Ibn al-Haytham. Most of what they have to say is therefore based upon secondary accounts and hearsay. Even so, by drawing upon the two biographers with care, we can piece together a fairly credible, if spotty, narrative of Ibn al-Haytham's career.¹ For instance, we are fairly certain that his birthplace was Basra on the Persian Gulf coastline of modern-day Iraq. According to one account, in fact, he eventually rose to the level of *vizier* there. We are less certain about Ibn al-Haytham's birthdate. One source allows us to pinpoint it to 965, but, despite its exactitude, this dating is suspect.²

Sometime around 1021, perhaps even earlier, he took up residence in Egypt. Why he did so is open to debate. One story has it that he came at the behest of the Fatimid Caliph, al-Hakim, who invited him to supervise a project for controlling the flow of the Nile, a project that Ibn al-Haytham had promoted for some time before al-Hakim extended his invitation. After surveying the Nile, the story continues, Ibn al-Haytham realized that the task was beyond his capacities. Fearing the wrath of his mercurial patron at his failure, he eventually pretended to be insane in the hope of escaping with his life.³ Confined to house-arrest until al-Hakim's death in 1021, he subsequently established residence at—or, more precisely, in front of—the Azhar mosque in Cairo. Occupying a tent there for the remainder of his life, Ibn al-Haytham led a spartan existence as a scholar, composing his own works, copying some for pay, and teaching.⁴

According to another account, by 'Ali ibn Zayd al-Bayhaqi, Ibn al-Haytham began to immerse himself in philosophical studies while serving as *vizier* in Basra. Realizing that his administrative obligations stood in the way of those studies, he feigned insanity in order to be relieved of his position. At that point he left Basra for Egypt in search of a more salubrious intellectual climate.⁵ Whichever the case, the eventual outcome was the same: sometime after 1021 Ibn al-Haytham fetched up at the Azhar mosque in Cairo, where he devoted himself to a life of the mind until his death some twenty years later.⁶

If the lists of his works drawn up by Ibn Abi Usaybi'a and Ibn al-Qifti are to be credited, Ibn al-Haytham was extraordinarily prolific. Over 180 tracts are attributed to him by title, and he himself claims to have authored others that fell out of his possession and were irretrievably lost.⁷ Even more astonishing than the sheer number of these works is that most of them seem to have been composed in the relatively short interval between 1027 and his death, which probably occurred in 1041.⁸

The scope of his *oeuvre* is remarkably broad as well, ranging from pure mathematics and astronomy to medicine, logic, metaphysics, and even *kalam*, or speculative theology. Indeed, commentaries on the natural and epistemological (especially the logical) works of Aristotle figure prominently in the catalogue of his earlier works.⁹ Still, the primary focus of Ibn al-Haytham's writings, particularly those composed after 1028, was upon scientific and mathematical rather than philosophical matters. Among the scientific works specifically credited to Ibn al-Haytham, at least nineteen bear directly or indirectly upon optics.¹⁰ Only one of the four that can be dated with relative assurance to the period before mid-1028 has survived. Of the three that have not, one in particular stands out by the suggestiveness of its title: "A Book in Which I have Summarized the Science of Optics from the Two books of Euclid and Ptolemy, to Which I have Added the Notions of the First Discourse Which is Missing from Ptolemy's Book."¹¹ Of the two other lost works, one is entitled "Treatise on Burning Mirrors," the other "Treatise on the Nature of [the Organ of] Sight and on How Vision is Achieved through It." Suffice it to say, the recovery of these three lost works would be immensely helpful to us in reconstructing Ibn al-Haytham's early thought on light and vision.

The single work that does survive from this early period is entitled "Commentary and Summary of the *Almagest*." One of the issues addressed in this treatise is the apparent enlargement of the sun and moon toward the horizon, the so-called Moon Illusion, which Ptolemy broaches in chapter 3 of the first book of the *Almagest*.¹² Judging by the number of subsequent writings devoted wholly or in part to it, Ibn al-Haytham seems to have been preoccupied with this issue throughout the last decade or more of his life.¹³

The remaining works that deal with optical matters—fifteen in all—date from the period between mid-1028 and late 1038. Among these treatises (which include the *Kitab al-Manazir*), thirteen are devoted exclusively to optical matters. The other two are concerned with optics only peripherally. Grouped according to subject-matter or approach, they are as follows:

Three works on the focusing properties of mirrors and spherical lenses:

1. "Treatise on Spherical Burning Mirrors."
2. "Treatise on Parabolic Burning Mirrors."
3. "Treatise on the Burning Sphere."¹⁴

Three works dealing with the problem of whether the light of the moon and other celestial bodies is intrinsic or extrinsic in origin:

4. "Treatise on the Light of the Moon."
5. "Treatise on the Light of the Stars."
6. "Treatise on the Nature of the Mark on the Face of the Moon."¹⁵

Three works that deal with optics in a more or less general way:

7. "Treatise on Optics According to Ptolemy's Method."
8. "Book of Optics" (*Kitab al-Manazir*).
9. "Discourse on Light."¹⁶

Three works devoted to atmospheric refraction and its effect on celestial observation:

10. "Treatise on the Appearance of the Stars."
11. "Disputable Points in Ptolemy" (*Dubitationes in Ptolemaeum*).
12. "Treatise on the Solution of Difficulties in the First Book of the *Almagest* which a Certain Scholar has Raised."¹⁷

Three works devoted to miscellaneous subjects involving ray-analysis:

13. "Treatise on the Rainbow and Halos."
14. "Treatise on the Quality of Shadows."
15. "Treatise on the Form of the Eclipse."¹⁸

Exactly where the *Kitab al-Manazir* fits chronologically in this listing is difficult, if not impossible to determine with precision, but all indications are that it antedates entries 3, 6, 9, 11, 12, 14, and 15 above. Likewise, we can be fairly sure that it postdates the four works composed before 1027 as well as entry 10 above.¹⁹ We can thus assume with fair certainty that Ibn al-Haytham had been engaged in the study of optics

well before he undertook to write the *Kitab al-Manazir*.²⁰ Nevertheless, our inability to determine the *Kitab al-Manazir*'s chronological position more accurately leaves us far less certain than we would like to be about the development of Ibn al-Haytham's thought before he began composing this grand synthesis.

Unlike the rest of his surviving treatises on optics, which are rather narrowly focused, the *Kitab al-Manazir* treats its subject in a truly comprehensive way. The first three of the seven books comprising this particular work are devoted to the problem of visual perception taken in its broadest sense. Book 1 lays the essential physical foundations for sight in terms of light- and color-radiation, the anatomical and physiological structure of the eye, and the various preconditions of sight: i.e., that the visible object be illuminated or luminous, that it face the observer, that the space between eye and object be transparent, etc. Book 2 explains how physical radiation is transformed into visual impressions by the optic complex between eye and brain. Among the specific topics addressed in this book are perceptual interpretation and perceptual certification. Book 3, finally, discusses the ways in which misperception can occur when the preconditions mentioned above exceed or fall short of certain limits: e.g., if an object is too bright or too dim, if it is too close or too far away, or if the intervening medium is inadequately transparent. Included in this account of visual illusions is an extensive analysis of binocular vision and diplopia. Altogether, then, the first three books of the *Kitab al-Manazir* form a discrete topical segment.

The second topical segment of the *Kitab al-Manazir* consists of books 4-6. Here Ibn al-Haytham deals with the visual effects of reflection, the analytic focus thus being upon mirrors and mirror-images. In order of analysis, book 4 lays out the basic principles of reflection, book 5 deals with image-formation in general, and book 6 takes up the issue of image-distortion according to the shape of the reflecting surface.²¹ Book 7 forms the third and final topical segment. In that book Ibn al-Haytham deals with the visual effects of refraction. The most signal of these effects are image-displacement and magnification, both of which bear upon the apparent positional displacement and enlargement of celestial bodies toward the horizon.²² At bottom, therefore, the *Kitab al-Manazir* is organized according to whether and how the visual act is mediated, each topical segment addressing one of the three modes of sight: direct vision (unmediated), reflected vision (mediated by mirrors), and refracted vision (mediated by transparent bodies of different optical density).

As noteworthy as the *Kitab al-Manazir* is for the topics it does cover, it is equally noteworthy for the two topics it does not. First, nowhere in the course of his analysis of reflection does Ibn al-Haytham discuss the

focal properties of parabolic or spherical concave mirrors: i.e., burning mirrors. As we have seen, these subjects were reserved for separate treatment.²³ The second topic not covered in the *Kitab al-Manazir* is the rainbow and its formation. This, too, as we have seen, was reserved for separate treatment.²⁴ Thus, two subjects that would seem to be of paramount concern in optics are ignored completely in the *Kitab al-Manazir*. However, as Sabra quite rightly points out, these subjects, particularly burning mirrors, were generally not included in the study of optics (or *manazir*), presumably because, unlike optics, these studies are concerned with light and its properties rather than with vision.²⁵

No summary can do justice to the meticulousness and depth of Ibn al-Haytham's analysis of sight and light in the *Kitab al-Manazir*. Nor can a summary do justice to the lucidity of that analysis. Yet despite its obvious standing as a definitive source, the *Kitab al-Manazir* seems to have suffered much the same fate as Ptolemy's *Optics* did some eight-and-a-half centuries earlier: it sank into oblivion almost as soon as it was completed.²⁶ Not until the late thirteenth century, some 250 years after its composition, did the *Kitab al-Manazir* attract serious attention among Arab scholars. The key figure in resurrecting it was Kamal al-Din al-Farisi, whose *Tanqih al-Manazir* ("Paraphrase of [Ibn al-Haytham's *Kitab*] *al-Manazir*") provides both a synopsis of, and a commentary on, the *Kitab al-Manazir* along with some of Ibn al-Haytham's shorter optical pieces. Kamal al-Din's *Tanqih* was thus instrumental in bringing Ibn al-Haytham's optical work to light and, on that basis, elevating Ibn al-Haytham himself to the high level of respect he still enjoys (and deservedly so) within the Arab world.²⁷

2. *From Kitab al-Manazir to De aspectibus*

The Evolution of the Latin Text: Of all the works ascribed by title to Ibn al-Haytham, some sixty have survived in Arabic according to Sabra's count.²⁸ Of those sixty, only three have come down to us in Latin. By far the most significant of these three is the *Kitab al-Manazir*. Of the other two, only one deals with optical matters: the "Treatise on Parabolic Burning Mirrors" (entry 2, p. xvii above), which circulated in Latin as the *De speculis comburentibus seu de sectione mukefi* ("On Burning Mirrors or On the Parabolic Section").²⁹ The third and final work rendered into Latin is a relatively brief treatise on cosmology entitled "On the Configuration of the World," which bears the Latin title *De configuratione mundi*.³⁰

Precisely when and by whom the *Kitab al-Manazir* was translated

into Latin is very much at issue. The traditional dating—late twelfth century—depends in great part upon the unfounded, or at least poorly founded, assumption that Gerard of Cremona served as translator. As far as concrete evidence is concerned, there is nothing yet discovered to indicate that the *De aspectibus* was in circulation before the 1220s or 1230s.³¹ The earliest incontestable evidence of its circulation is to be found in Bartholomeus Anglicus' *De proprietatibus rerum*, where the *De aspectibus* is cited several times. This work probably dates to the later 1240s.³² It was not until the 1260s, however, that the *De aspectibus* began to circulate in earnest, its increasing popularity reflected in such key derivative works as Roger Bacon's *Perspectiva* (c. 1265), Witelo's *Perspectiva* (c. 1275), and John Pecham's *Perspectiva communis* (c. 1280).³³ By the mid-fourteenth century, it had become enough of a staple to have been translated into Italian.³⁴

No less indeterminate than the date of the translation is its source. Although the *De aspectibus* is commonly ascribed to Gerard of Cremona, that ascription is problematic in several ways. For one thing, the *De aspectibus* is not included in the standard list of Gerard's translations.³⁵ It is difficult to understand how a work of such monumental significance and size could have been overlooked when that list was compiled by Gerard's students. For another thing, Gerard is linked with the *De aspectibus* through a brief treatise entitled *De crepusculis et nubium ascensionibus* that is appended to the *De aspectibus* in several manuscripts.³⁶ So placed, it was taken to be an integral part of the *De aspectibus* during the later Middle Ages and Renaissance. Accordingly, Pedro Nuñez, who first published the *De crepusculis* in 1542, attributed it to Alhacen. So did Friedrich Risner, who included the *De crepusculis* in his edition of the *De aspectibus*. Like Nuñez before him, moreover, Risner cited Gerard of Cremona as translator.³⁷ As it turns out, Nuñez and Risner were only half right: Gerard of Cremona probably did translate the *De crepusculis*, but Alhacen was definitely not its author.³⁸ That distinction falls to Ibn Mu'adh al-Jayyani, a late-eleventh-century Muslim scholar from Jaén in southern Spain.³⁹ Hence, Gerard's association with the *De aspectibus* is based, at least in part, upon a spurious link between the *De aspectibus* and the *De crepusculis*.

A further problem with identifying Gerard of Cremona as translator is that at least two translators (or translation-styles) appear to have been at work in the *De aspectibus*. Up to the third chapter of book 3, the Latin text is remarkably faithful to the Arabic original. At that point, however, the two texts part company, the Latin translation degenerating into a rather inept distillation of the Arabic original.⁴⁰ In terms of translation-style, then, books 1-3 of the Latin text consist of two distinct

sections. The first runs from the beginning of the first book to the middle of chapter 3 of the third book, the second from the middle of chapter 3 of the third book to the end of the book.⁴¹ Clearly, then, if Gerard of Cremona did have a role in translating the *Kitab al-Manazir*, it was a shared one.

Although the issue of when and by whom the *Kitab al-Manazir* was rendered into Latin remains unresolved, two other longstanding issues can be quite easily put to rest. The first has to do with the proper title of the Latin version. Lindberg, and Sabra following him, suggests that “*De aspectibus*” and “*Perspectiva*” are legitimate alternatives.⁴² But a close examination of the manuscripts reveals this suggestion to be misleading. There is absolutely no doubt that the proper title of the treatise—the one actually chosen by the translator(s)—is “*De aspectibus*.”⁴³ I am in fact aware of only four cases in which the term “*Perspectiva*” occurs in the manuscripts. In two instances it is indeed used as a titular designation, but in both cases it constitutes a later interpolation, not an integral part of the original text. In the remaining two instances the term is not intended as a titular designation at all.⁴⁴

The second issue involves the correct Latin form of Ibn al-Haytham’s name. Until quite recently, “*Alhazen*” was the unanimous choice among scholars. There is, however, no support whatever within the manuscript-tradition for that choice. The only forms to be found in the manuscripts themselves are “*Hacen*,” “*Alacen*,” “*Achen*,” and “*Alhacen*,” this last being the most common. “*Alhacen*,” moreover, is an appropriate Latin transliteration of “*al-Hasan*,” Ibn al-Haytham’s given name.⁴⁵ The form “*Alhazen*,” on the other hand, seems to have originated with Friedrich Risner, and its persistence since the publication of the *Opticae thesaurus* is a testament to the speed and force with which that work swept the field of optics after its appearance in 1572.⁴⁶

The pattern according to which the *De aspectibus* was disseminated during the three centuries or so after its initial appearance is probably reflected, however dimly, in the chronological and geographical distribution of the twenty-two surviving manuscripts or manuscript-fragments of the work. Nine date to the thirteenth century, nine to the fourteenth, two to the fifteenth, and two to the sixteenth.⁴⁷ These figures suggest fairly strongly that the *De aspectibus* saw its widest dissemination in manuscript form during the thirteenth and fourteenth centuries—i.e., between roughly 1250 and 1400. After that, most of the momentum for “publication” seems to have been lost until the printing of Risner’s edition in 1572. A probable factor in this loss of momentum is the parallel dissemination of various derivative works, particularly John Pecham’s *Perspectiva communis*.⁴⁸

As to geographical distribution, copies of the *De aspectibus* are currently to be found in fourteen locations scattered throughout "Latin" Europe. Listed in alphabetical order, they are as follows: Bruges (1 complete); Cambridge (2 complete or almost complete); Cracow (1 fragment); Edinburgh (1 complete); Erfurt (1 complete, 1 fragment); Florence (1 almost complete); London (3 complete or almost complete); Milan (1 fragment); Munich (1 complete); Oxford (1 complete); Paris (3 complete); Rome (1 fragment, 2 complete, including the fourteenth-century Italian translation); St-Omer (1 complete); Vienna (1 complete, 1 fragment).

To be sure, these chronological and geographical data are indicative at best, certainly not definitive. For a start, the survival of ancient artifacts, manuscripts included, is a chancy business. The relative dearth of manuscripts from the fifteenth and sixteenth centuries may thus reflect nothing more than the vagaries of time. Or, as has already been suggested, it may be the result of saturation. Likewise, for several of the manuscripts, current provenance reflects the whim of modern collectors or antiquarians rather than the actual working life of those manuscripts. This is certainly the case with such agglomerated holdings as those currently in the Bibliothèque Nationale in Paris or the Bayerische Staatsbibliothek in Munich. Still, we can conclude with moderate assurance that the *De aspectibus* enjoyed its broadest diffusion in manuscript-form, both chronologically and geographically, during the period from roughly 1250 to 1400. The period after 1400 seems to mark a settling-in of sorts, the supply of manuscripts having more or less matched demand.

Still, there must have been considerable pent-up demand by the second half of the sixteenth century, for by far the broadest dissemination of Alhacen's treatise came after 1572, when the *De aspectibus* saw print for the first time in Friedrich Risner's *Opticae thesaurus*. Virtually as soon as it appeared, this edition superseded everything that went before it. The reasons are not far to seek. First, Risner's text is much easier to read and use than any of the manuscript-sources; not only is the type-face distinct and easily deciphered, but Risner kept abbreviations to a minimum in order, presumably, to reduce the possibility of ambiguous readings. In addition, by breaking the text into propositions, adding enunciations, providing cross-references, and giving source-citations not in the original, Risner made the text as a whole much more accessible as a research-tool. As with the text, so with the diagrams, Risner made significant clarifications and improvements, thus easing the reader's burden, particularly after book 3, when the analysis becomes increasingly technical.

As to the genesis of Risner's edition, we are fortunate to have a brief background account in the dedicatory preface he composed for Catherine de Medici, queen mother of Charles IX of France. It was at the urging of Petrus Ramus (or Pierre de la Ramée), Risner informs us, that he undertook to edit the treatise, using two manuscripts (one supplied by Ramus after a long search through libraries and among booksellers) as the basis.⁴⁹ Which two, if any, among those currently at hand is open to question and may well remain so forever, given the substantial editorial changes and additions that Risner imported into the original text. But we can at least narrow the possibilities to a particular subfamily—one of three—within the overall manuscript-tradition.⁵⁰ Consisting of six manuscripts, this subfamily is firmly linked to Risner's text through a number of distinctive common features, such as the inclusion of Ibn Mu'adh's *De crepusculis*, the repetition of glosses, and the sharing of a significant number of detailed textual variants.⁵¹ Risner's text therefore represents the last and most divergent member in a subfamily of manuscripts that itself turns out to be most divergent from the *Urtext*. There is more than a little irony in this fact. For, in doing his best to improve the Latin text, Risner went farther than anyone before him toward corrupting it. More to the point, it is upon this corrupted version of the *De aspectibus* that most modern scholarship has been based.

A Structural Comparison of Texts: By far the most significant structural difference between the Arabic and Latin texts is found in book 1, where the first three of eight chapters in the Arabic original are missing in the *De aspectibus*. In terms not only of size, but also of content, this omission is as remarkable as it is unfortunate, because the three chapters in question constitute nearly half the first book in Arabic.⁵² The Latin version of book 1 is therefore badly truncated, opening with chapter 4 rather than chapter 1 of the Arabic original.

As it stands in the Latin text, moreover, the fourth chapter of the Arabic original (i.e., the opening chapter of the Latin version) is sectioned arbitrarily into three, four, or even five subchapters in various manuscripts. As a result, the first book in the Latin text comprises as few as seven and as many as ten chapters, depending upon which manuscripts are taken into account.⁵³ This is more than a little puzzling. Why subdivide the first chapter at all? The most obvious explanation is that the translator(s) sectioned the first chapter in such a way as to bring the total number of chapters in book 1 of the Latin version into line with the total number of chapters in book 1 of the Arabic original. Yet there is no overt indication in any of the Latin manuscripts that the translator(s) was aware that his text (or his Arabic exemplar) was deficient in any

respect whatever.⁵⁴ Furthermore, the canonical number of chapters for book 1 in the original Latin version, as established in the critical text that follows, differs from the canonical number of chapters in the Arabic original—i.e., nine as opposed to eight.⁵⁵ To confuse things even further, several of the manuscripts disagree about the specific placement of chapter-heads, creating breaks where none by rights belong according to the Arabic original.⁵⁶

Similar structural anomalies can be found in the other books as well. Several of the manuscripts subdivide book 2 into five rather than the four canonical chapters of the Arabic version. Chapter 3 of that second book is further broken into subsections in a number of different ways, depending upon which manuscripts are examined.⁵⁷ In the third book, on the other hand, the pattern of seven chapters set by the Arabic original is followed in most of the manuscripts, although six of them have two versions of chapter 3. As we shall show later on, this anomaly is of particular significance for our understanding of the generation and dissemination of the Latin text. Like chapter 2 of the second book, chapter 7 of the third book is subsectioned in several different ways among the manuscripts.⁵⁸ So it is with the remaining books; the way they are subdivided into chapters varies among the manuscripts, sometimes to a significant extent.⁵⁹ With no critical Arabic text against which to compare them, however, there is no way of determining which manuscripts conform to the Arabic original and which do not.

As in the gross structure of the treatise, so in its finer structure, there are significant differences between Arabic and Latin texts over the course of books 1-3. Aside from the occasional omission of a paragraph in the first two books, the most salient of these differences is to be found in the text that follows chapter 3 of the third book, a portion that consists of four chapters. In the Arabic version, this swath of text constitutes nearly eighty percent of book 3. In the Latin version, it has been reduced to fifty percent. This means that chapters 4-7 of book 3 in the Latin version have been distilled to just over twenty-five percent of their counterpart in the Arabic version.⁶⁰

As far as format is concerned, then, the Latin text is far from a duplicate of the Arabic original. In some case, the differences in format are so acute as to be obvious at first glance. In others, they are somewhat more subtle. Cumulatively, however, they change the textual framework of the Latin version in significant ways that add to the interpretive distance between Latin and Arabic texts.

3. *Ibn al-Haytham's Core Sources*

The Problem of Sources: In typical fashion for his day, Alhacen felt no obligation to cite sources by name. Accordingly, in those rare instances when references do crop up in the *Kitab al-Manazir*, they are generic, designating groups rather than individuals. Context allows us to be somewhat more specific, though. For instance, by “mathematicians” and “those who posit rays” (*mathematici* and *ponentes radios*) Alhacen doubtless means those scholars who follow Euclid and Ptolemy in supporting the visual-ray theory of sight. By “natural philosophers” (*naturales*), on the other hand, he seems to designate those scholars who rely upon Aristotle for their analytic principles. Finally, in mentioning “anatomists” (*anathomici*) and practitioners of “the medical art” (*ars medicinalis*), Ibn al-Haytham presumably has in mind those scholars who follow the anatomical and physiological lead of Galen.⁶¹

That Euclid, Ptolemy, Aristotle, and Galen were known to Ibn al-Haytham not just mediately, through their later proponents, but immediately, through their actual writings, is evident from Ibn Abi Usaybi'a's catalogue. We have already noted among the listed tracts one that makes explicit reference to Euclid's and Ptolemy's *Optics*: “A Book in Which I have Summarized the Science of Optics from the Two books of Euclid and Ptolemy, to Which I have Added the Notions of the First Discourse Which is Missing from Ptolemy's Book.” Although the treatise itself is lost, its title suggests far more than passing familiarity with the two optical sources cited. This suggestion is borne out by the two other works (listed as entries 7 and 11, p. xvii above) that deal explicitly with Ptolemaic optics. So too with Galen, there is clear evidence that Ibn al-Haytham had mastered several relevant works, foremost among them the *De usu partium*, the *De placitis Hippocratis et Platonis*, and *On Diseases of the Eye*.⁶² As for Aristotle, finally, we have good reason to suppose that Ibn al-Haytham paraphrased several of his works in the relatively early phase of his scholarship. Especially important in this regard would have been the *De anima*.⁶³

It is one thing to isolate the specific sources used by Ibn al-Haytham and quite another to understand how he actually used them. To do that, we must take the following three points into account. First, Ibn al-Haytham viewed his sources ahistorically, not as marking stages in a line of development but as offering parallel, often complementary, accounts. As a result, he managed to discern some level of “truth” in each of them without being diverted by the fundamental conflicts among them.⁶⁴ Second, taken as a whole, those sources provide an interpretive context within which Ibn al-Haytham would have read and construed

each one individually. Thus, for example, his reading of Ptolemy had to have been colored by his understanding of Aristotle and Galen. Finally, there is a larger interpretive context, or tradition, within which Ibn al-Haytham worked, a tradition that coalesced around these particular sources. Based primarily upon derivative works, particularly commentaries, this larger interpretive tradition manifested a strong tendency toward textual reconciliation and integration.⁶⁵ As we shall see, Ibn al-Haytham's *Kitab al-Manazir* reflects this tendency in several critical ways.

In light of these three points, let us take a brief look at the key formative sources for Ibn al-Haytham's theory of vision. We will start with a brief examination of Aristotle's account of vision as he analyzes its progression from initial physical cause to final perceptual effect. We will then do the same for the Euclidean-Ptolemaic account, after which we will turn to Galen, placing special emphasis upon his anatomical and physiological model of the eye and brain. We will conclude in the next section (i.e., section 4) by following the course of these three accounts as they were taken up, elaborated upon, and to some extent integrated, by such early-medieval Arab scholars as Hunayn ibn Ishaq and Yaq'ub al-Kindi.

Aristotle's Theory of Visual Perception: The two principal sources for Aristotle's ideas about visual perception are the *De sensu et sensato* and the *De anima*. In both of these works the focus is not so much upon vision as upon sensation in general. Nonetheless, from the two of them we can develop a fairly coherent account of sight. According to that account, the initial cause, or "proper object," of vision is color. Being an inherent property of physical bodies, color is therefore what renders them potentially visible.⁶⁶ To become actually visible, those bodies must occupy a continuous transparent medium, such as air, that links them directly with the eye. Yet, without light such media are only potentially transparent. In order to become effectively transparent they must be illuminated. Light therefore plays the role of catalyst in the visual act: not itself visible, it is nonetheless crucial to that act, for without light the media through which color manifests itself would remain perfectly black and opaque.⁶⁷

As soon as their potential transparency is actualized by light, such media as air or water are apt, by their very nature, to assimilate color. They do so in an incidental way that leaves them essentially unaltered. The "coloring" of transparent media, in short, is qualitative or formal, not material. In that respect it is wholly unlike the tinting of water by dye or the coloring of a wall with pigment. Diffused instantaneously through the continuous medium, the visible color-effect reaches the eye,

then passes into and through it in a process of continuous replication.⁶⁸ The eye, for its part, has a dual nature. As a material entity, on the one hand, it is physically tinged by the impinging color—hence, the reflection of images in the smooth, corneal surface. As a sentient entity, on the other, it assimilates the physical color-effect in a visual way, transforming it into a sense-impression, much as soft wax takes on the impression of a seal without being thereby altered in its essential nature.⁶⁹

From the eye, this visual color-impression is passed inward to a generalized faculty that is able to assimilate not only it, but all the attendant impressions, such as touch, taste, and smell, that are passed to it by the individual senses. Called the “common sensibility” (*aisthesis koinē*), this faculty has two basic functions, the first of which is to combine various sense-data into a single sense-representation of the given object. Its other basic function is to abstract the so-called common sensibles from the primal sense-impressions. Comprising the spatial attributes of things (e.g., motion, rest, magnitude, shape), these sensibles are “common” insofar as they can be apprehended by more than one sense.⁷⁰ Thus, for example, shape can be both seen and felt, as can magnitude, or even motion.

The sensible “image” abstracted by the common sensibility is passed on, in turn, to the imagination (*phantasia*), where it serves as a perceptible representation of its generating object. As such, it conveys not only the full range of sensible properties belonging to the original object, but also a range of characteristics that transcend sensibility. These characteristics, which Aristotle dubs “incidental sensibles,” are implicit rather than explicit in the sensible representation. As an example Aristotle cites the realization that “the white object which we see is the son of Diares.” Since “being the son of Diares is incidental to the white which is perceived,” Aristotle explains, “we speak of the son of Diares as being incidentally perceived [because] it in no way as such affects the senses”⁷¹ In other words, incidental sensibles are neither sensible nor perceptible in a strict sense. They are the product of interpretation or inference, conceptual representations abstracted by the reasoning faculty (*logistikon*) from the perceptible representations occupying the imagination.⁷² Presumably, then, our conceptual (or intellectual) apprehension of external reality is based on such incidental sensibles.

Four points in particular stand out in Aristotle’s account of sight. First, according to that account, the act of seeing is unequivocally intromittive: the cause-and-effect sequence flows inward, from external object to the eye and thence into the soul. The eye is therefore essentially receptive, not active, in the process of visual apprehension. Second, the ulterior cause of vision is color. In other words, color is all that

is ever really seen. Third, the underlying physical cause of sight is formal rather than material. Sight is therefore not due to an influx or efflux of matter. Fourth, taken in its broadest sense, seeing unfolds in four stages: (1) the physical impression of color in the eye, (2) brute sensation, during which the sense-impression of color arises from the physical impression made upon it, (3) perception, during which a composite sensible impression is abstracted from sense-impressions by the common sensibility and presented to the imagination, and (4) apperception, during which conceptual impressions are abstracted from perceptual impressions by the reasoning faculty. For Aristotle, therefore, sight is neither simple nor intuitive; it requires a considerable amount of psychological and intellectual mediation.

The Visual-Ray Theory: Euclid was by no means the first to apply ray-analysis to optics, but, as far as we know, he was the first to develop a systematic theory of vision on its basis.⁷³ Articulated in his *Optics* (c. 300 B.C.), this theory is grounded in the premise that the eye sees by reaching out to visible objects. This it accomplishes by emitting visual flux along discrete radial lines. These radial lines bundle together to form a cone with its vertex at the common origin-point for the flux. Lying within the eye at an unspecified location, this vertex-point also defines the center of sight. The cone's base, on the other hand, defines the field of vision. Whatever lies within that field is seen by the rays that make physical contact with it, so vision is reduced to a form of touch in Euclid's account.⁷⁴

As an analytic device, the visual cone is especially effective in explaining how we see things spatially—in short, how we perceive the Aristotelian common sensibles. Shape is revealed when visual rays “feel” an object's surface and thereby get a sense of its defining form. Position is visually determined according to the relative upwardness, downwardness, leftwardness, or rightwardness of the sensing rays.⁷⁵ Size is apprehended according to the extent of the visual angle subtended by the object: the greater that angle, the larger the object will appear.⁷⁶ Lateral motion is sensed by the tactile ends of the visual rays as objects sweep through them. When no such sweep is detected, the object will be perceived to be at rest.⁷⁷

In addition, variations in visual acuity according to distance can readily be explained on the basis of Euclid's visual-ray model. A given object is seen more clearly at a closer distance because its surface is touched by more rays, or, to put it somewhat more accurately, by a more densely-packed sheaf of rays. The farther away it gets, the fewer rays make contact with it until, finally, it falls into the inter-radial gaps. At

that point the object disappears entirely from sight.⁷⁸

The deficiencies of this account are as evident as they are manifold. For one thing, Euclid's analysis is much too limited in scope. All it can effectively address are the palpable features of things. Color-perception is never broached, nor, for that matter, is light and its role in the visual process. Perception of abstract qualities—i.e., the Aristotelian incidental sensibles—is completely ignored as well. How do we see beyond the physical shell of things to their inner, defining forms (“that white thing before me is Diares’ son”)? Under what conditions is vision veridical (“that white thing before me is indeed Diares’ son, not Socrates”)? Why and how do we misperceive things (“that bright white body looks larger than the identical black body beside it”)? These sorts of issues are passed by entirely in Euclid's *Optics*. Likewise, binocular vision is all but ignored. And so is the variation of perceptual acuity within the visual cone itself according to relative distance from the visual axis.⁷⁹

Even within its own analytic limits, the Euclidean account is problematic. Take Euclid's explanation for why objects eventually disappear from sight as they get farther away. If that happens because the objects fall within inter-radial gaps, then surely those objects ought to appear and disappear by turns as we visually scan the region they occupy. Size-perception is a problem too. If we judge size by visual angle alone, as Euclid does, then tiny objects seen up close should be perceived as larger than massive objects seen from afar. Accordingly, when we place our hand before our face in such a way that it blocks our view of a distant mountain, we ought to perceive our hand as larger than the mountain. This in fact does not happen. Even though our hand may subtend a larger visual angle than the mountain beyond it, we realize that it is much smaller, and we perceive it that way.

These are not trivial issues. Indeed, they had to be addressed squarely if the visual-ray theory was to succeed as an effective explanatory model. Ptolemy's *Optics* can best be understood as a response to this imperative. Ptolemy agrees with Euclid that the eye emits visual flux in the form of a cone, although, unlike Euclid, he is explicit in locating the cone's vertex at the center of the eyeball. The eyeball itself is now taken to be a true sphere, at least in its frontal portion. Unlike Euclid, as well, Ptolemy supposes that the visual cone is not a bundle of discrete radial lines but an actual continuum.⁸⁰ The visual ray is therefore no longer real but imaginary, a conceptual device that permits us to analyze the world of appearances mathematically.

Since Ptolemy assumes the visual flux to be perfectly continuous, he cannot, as does Euclid, explain variations in visual acuity on the basis of

individual rays and their separation. Instead, he appeals to a dynamic model according to which visual acuity is a function of the sensitive power of the flux. The more intense that power, the more intense the visual impression it yields. Most intense when the flux is near its origin at the eye's center, this power diminishes continuously as the flux recedes from that point. Thus, as Ptolemy sums it up,

... powers that approach their generating sources are more effective. The farther such powers extend from their sources, then, the weaker they become—as, e.g., [the power of] projection [in relation to] the thrower, or of heat in relation to the heater, or of illumination in relation to the light-source.⁸¹

Conversely,

... among objects whose appearance depends upon the quality of [radiative] effects, those that lie directly in front of, and at right angles to the rays are seen more clearly than those that do not. For everything that falls orthogonally strikes its subjects more intensely than whatever falls obliquely.⁸²

According to Ptolemy, then, the closer an object is (within limits) to the center of the eye, where the flux originates, and the more direct the impingement of that flux on the object, the more clearly it will be seen.

Finally, to explain why acuity is optimal along the visual axis, Ptolemy relates the flux's sensitive power to its lateral distance from the center of the visual field within the frontal plane :

And since [each] visual ray terminates at its own unique point, what is seen by the central ray—i.e., the one that lies upon the axis [of the visual cone]—should be seen more clearly than what is viewed to the sides [of the visual axis] by lateral rays. The reason is that those rays lie nearer to [the edge of the visual cone where there is an increasing] absence [of rays], whereas those rays that approach the [visual axis] lie farther from [such an area of] absence.⁸³

Implicit in this dynamic account of visual acuity is a model of radiation based upon projectile motion. Accordingly, the visual flux is treated as a composite of tiny bodies hurled at great speed in all directions and along radial trajectories from a single point. In theory, then, the flux should propagate overall in the form of a sphere, although it is presumably channeled by the pupil into a cone. As we shall see later on, this

radiative model was crucial to Alhacen's account of image-selection in the visual process.

On its own, visual flux is insufficient to cause sight, even when it encounters external objects. Two other preconditions must be met. For a start, "objects that are subject to vision must somehow be luminous, either in and of themselves or from elsewhere, since that is essential to [the functioning of] the visual sense." Furthermore, Ptolemy continues,

visible objects must . . . be compact in substance in order to impede the visual flux, so that its power may enter into them rather than pass through without incident effect. Thus, it is impossible for anything to be seen without these two conditions' being met, nor [can anything be seen] when one of them is met without the other.⁸⁴

According to Ptolemy, then, luminosity and compactness—i.e., opacity—render objects sensible to the visual flux.

But luminosity and compactness are not themselves actually visible; they simply form the grounds of visibility. Strictly speaking, the only thing that *is* visible for Ptolemy is color. Even what we see as "light" is not light *per se* but, rather, the dazzlingly bright color of the luminous source.⁸⁵ To put it in Aristotelian terms, color, for Ptolemy, is the proper object of sight, the sole property of things that can be apprehended by the visual flux. The apprehension itself takes form as a "passion" (*passio*), or feeling, through which the flux undergoes "coloring" (*coloratio*). Arising at the object's surface, the resulting color-effect is transmitted back through the visual flux to the eye, where it makes a visual impression.⁸⁶ This color-impression is absolutely primal; from it everything else that is seen derives. Color thus constitutes the primary visible (*primo videtur*) in Ptolemy's account. Everything else that is seen is secondarily visible (*sequenter videntur*) because it is apprehended on the basis of color alone.⁸⁷ Color, in short, is immediately visible; all other qualities that are subject to visual perception are mediately visible.

As for Aristotle, so for Ptolemy, color is an inherent, objective property of physical bodies, not a mere subjective effect arising from physical (i.e., material and quasi-mechanistic) interactions between ourselves and external particulars.⁸⁸ Occupying the surfaces of bodies, moreover, color defines them for sight by providing the boundary-conditions under which they are visually grasped as discrete wholes. Hence, it is through color that we are able to perceive the spatial features of external objects as well as to locate them relative to all other objects in space.⁸⁹

Like Euclid, Ptolemy places the burden for explaining spatial perception squarely upon the visual cone. For instance, he follows Euclid

in granting directional privilege to individual rays within the cone so that they can sense where things lie within the visual field (i.e., up, down, left, right). He follows Euclid, as well, in looking to the visual angle as a key determinant of size-perception. Unlike Euclid, however, he endows the perceiver with an innate sense of ray-length so that he can gauge distances more or less intuitively—at least within moderate limits.⁹⁰

This ability to gauge distances plays a crucial part in most spatial perceptions. For instance, the perception of obliquity is clearly dependent on it. As figure 1 illustrates, when rays **EA** and **EC** that flank the axial ray **EB** at equal distances are perceived as equal in length, the surface **AC** that they sense will be perceived as perfectly frontal. On the other hand, when flanking rays **ED** and **EF** are perceived as unequal in length, surface **DBF** will be adjudged oblique.

Perception of distance and obliquity is crucial, in turn, to size-per-

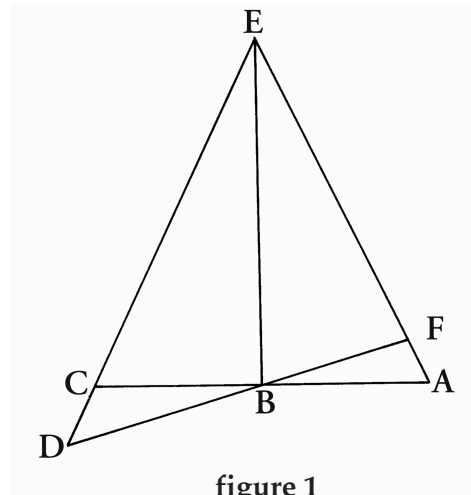


figure 1

ception. Thus, if two objects subtend the same visual angle but one of them is judged to lie farther away, the farther object will appear larger. Likewise, if two objects subtend the same visual angle, but one of them is adjudged to be more oblique than the other, the one that is more oblique will appear larger.⁹¹ Being able to perceive obliquity is critical to shape-perception. Hence, when we perceive a circle at a slant, we still perceive it to be circular rather than elliptical.⁹²

Distance- and size-perception can also be determined in extrageometrical ways. For instance, if two neighboring bodies of significantly different brightness are seen under equal visual angles, and if their distances are indeterminate, the dimmer body will be judged to lie farther away because it appears less distinct. This, Ptolemy concludes, is why

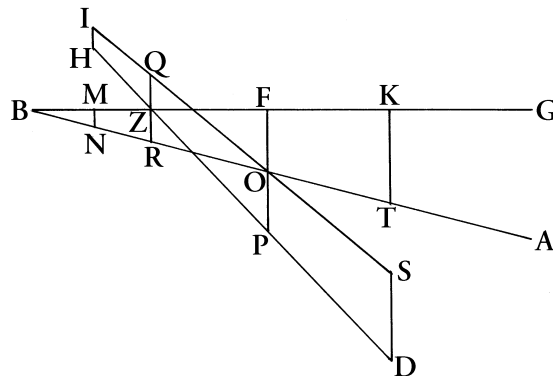
“mural painters use weak and tenuous colors to render things that they want to represent as distant.”⁹³ Furthermore, being perceived to lie farther away, the dimmer body will also appear larger, since size-perception depends upon both perceived distance and visual angle.

Although it, too, is subject to geometrical analysis, shape-perception can also be based upon color-contrasts. Take convexity or concavity, for example. One way of perceiving them is through a “feeling” aroused in the visual flux, “just as [they] are perceived by touch, convex[ity] being apprehended through the concavity of the encircling hand, and concav[ity] being apprehended through the convexity of the encircled hand.”⁹⁴ But the same perceptual effect can be created by an artist who “paints the part he wants to appear higher a bright color, whereas the part he wants to appear concave he paints with a weaker and darker color.”⁹⁵ It is therefore through such color-effects that painters convey the illusion of spatial reality in their representations of it. In short, these color-effects cause us to misperceive what we see. Obviously, there is no actual difference in distance between the bodies represented in the mural, even though we may perceive there to be. Nor is the spatial depth implied in the painted representation of concavity really *in* the painting, since that painting is rendered on a flat surface.

Such misperceptions arise when the object that is seen cannot be properly viewed because the circumstances under which it is seen are abnormal. In the case of artistic illusionism, the illusion is successful only as long as we are far enough away from the painting to be unable to detect that it actually is an illusion. In other cases, the misperception is due to some impediment that prevents a proper view. Diplopia, or double vision, is a clear example. Under normal circumstances, Ptolemy explains, we see objects as single because both of our eyes work naturally in concert to produce a single image from the separate images apprehended by each eye.⁹⁶ They do so by focusing their respective visual axes at a single point upon whatever is being scrutinized. That way the bases of the two visual cones overlap perfectly. Thus sharing the same visual field, both eyes see precisely the same thing. Diplopia, on the other hand, occurs when the two visual axes are prevented from meeting on the object. In that case, the two bases do not overlap perfectly, so the two eyes do not see precisely the same thing. The result is a double image.⁹⁷ The more imperfect the overlap of visual fields, the greater the displacement of the two images.

The degree of displacement is geometrically determined according to what Ptolemy calls the common axis, which extends from “where the vertices of the visual cones ought to intersect” to the point at which the two visual axes intersect, as is illustrated in figure 2, where A and C

When all three axes meet at a single point on the object-surface being viewed, image-fusion will be perfect. Otherwise, diplopia will result, the amount of relative displacement being contingent upon how far beyond or in front of the object under scrutiny the three axes join. Thus, if **A** in figure 3 (adapted from Ptolemy, *Optics*, II, 48-54) represents the center of sight with visual axis **AB** intersecting common axis **GB**,



and if **DH** is the visible object, then, as seen from **A**, it will appear along **SI**, its displacement diminishing continuously as it approaches **B** according to the amounts **TK**, **OF**, **RZ**, and **NM** (i.e., displacement **DS** =

TK; displacement $\mathbf{PO} = \mathbf{OF}$; displacement $\mathbf{RZ} = \mathbf{ZQ}$; and displacement $\mathbf{NM} = \mathbf{HI}$).

Diplopia is one of three visual illusions that entail image-displacement. The other two arise when the visual radiation is physically diverted by a reflecting or refracting surface. In the first case, the radiation is completely interrupted so that the flux rebounds from the surface. In the second case, the visual radiation is only partially interrupted so that the flux is diverted but not completely broken. In both cases, however, the results are similar: the object and its image occupy different locations and the image may be distorted in size or shape. Thus, things seen underwater appear closer and larger than they actually are, whereas things seen in convex mirrors appear more distant and smaller than they actually are.

Ptolemy's preoccupation with visual illusions of all kinds is clear in his effort to categorize them systematically toward the end of the second book of the *Optics*. Of the three basic types of visual illusion he lists, the first stems from the physical conditions under which vision occurs. For instance, because of a deficiency of visual flux, older people tend to have weak sight. On that account, they often misperceive distant objects. Another example is to be found in the failure to perceive the motion of rapidly spinning disks because the time-interval for detecting such motion is too short. The second type of illusion can be traced to some anomaly in the visual faculty itself. Radial breaking and bending are prime examples, because in both cases the illusion (e.g., that the object lies behind the mirror) is due to a physical disruption of the visual flux. The third, and final, type of illusion is interpretive or inferential in origin. This type of misperception is exemplified by the artistic illusions discussed above.

Ptolemy's focus on visual misperception serves as a reminder that ancient optics was the science of sight, not light, its primary goal thus being to reconcile appearance with reality. This goal is reflected in the threefold analytic structure of Ptolemy's *Optics*. First comes the analysis of appearances arising from direct, or unimpeded, visual radiation. This is the only kind of vision in which appearance corresponds to reality, albeit only under specific conditions, such as proper light and distance. The study of direct vision falls under the head of *optics* proper. Next comes the analysis of appearances arising from complete breaking, or reflection, of the visual ray. The study of this sort of vision, which is mediated by mirrors, falls under the heading of *catoptrics*. Finally comes the analysis of appearances arising from partial breaking, or refraction, of the visual ray. The study of this sort of vision, which was first systematized by Ptolemy, falls under the heading of *dioptrics*.

Thus, it is with Ptolemy that the study of optics takes canonical form according to the analysis, first, of *optics* proper, then of *catoptrics*, and finally of *dioptrics*.

In addition to systematizing the study of optics, Ptolemy gave that study an empirical, indeed an experimental, focus that is decidedly absent from Euclid's *Optics* and *Catoptrics*.⁹⁸ The clearest evidence of Ptolemy's empirical bent is found in his analyses of diplopia, reflection, and refraction. In all three cases, the phenomena are investigated on the basis of relatively simple yet ingeniously contrived experimental apparatus. In the case of diplopia, for instance, the apparatus consists of a small board upon which colored pegs and sighting lines can be placed at various locations to produce multiple imaging. Reflection is analyzed inductively through the use of a circular measuring plaque to which a sighting-device is attached and upon which plane, concave, and convex mirrors are attached for examination. Refraction, finally, is analyzed on the basis of that same plaque immersed upright in semicylinders filled with water or glass.⁹⁹

As the culminating step in the evolution of ancient visual-ray theory, Ptolemy's *Optics* reflects a number of ideas and concerns that bear directly upon Ibn al-Haytham's later analysis of light and sight. For one thing, Ptolemy's *Optics* is about the act of sight not the radiation of light. It is presumably for this reason that Ptolemy (like Ibn al-Haytham) ignores such tangential topics as the rainbow and burning mirrors that have little or nothing to do with vision. The depth of Ptolemy's concern with sight is reflected in the depth of his concern with visual illusions. Indeed, the very governing structure of his analysis—i.e., the threefold division into *optics* proper, *catoptrics*, and *dioptrics*—bespeaks this concern.

At bottom, of course, Ptolemy's analysis is based upon the visual cone, but Ptolemy (and Alhacen after him) conceives of the constituent visual rays as virtual, rather than real, entities. Using projectile motion as an analogue, Ptolemy transforms the ray into a virtual trajectory, the activity of the flux along it being thus reduced to kinetic and dynamic terms. The intensity of that radiation, as well as its resulting effect, will therefore vary according to the force of its projection and impingement along the ray. The closer to the source the projection and the more direct the impingement, the greater the effect. As will become clear in due course, Alhacen drew upon this dynamic conception of radiation to good effect in his analysis of sight and refraction.

Given its virtual status, moreover, the Ptolemaic ray becomes a mere analytic device. As such, it provides one way—but not the only way—of explaining visual phenomena. Consequently, Ptolemy's analysis of

sight is largely dependent upon, but by no means limited to, ray-geometry. That Ptolemy was well aware of the limitations of ray-geometry in explaining sight is evident from his theory of visual perception, which is ultimately based on color rather than upon the mathematical (i.e., spatial) or tangible properties of things. As the proper object of sight—and thus the only thing that is visible *per se*—color is absolutely primal. Rendered effectively visible by light, it is the first thing sensed by the visual flux. The resulting color-impression provides the basis upon which all other perceptions are derived, particularly those involving the spatial characteristics of things. Thus, as for Aristotle, so for Ptolemy, whatever else we “see” beyond color, we infer perceptually from the primal color-impression that inaugurates the visual process.

The Galenic Model of Vision: According to Galen’s description of the optic complex, primarily in the *De usu partium*, the eye is an outgrowth of the brain, its softer components springing from the *pia mater* (the inner of the two membranes encasing the brain), its harder components from the *dura mater* (the outer of those two membranes)¹⁰⁰ The hollow optic nerves form the essential connection. Originating at the forefront of the brain, on either side of its midline, they cross at the optic chiasma, whence each continues to the eye opposite its origination-point in the brain. As a result, Galen asserts, “the shape of these nerves does greatly resemble the letter Chi.”¹⁰¹ After passing through the eyesocket and reaching the eye, each nerve funnels outward to “embrace the vitreous humor like a tunic,” reaching toward the front of the eyeball where “it is [finally] inserted into the crystalline humor.”¹⁰²

Exquisitely transparent, the crystalline humor, one of three fluids or gels filling the eye, is enveloped by a very thin transparent membrane to form the crystalline lens (*krystalloides* = “ice-like”) toward the front of the eye. This lens takes shape as an oblate sphere that is immersed to its “equator” in the vitreous humor (*hyaloeides* = “glass-like”), a second gel contained by the eye. Filling the major portion of the ocular globe behind the crystalline lens, this humor has the consistency of fused glass and is therefore less exquisitely transparent than the crystalline humor.¹⁰³ For its part, the vitreous humor is enveloped and restrained by the choroid tunic (*chiton choroeides*), which forms the embracing extension of the optic nerve mentioned above. In fact, the choroid tunic is an extension of the *pia mater*, the softer of the two covering membranes of the brain. Along the inside surface of the choroid tunic is the retina (*amphiblestroeides* = “net-like” = retina), which, despite appearances, is not a true tunic, according to Galen. Both the retina and the choroid tunic to which it clings are attached to the crystalline lens at its equator.¹⁰⁴

Arising from the outer sheath of the optic nerve, which in turn originates with the *dura mater* of the brain, is the sclera (*chiton skleros*). This tough, durable tunic encloses the choroid and attaches along with it at the equator of the spherical crystalline lens. Its main function is to protect the softer choroid tunic and thus help it to hold the vitreous humor firmly in place. Over the sclera, finally, is an outer sheath or tunic that forms the conjunctiva. This outermost sheath is also connected to the muscles and fat surrounding and filling the eyesocket. Its anterior portion forms the white of the eye.¹⁰⁵

Figure 4 below illustrates the structure of the eye as described to this point. The ellipsoid at the right of the figure represents the oblate crystalline lens. Filled with crystalline humor, this body is immersed to its "equator" in vitreous humor. The eye, as a whole, is encompassed by two nesting tunics. The inner, black tunic is the choroid, which extends from the inner sheath of the optic nerve, this sheath originating in the brain's *pia mater*. The outer tunic is the sclera, which extends from the outer sheath of the optic nerve, this sheath originating in the *dura mater*. It, in turn, is encased by the conjunctiva, which is not shown but which covers it to the outer edges of the cornea. Inside the choroid tunic, finally, is the retina. All three of these tunics or membranes are attached to the crystalline lens at or around its "equator."

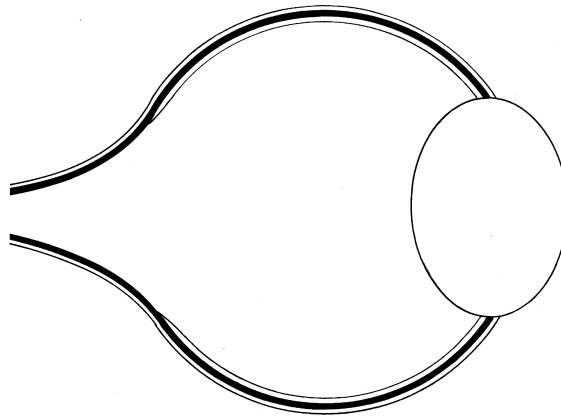


figure 4

To this point, the eye is structured in such a way that the anterior "hemisphere" of the crystalline lens protrudes from the succession of sheaths that come together at its equator. Were it to be thus exposed to external irritants, it would suffer immediate damage because of its fragile structure. Consequently, it is afforded dual protection, first by an

extension of the choroid tunic that originates at the equator of the spherical crystalline lens and enfolds some, though not all, of its anterior portion. This anterior extension constitutes what we today call the iris, the circular perforation in its middle forming the pupil. The second level of protection is provided by a thin, transparent, and very hard extension of the sclera that projects out beyond both the anterior surface of the lens and the iris that covers it. This extension constitutes the “horn-like” tunic (*keratoeides*), or cornea.¹⁰⁶ The space lying between its inner surface and the outer surfaces of the crystalline lens and iris is filled with yet a third humor, the aqueous humor (*ooeides* or *hydatoeides*), which keeps those surfaces separated.¹⁰⁷ Otherwise, continual contact between the soft outer surface of the lens or iris and the hard inner surface of the cornea would hurt the former. Figure 5 illustrates this frontal portion of the eye, with the iris extending forward from the choroid tunic to partially cover the anterior surface of the crystalline lens. The cornea, for its part, extends forward from the sclera to create a space between its inner surface and the anterior surface of the iris. This space is filled with the albumen-like (*albugineus*) aqueous humor (*ooeides*). Sheathing the sclera up to the cornea is the conjunctiva, to which the soft tissues (fat and muscle) binding the eye within the eyesocket are attached.

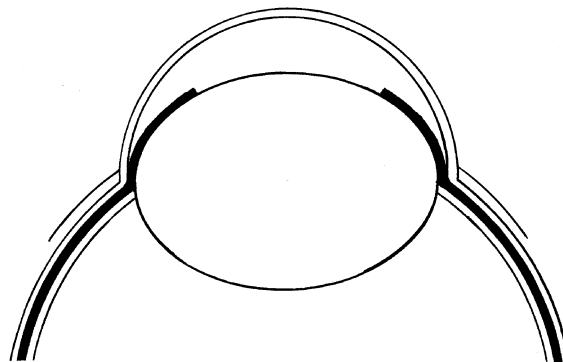


figure 5

As far as the eye's sensitive capacity is concerned, the crystalline lens plays the central role. On the one hand, it is most apt of all the ocular components to be altered by color insofar as it is “radiant, pure, and glistening.” However, Galen continues, “it would be of no use for this alteration to take place unless it was recognized by the ruling principle [i.e., the *hegemonikon*] which forms images, remembers, and reasons.”¹⁰⁸ In order for this perceptual recognition to occur, the lens must be linked to the brain, which is the seat of percipience and reason, both

faculties under control of the ruling principle. The medium through which the ruling principle exercises this control is psychic pneuma (*pneuma psychikon*), which is distilled in the brain and then passed through the hollow optic nerves to the eye.¹⁰⁹ Upon reaching the back of the eye, this pneuma is diffused to the crystalline lens through the retina, which consists of a fine network of conduits. Upon reaching the lens itself, this continual charge of pneuma animates it and thereby gives it the capacity to sense the color-impressions it receives. Those impressions are then passed back through the retinal network to the optic nerves and thence to the brain.¹¹⁰

The brain itself is divided into four ventricles or chambers. Lying side-by-side at the front of the brain, the first two ventricles are functionally paired insofar as they form the wellspring for all of the sense-conduits, including the optic nerves. It is in these two ventricles that the psychic pneuma is elaborated so as to be properly receptive of the sense-data passed through the nerves into the brain. This pair of anterior ventricles is followed by two others in succession from front to back, the central of them (i.e., the third ventricle) being the larger. At the base of the brain lies a fine network of arteries—the so-called retiform plexus (or *rete mirabile*)—into which blood charged with vital pneuma is passed upward to the head through the carotid arteries. As it circulates through this arterial network, the blood arriving through the carotid artery and infused with vital pneuma is further refined or “elaborated” to yield psychic pneuma.¹¹¹

As was mentioned earlier, Galen's account of visual physiology is rooted in the assumption that the psychic pneuma elaborated in the anterior ventricle of the brain flows through the optic complex to the crystalline lens. After perfusing the lens and thereby imbuing it with visual sensitivity, this pneumatic flux streams outward beyond the corneal surface into the surrounding air. Unlike Ptolemy's visual flux, however, Galen's pneumatic flux does not then radiate through the air to surrounding objects. Rather, it transforms the air itself into a percipient extension of the optic complex extending from the brain, through the optic nerves, to the front of the ocular globe. What results is a cone of visibility with its vertex at the eye and its base ever-expanding over distance. Strictly speaking, then, Galen's theory is not extramissionist—certainly not in the same sense as the Euclidean-Ptolemaic visual-ray theory—because, according to Galen's physical account, what passes from eye to object is a pneumatic effect, not a material efflux.

Galen agrees explicitly with Aristotle, and thus implicitly with Ptolemy, that color, and color alone, constitutes the proper object of sight.¹¹² Without color, then, no physical body can be seen. Further-

more, even if it is colored, such a body will remain invisible unless the air within which it subsists is properly illuminated and therefore rendered permeable to sight. In essence, then, illumination transforms the air from opaque (dark) to transparent, a transformation that is complementary to the alteration caused by psychic pneuma. Thus, as Galen puts it:

When [the air] has been illuminated by the sun, it is already an instrument of vision of the same description as the pneuma coming to it from the brain; but until it is illuminated it does not turn into a sympathetic instrument by virtue of the change effected in it by the outflow of the pneuma"¹¹³

So transformed by light, the air is apt to assimilate the color of various bodies within it, the resulting alteration being transmitted almost instantaneously through it to surrounding bodies, including the eye.¹¹⁴ Hence, for Galen, as for Aristotle, light serves as a catalyst for, rather than an object of, vision.

The Galenic cone of visibility alluded to previously is the product of complementary transformations of the air: one by the external light of such sources as the sun, the other by the internal light, or pneuma, of the eye.¹¹⁵ In its properly altered state, the air has two functions: to permit the eye to make visual contact with outlying objects and to serve as a medium through which the information gained by that contact is conveyed back to the optic complex for visual scrutiny. The resulting visual impression, which occurs at the crystalline lens, is of color; and from that initial, primitive color-impression is derived a set of secondary impressions about the spatial disposition of the object seen. According to Galen's own summary, then:

The proper object of sight . . . is the class of colors. For colors are the first thing it perceives, and it perceives them by itself, and it alone of all sense organs perceives them [and] it alone can discern along with the color of the thing seen its size and shape [as well], in addition to other things, the position and distance of the colored body.¹¹⁶

These properties, Galen goes on to say, "are incidental [insofar as] they require reasoning and memory, not merely sensation—at least in the case of touch and sight."¹¹⁷ Suffice it to say, these incidental properties, which are seen at a secondary, inferential level, are strongly reminiscent of Aristotle's common sensibles.

Geometrically, the cone of visibility that is created in the surround-

ing air by ocular pneuma and ambient illumination can be thought of as a bundle of cobweb-thin filaments radiating from the vertex-point in the pupil of the eye. Each filament constitutes a radial sighting-line connecting the center of sight to a given point in the plane of the visual field. These lines are perfectly rectilinear.¹¹⁸ Since we actually see with two eyes and therefore with two visual cones, neither eye shares precisely the same visual field. Accordingly, everything seen by the right eye appears somewhat to the left of everything seen by the left eye. As figure 6 illustrates, if **GD** is the object seen by the two eyes **A** and **B**, then, against the background of the larger circle of the visual field, **GD** will appear in different sectors according to whether it is viewed by **A** or **B**. From **B**, for instance, it will appear in sector **TI**, whereas from **A** it will appear in sector **EZ**. Furthermore, since object **GD** is oblique with respect to both visual cones, the two visual axes will not intersect its surface at the same point, as it should do by Ptolemy's account

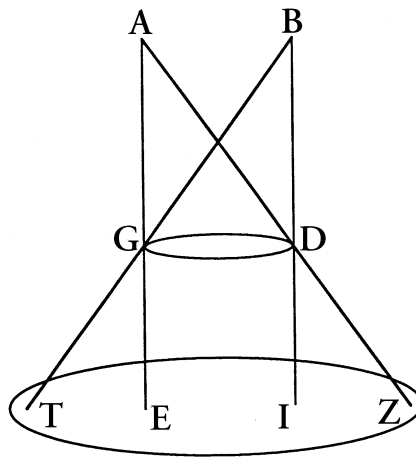


figure 6

Hence, given the imperatives of Galen's analysis, **A** and **B** will not see that object at precisely the same spot. Nevertheless, when we look with both eyes, the object appears to occupy a single spot midway between where **A**'s and **B**'s images appear.¹¹⁹ In short, image-fusion does not occur at the object's surface. But if not there, then where? In response to this question, Galen points to the joining of the optic nerves at the optic chiasma. "Nature," Galen assures us in explanation, "does some things for a principal reason and others out of her abundance; so here too [i.e., in having the nerves cross at the optic chiasma] the first and most necessary use is to keep us from seeing external objects

double.”¹²⁰ That we normally see single rather than double images is therefore due not so much to the geometry as to the physiology of vision. Still, Galen agrees with Ptolemy that diplopia is the result of a displacement of the eye so that, in essence, the two axes fail to meet properly on the object’s surface.¹²¹

Conclusion: There is no denying the fundamental differences among Aristotle’s, Ptolemy’s, and Galen’s accounts of sight. Aristotle’s theory is, after all, unequivocally intromissionist, Ptolemy’s unequivocally extramissionist, and Galen’s equivocally extramissionist. Yet despite such differences, the three accounts by no means conflict with, much less contradict one another, at all levels. Indeed, in certain ways they can be viewed as complementary. All three thinkers agree that color is the proper object of sight, the sole visible *per se*. All three agree, as well, that there must be a properly transparent medium between eye and object if vision is to occur. All three agree that the color-effect that induces vision is somehow conveyed back through this medium to the eye for perceptual delectation. All three agree that light is a necessary precondition for, but not, strictly speaking, a proper object of, sight. And all three agree that spatial perception is mediate rather than immediate.

This complementarity is especially clear in the case of Ptolemy and Galen, whose accounts of visual perception have far more in common than in conflict with one another. This is hardly surprising, given that the intellectual context within which the two thinkers worked was one of eclecticism and that both drew upon many of the same sources. Among the authorities explicitly acknowledged by Galen, Aristotle, Plato, Erasistratus, Herophilus, “Hippocrates,” and various Stoics figure prominently. Galen is far from uncritical in his use of these sources, though. For example, while agreeing with Aristotle that color is the proper object of sight, he disagrees vehemently with Aristotle’s claim (echoed by the Stoics) that the heart serves as the seat of sensation and reason.¹²² Citing Plato as support, he locates this ruling principle in the brain, rather than the heart, and he goes on to provide both empirical and theoretical justification for this position.¹²³ Likewise, while adopting the pneumatic system championed by the Stoics, at least in a general way, Galen rejects the Stoic idea that the pneumatic connection between eye and object acts as a sort of walking stick by means of which we visually feel our way about the physical world.¹²⁴

Ptolemy, as well, draws upon many of the same sources, although, unlike Galen, he does not mention them by name. Still, there are discernible traces of Aristotelian and Stoic, perhaps even Platonic, ideas throughout his works.¹²⁵ It not unlikely, for example, that Ptolemy fol-

lowed the Stoic lead in his conception of visual flux, understanding it as a pneumatic stream originating in the soul and passing through the eye to the outside air. Moreover, like the Stoics and Galen, Ptolemy posits a sovereign faculty (*virtus regitiva* = "governing faculty" = *hegemonikon*) that operates through a generalized "nervous principle" (*principium nervosum*) to regulate all perceptual and intellectual functions.¹²⁶

In view of these considerations, it is evident that Ptolemy and Galen were at pains to accommodate and integrate not only a variety of ostensibly disparate sources (e.g., Aristotle, the Stoics, Plato, Euclid), but also a variety of ostensibly disparate disciplines (i. e., "physics" or natural philosophy, mathematical optics, anatomy and physiology, and psychology) into their accounts of visual perception. Their ultimate goal in this, presumably, was to place the study of visual perception on as broad a theoretical and empirical basis as possible. Thus, well over eight centuries before Ibn al-Haytham undertook his grand optical synthesis in the *Kitab al-Manazir*, the pattern of accommodation and integration was already well established in his key Hellenistic sources.

4. *Ibn al-Haytham's Sources in Context*

General Intellectual Background: The roughly 600 years between the death of Ptolemy (late second century) and the ascendancy of the Abbasid caliphate in the second half of the 700s seems, given the textual evidence, to mark a period of intellectual stagnation, if not regression. There are a few bright spots—e.g., Diophantus' work on "algebra" (later third century?) and some of the critical Neoplatonist commentaries on Aristotle¹²⁷—but all evidence points to the conclusion that during these six centuries little was done to build on the classical intellectual heritage. Indeed, in some cases, optics in particular, that heritage was barely preserved, and then only in a fragmentary way.¹²⁸

With the accession of the Abbasid dynasty at the expense of the Umayyads in 750 came an incipient "Hellenization" of Islam along with a fundamental shift away from the militarism and conservatism of the Umayyads. This shift toward a more favorable political and intellectual climate was symbolized in the change of capitals from "Arab" Damascus to "Persian" Baghdad. Although the process of intellectual recovery under the Abbasids started quite early, with al-Mansur (754-775), it took off in earnest under the patronage of Harun ar-Rashid (786-809) and his son al-Ma'mun (813-833). Not only did both caliphs encourage scholars to root out Hellenic and Hellenistic texts, but al-Ma'mun established a scholarly center at Baghdad, the House of Wisdom, where

scholar-translators, most notably Hunayn ibn Ishaq (808-873), were given the resources to render these texts into Arabic either directly or through the mediation of Syriac.

Accordingly, by the second half of the ninth century, an extensive corpus of classical scientific and philosophical works was becoming accessible in Arabic. Among the earliest scholars to take advantage of this intellectual windfall was Ya'qub al-Kindi (801-866), who spent a considerable portion of his scholarly life in Baghdad, presumably associated with the House of Wisdom. Like so many Arabic thinkers after him, al-Kindi did not just assimilate this classical bequest; he subjected it to close, critical scrutiny, revising and molding it to his own purposes. "Numerous themes and concepts that were elaborated by the Greeks," observes Roshdi Rashed in a recent study, "were selected and reconceptualized by al-Kindi, integrated into the original work that he himself constructed."¹²⁹ Al-Kindi and his successors, in short, were engaged not merely in transmitting but in appropriating classical thought.

Between al-Kindi's death and the early eleventh century, Arabic thinkers had developed their own corpus of philosophical and scientific works in the form not only of critical commentaries, but also of original treatises. These were based on classical sources, to be sure, but in many respects they transcended those sources in acuity and depth of insight. Hence, by the time Ibn al-Haytham undertook his study of vision, not only had the core sources for that study been transformed in various subtle and not-so-subtle ways, but the interpretive context within which they were read had also been transformed. With that in mind, let us first look at Aristotle's account of visual perception as it was received and revised between the time of al-Kindi and Ibn al-Haytham's somewhat younger contemporary, Ibn Sina, or Avicenna (980-1037).

Psychology and Epistemology: As we saw earlier, Aristotle provided a rather vague account of sense-perception and its psychological underpinnings in the *De anima*. By Ibn al-Haytham's day, that account had undergone a modicum of specification in terms of particular psychological faculties accorded particular functions in a more-or-less hierarchical order.¹³⁰ In his extensive discussion of psychology and epistemology in the *Kitab al-Shifa*,¹³¹ for instance, Avicenna outlines this system of faculties and functions roughly as follows. First, each proper sensible is conveyed through its appropriate channel (sight, taste, touch, etc.) to the common sense. There the individual proper sensibles are gathered together into a single, unified sense-representation that is passed to the imagination (fantasy), which serves as a temporary repository for such representations. These formal impressions are then

arranged by a subsequent imaginative faculty (cogitative in nature), which puts them into a sort of discursive order according to which the next faculty, that of estimation, is enabled to make various inferences or judgments. The final faculty is memorative. It is in this faculty that the formal conclusions drawn by estimation or reason come to rest, eventually to be recalled as general models (or universals) according to which new perceptions (or forms) can be recognized and evaluated.¹³²

If, as this model suggests, sense-induction unfolds in stages from lower (sense) to higher (reason) faculties, then it must occur somewhere in the physical structure of the body. In short, the "soul," with its attendant faculties, must have some material substrate within which to carry out its perceptual and epistemological functions. Aristotle and the Stoics, of course, looked to the heart as the seat of these functions. But, as Galen observed, it made more sense to locate them in the brain, where all of the sensory nerves come to focus. Galen, moreover, had pinpointed an appropriate material substrate for these functions in the *pneuma* pervading the cerebral ventricles. "It is better, then," he concluded, "to assume that the soul dwells in the actual body of the brain . . . and that the soul's first instrument for all the sensations of the animal, and for its voluntary motions as well, is this *pneuma*."¹³³

Arabic thinkers were not slow to seize on the implications of this account. Why not, in fact, locate the material, or "sensitive," soul in the brain and explain its functions in terms of the brain's physical structure? In response, medieval Arabic thinkers undertook to "Galenize" Aristotelian psychology by, as it were, mapping the faculties within the brain itself. Accordingly, the faculty of common sense was located in the frontal pair of ventricles, where the sensory nerves converge. Accepting the sense-impressions conveyed by those nerves, this faculty acted in concert with the imagination, Aristotle's *phantasia*, to subject those impressions to perceptual elaboration. For their part, the estimative and cognitive faculties were located in the brain's central ventricle, where the perceptual representations formed in the imagination were passed for further, discursive elaboration. The results of that elaboration, finally, were remanded to the posterior ventricle of the brain, where they were stored for recall.

Not everyone agreed about the precise number or terminological designation of these faculties; nor, for that matter, did everyone agree about the precise internal structure of the brain.¹³⁴ However—and this is the crucial point—all of these thinkers worked within, and elaborated upon, the same conceptual framework and, in the process, articulated a model according to which sense-perception and its epistemological entailments could be readily explained in anatomical and physiological

terms. Equally important, by the time Ibn al-Haytham undertook his study of vision, that model had achieved more-or-less canonical status within the Arabic tradition of natural philosophy, particularly along the Aristotelian line of development. Whether, in fact, Ibn al-Haytham had that model in mind as he framed his own account of visual perception is by no means certain, but, as we shall see, there is reason to suppose that he did, at least to some extent.

Anatomy and Physiology: Like Aristotle within the medieval Arabic philosophical tradition, Galen carried enormous weight as an anatomical and physiological authority within the medieval Arabic medical tradition. This deference to Galen's authority was, of course, well-founded in view of his obvious acumen as both observer and critical thinker. It should therefore come as no surprise that, from at least the mid-ninth century on, the anatomical and physiological basis of Arabic medicine became Galenic to the core. It should also come as no surprise that, like Aristotle, Galen did not pass unchallenged, despite a general acceptance of his conceptual framework.

Among the earliest of Galen's Arabic partisans was Hunayn ibn Ishaq. A Nestorian Christian and physician, Hunayn spent most of his professional life in Baghdad, where, like his close contemporary, al-Kindi, he had firm ties to the House of Wisdom. Such was his fame as both scholar and medical authority that he was eventually appointed head physician to the caliph, a post he held, with one brief interruption, until his death. Having demonstrated a rare facility with languages, Hunayn was early charged with finding Greek texts and translating them into Syriac or Arabic. That he accepted this charge with alacrity is clear from the number of works he eventually translated, or whose earlier translations he revised. Although several of those works are of philosophical import (e.g., Plato's *Timaeus*, Aristotle's *De anima* and *Metaphysics*), the majority deal with medical subjects. Of that majority, the overwhelming majority are Galenic—some 130 treatises in all.¹³⁵

In addition to these translations, Hunayn wrote a number of original pieces, many of them, as might be expected, focusing on medicine. Among these original works, one in particular concerns us here: an ophthalmological compendium entitled *The Ten Treatises on the Eye*.¹³⁶ In the first three treatises of this compendium, Hunayn provides a complete description of the anatomy, physiology, and function of the eye. Almost all of what he has to say is a recapitulation of Galen's earlier account. Accordingly, Hunayn describes the same three humors (albuminous, crystalline, and vitreous in order from front to back) and the same succession of tunics from outside in, three toward the front of the

eye (conjunctiva, cornea, and uvea) and three toward the rear (sclera, choroid, and arachnoid—or retinal). The eye as a whole, he continues in the same Galenic vein, is attached to the hollow optic nerve, which consists of two sheaths, the innermost, and softer, of which gives rise to the choroid tunic, the outermost, and harder, of which gives rise to the sclera. Originating on both sides at the forefront of the brain, these nerves descend to the optic chiasma and, after joining there, continue to their respective eyes.

The brain itself, Hunayn echoes Galen, is divided into four cavities, or ventricles, which are charged with animal (i.e., psychic) pneuma. Elaborated from vital pneuma carried through the retiform plexus at the base of the brain, this animal pneuma pervades all four ventricles. In the front two, which are paired, the animal pneuma takes a particular form suitable to sensation.¹³⁷ The portion of this sense-receptive pneuma that passes into the hollow optic nerves is, in turn, suitable for visual sensation. Conducted by those nerves into the eyes, this visual pneuma flows through the appropriate retinal passages to the crystalline humor and proceeds thence through the pupil to the surface of the eye. From there it enters into the surrounding illuminated air and, upon meeting it, transforms it into the instrument through which the eye establishes visual touch with external objects. All that is actually sensed on that basis is color, so color is the proper object of sight. As such, it provides the means by which the object itself and its spatial properties (i.e., size, shape, situation, distance, and movement) are perceived.

As described to this point, Hunayn's account of the eye's structure and function represents little more than a variation on Galen's theme.¹³⁸ But Hunayn adds one distinctly jarring note. Instead of locating the crystalline lens toward the front of the eye, as did Galen, he placed it at the very center, and he did so quite purposefully. What makes this relocation of the crystalline lens significant is not so much the relocation itself as Hunayn's reason for carrying it out. Quite simply, it was to restructure the eye in a more systematic and functional way than had Galen. The lens had to be in the center because, as Hunayn himself puts it, "all that surrounds it in the eye was created for it, either to protect it from injury or to be useful to it. Therefore, those parts surround it from all sides, whilst it is in the middle itself."¹³⁹

The shape of the lens is functional as well. It is oblate, rather than perfectly spherical, so that it can "receive impressions of more perceptible objects than would be the case if it were perfectly round; for a flattened body meets more of the objects which are in its path than does a perfectly spherical body."¹⁴⁰ At first glance, this looks like a mere restatement of Galen's assertion in *De usu partium*, X, ii, 111 that the crys-

talline lens is flattened so that “a greater part of it would be in . . . communication [with external objects], because the straight lines touching a body will embrace a smaller part of it if it is very convex.”¹⁴¹ As Bruce Eastwood points out, though, there is a subtle but important difference between the two claims. Galen, on the one hand, stresses the efficiency with which the lens is designed to take visible impressions (i.e. to communicate with objects) on a relatively minimal surface-area. Hunayn, on the other, stresses the effectiveness with which the lens is designed to widen the visual field.¹⁴² Hunayn’s reasoning is therefore essentially functional, Galen’s essentially aesthetic, in orientation. Or to put it in somewhat different terms, for Hunayn, the lens is flattened so that it can achieve greater operational efficiency (via the most effective use of space); for Galen, it is flattened so as to achieve greater physical efficiency (via the least wasteful use of space).

As far as the physical and functional structure of the eye as a whole is concerned, the difference between Galen and Hunayn boils down to a reversal of the terms of explanation. For Galen, the teleological argument proceeds from effect to cause: because the eye is structured in a certain way, then, given its visual function, it *ought* to be structured in that particular way. For Hunayn, on the other hand, the direction of argument is from cause to effect: because the eye, given its visual function, *ought* to be structured in a certain way, then it must be structured in that particular way. There is thus a fundamental apriorism in Hunayn’s approach that is missing from Galen’s. It is this apriorism that permits him to reconstruct the eye in response to theoretical imperatives that force him to ignore the observed fact that the crystalline lens lies nowhere near the center of the eye. As will become clear later, when we examine Alhacen’s account of ocular anatomy, this same sort of apriorism is at play, leading Alhacen to describe an eye that is at least as theoretical as it is real in its physical structure.

Optics: While Arabic philosophy and medicine developed along increasingly systematic lines between the late ninth and early eleventh centuries, the same cannot be said of Arabic optics, at least not if we are to judge by the sparse textual evidence so far uncovered. For one thing, there is no indication of a concerted effort before Ibn al-Haytham to formulate a complete and coherent account of visual perception in the mold of Ptolemy’s *Optics*. This failure may well have been due to the lack of an appropriate model. For, to the best of our knowledge, Ptolemy’s *Optics* remained virtually unknown to, or ignored by, Arab scholars until relatively late.¹⁴³ Thus, in its early development, Arabic optics tended to be “Euclidean” in its basic approach.¹⁴⁴

The earliest indisputable testimony to the use of Ptolemy's *Optics* comes with the mathematician, Ibn Sahl (fl. c. 980), who took Ptolemy's analysis of refraction in the fifth book of the *Optics* as the springboard for his own analysis of burning mirrors and lenses.¹⁴⁵ Although there is no disputing the ingenuity and sophistication of that analysis (Ibn Sahl formulated Snel's law of refraction in the process of analyzing lenses), the fact remains that his primary concern was with light, not sight. Furthermore, Ibn Sahl's approach was problem-oriented rather than theoretical; he was concerned with solving a discrete set of problems rather than creating a broader theoretical or analytic framework within which to understand them.

This piecemeal approach characterizes most of the optical works from the period under discussion. At separate occasions, for instance, al-Kindi addressed the problems of parabolic burning mirrors and image-magnification through refraction.¹⁴⁶ Equivalently focused studies by Hellenistic and early Byzantine authors were also in circulation during this period. Anthemius of Tralles' rather maladroit study of parabolic burning mirrors was certainly known to Ibn Sahl, who also mentions a certain "Dtrums" in the course of his analysis.¹⁴⁷ Likewise, Diocles' exquisite study of spherical and parabolic burning mirrors was probably known by at least the late tenth century, and Ibn al-Haytham may have relied upon it, among other works, for his own *De speculis comburentibus seu de sectione mukefi*.¹⁴⁸ On reflection in general, we have two works entitled *De speculis*, one ascribed to Tideus, the other to Euclid, this latter text apparently an Arabic compilation of theorems from Euclid's *Optics* and *Catoptrics*, as well as from Hero of Alexandria's *Catoptrics*.¹⁴⁹ On refraction we have al-Kindi's study as well as that of a certain "Futhitos" (an Arabic transliteration of the Greek name "Potitos"?), and on optics in general we have al-Kindi's "Optics" (*De aspectibus*) and Ahmad ibn Isa's ninth-century "Book on Optics and on Burning Mirrors." None of these studies, however, no matter how general the scope, offers a truly systematic theoretical treatment of its subject.

Al-Kindi's *De aspectibus* is especially intriguing as an example of how Euclidean ray-theory was developed and revised within the Arabic context.¹⁵⁰ As one might expect, al-Kindi follows Euclid in supposing the eye to be responsible for making contact with external objects; his theory, in short, is extramissionist. Yet somewhat unexpectedly, al-Kindi rejects Euclid's assumption that the eye emits a material flux along discrete lines to establish this contact. Rather, for al-Kindi, the eye exerts a power (*virtus*) that renders external objects visible, in much the same way that light exerts the power of illumination on things. Furthermore, if what passes from the eye is immaterial, then it cannot be discrete. Visual

radiation, in short, must be continuous, so the constituent rays, as well as the visual cone formed by them, are virtual, not real.¹⁵¹ Al-Kindi illustrates this point in proposition 14 of the *De aspectibus*. Suppose that the visual power is generated at points **A**, **B**, and **G** on the surface of the eye, whose center is **D** in figure 7. That power will propagate in all possible directions from each point within the plane **HLK** to form arcal segments **HIT** (for point **A**), **ELZ** (for point **B**), and **ITK** (for point **G**). Clearly, then, these arcal segments will overlap, and the closer to axial line **BL** they get, the more of them will overlap. Hence, the area of greatest overlap, where the visual power is most concentrated, will be in the vicinity of point **L**.¹⁵²

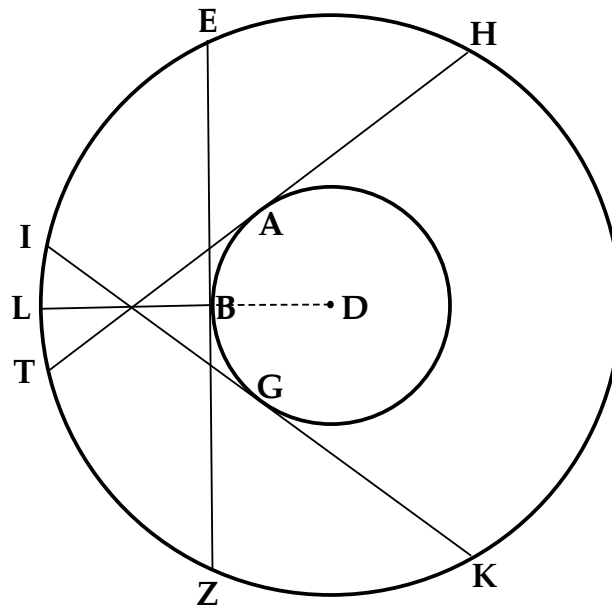


figure 7

With this demonstration, al-Kindi has brought three points to the fore. First, radiation should be understood as absolutely punctiform, each “luminous” point radiating its “form” in a sphere of propagation, insofar as that is possible, barring any impediment (as, for example, from the surface of the eye). Second, radiation is absolutely continuous; it does not occur along discrete, rectilinear lines, although the sphere of propagation can be resolved into such lines for analytic purposes. Third, the operative part of the eye in the generation and propagation of visual power is not the center, as it is for Ptolemy and, by implication, Euclid; it is, rather, the surface itself. Thus, although the axial line that connects

L, the point of maximum concentration, and point **B** on the surface of the eye runs straight through centerpoint **D**, this connection is incidental, or accidental, not essential. Centerpoint **D** is therefore geometrically relevant but physically irrelevant.

Conclusion: How many of the psychological/epistemological, medical, or optical sources discussed in this section were actually known to Ibn al-Haytham, much less drawn upon by him in the composition of his *Kitab al-Manazir*, is a moot point, given his failure to cite sources by name.¹⁵³ That his work bears apparent (and I stress “apparent”) traces, in idea and conception, from those sources is suggestive but not probative. What our brief survey does establish beyond doubt, however, is that Alhacen’s work on visual perception fits within an evolving intellectual tradition that is both complex and integrative. This tradition is well-represented according to the three groups cited at various reprises in the *De aspectibus*: (1) natural philosophers (*naturales*), such as al-Farabi and Avicenna, as well, to some extent, as al-Kindi and Hunayn; (2) practitioners of the medical art (*ars medicinalis*), such as Razes and Hunayn; and (3) “mathematicians” (*mathematici*), such as al-Kindi, Ahmad ibn Isa, and Ibn Sahl. It is therefore safe to assume that when he refers to these groups and their opinions, Alhacen has in mind, if not the actual representatives we have mentioned, then others of their ilk.

5. *Alhacen’s Account of Visual Perception: An Overview*

Background Summary: Alhacen’s account of visual perception is exceptionally cautious and considered. There is remarkably little in it that is overtly hypothetical or deductive and much that is overtly empirical and inductive. Furthermore, Alhacen is extraordinarily systematic and precise, almost mathematically so, in developing that account element-by-element in a logical order that is as inexorable as it is clear. Leaving virtually nothing to chance, he guides the reader along by the shortest of leashes, not only forcing him to follow the beaten path within straitened bounds, but also pointing out the exemplary landmarks—in the way of illustrative examples, many of them experimentally-based—along the way. As a result, Alhacen’s exposition tends to come across as somewhat repetitive, even long-winded, a fact that led his Latin disciple Witelo to charge him somewhat uncharitably with tediousness.¹⁵⁴ But what Witelo viewed as tediousness is better understood as completeness. Alhacen was determined to ensure that his readers not only fully understood the rationale behind his account and its attendant claims, but

also grasped the entire range of supporting evidence.

For the most part, our overview of Alhacen's account of visual perception will follow the order of his presentation. We will begin with his analysis of the physical grounds of sight in the radiation of light and color through transparent media. We will then turn to his account of the eye and its structure, for it is in terms of that structure, according to Alhacen, that the eye is uniquely suited to see. With that established, we will pass to his explanation of the peculiar sensitive capacity of the eye and how it permits the eye to select coherent visible impressions from the light and color radiated to it from external objects. As we shall go on to see, the forms or "images" derived from these visible impressions provide the basis for our perceptual apprehension of physical characteristics that are not truly visible. These range from size and shape to beauty and ugliness. In the process, we will examine Alhacen's account of visual certification, according to which we make actual sense of what we see. Having thus ascertained how, under proper circumstances, we achieve a veridical perception of external particulars, we will close with an account of visual illusions, or misperceptions, and their genesis in the transgression of certain threshold conditions critical to proper visual perception.

The Physical Grounds of Sight: According to Alhacen, eight preconditions must be met if visual perception is to occur at all, much less properly. First, there must be some separation between the eye and the object that is to be seen. Second, the object must face the eye. Third, the object must be of a perceptible size. Fourth, it must face the eye long enough to be perceived. Fifth, there must be some light present. Sixth, the object must be at least somewhat opaque. Seventh, there must be a continuous transparent medium between eye and object. And, finally, the eye itself must be adequately sound to fulfill its basic visual function.¹⁵⁵ These preconditions are normative; an excess or deficiency in any of them will impede proper vision. Too little light, too much distance between eye and object, or an inordinately impaired eye can cause an object not to be seen, even when, *ceteris paribus*, it should be.

Of the eight preconditions listed above, the last four are of special concern to us here, so let us deal with them in order, starting with light. According to Alhacen, light (*lux*) is an inherent and essential property of self-luminous objects, such as the sun or stars. Thus embodied, light is inherently disposed to replicate itself through continuous transparent media. Such media, in turn, are inherently disposed to accept and transmit light as a similitude, or formal representation (*forma*), of its original instantiation in the luminous object. In this state, as an accidental mani-

festation of itself in the transparent medium, light is generally designated by the Latin term *lumen*.¹⁵⁶

Each point on the surface of a luminous object is to be thought of as an independent source of radiation, propagating its form everywhere transparency permits. Ideally, what results is a sphere of propagation within which every radius represents a rectilinear trajectory, or ray, along which *lumen* is transmitted.¹⁵⁷ All luminous surfaces can be resolved into a mosaic of independent point-sources sending their forms outward in all possible directions. It is crucial to realize, however, that the radial lines along which light is assumed to propagate are virtual rather than real. In actuality, light emanates from spots, not actual points, on the luminous surface, and the ensuing sphere of propagation is perfectly continuous. The mathematical ray is thus a virtual representation of the physical ray, which is itself an abstraction from the continuous physical sphere of propagation.¹⁵⁸

Opacity (*densitas* or *soliditas*) is the gauge of an object's ability to block light. In the case of reflective bodies, this ability is manifested in their capacity to make all or most incoming light rebound. In the case of all other opaque bodies, their ability to block light is manifested in the capacity to absorb or trap it. Surface-texture differentiates the two, reflective bodies being smoother than nonreflective ones. Opacity is relative. Some objects are perfectly opaque, absorbing all the light that shines upon their surfaces. Others are only partially so, their surfaces absorbing some of the incoming light and allowing the rest to pass through. Misty air is an example of the latter. Once they have absorbed incoming light, opaque bodies become luminous sources in their own right, radiating light in precisely the same way as self-luminous bodies, although more weakly. The light that is propagated in this mediate fashion is referred to by Alhacen as "secondary light" (*lux secundaria*) to distinguish it from the primary light (*lux prima*) that shines from inherently self-luminous bodies.¹⁵⁹

Color is a natural concomitant of opacity, so, at least in practice, if not theory, neither can exist without the other. Like light, color is naturally apt to replicate itself through transparent media, but its "illuminative" effect is far weaker than that of light.¹⁶⁰ On its own, in fact, color has virtually no illuminative effect, as is evident from our inability to see things in pitch-black darkness. In order to manifest itself—e.g., by shining on other opaque objects and imparting its own hue to their surfaces—color requires illumination. Color and light are naturally disposed to intermingle, light providing color with the ability to shine, color in turn providing light with a sort of screen upon and through which to exert its illuminative power. Hence, while they are ontologically dis-

tinct, light and color seem not to be functionally distinct for Alhacen. On the one hand, color cannot manifest itself without light. On the other, all physical bodies possess some opacity by virtue of which they tinge the light that strikes or passes through them. Pure light would thus seem to be a theoretical abstraction rather than a physical reality for Alhacen.¹⁶¹

Transparency (*diafonitas*) is the obverse of opacity, the gauge of a body's ability not to block but to transmit light. Like pure light, perfect transparency seems to be a theoretical abstraction instead of a physical reality for Alhacen. Even such exquisitely transparent media as clear air and pure crystal are not perfectly diaphanous. They have at least a modicum of consistency (*spissitudo*) that enables them to trap some of the light radiating through them. Thus, for example, as light passes into a deep pool of clear water, the water imparts a bluish tinge to it. Likewise, in passing through hazy air, light takes on a whitish cast from the vapor that perfuses it.¹⁶²

The consistency of transparent bodies also seems to be responsible for their tendency to refract or deflect light that penetrates their surfaces at an angle. This refractive effect is not, however, due to the intrinsic color of the medium or the presence of adulterants in it. Milky water, for example, is no more refractive than clear water. The internal structure of such refractive media seems to be the determining cause, so that the looser and more permeable that internal structure, the less resistance the body poses to the penetration of light and, therefore, the less its refractive tendency. The more compact the internal structure, on the other hand, the greater the resistance and, therefore, the more the passing light is shunted toward the normal.¹⁶³

In terms of how they act upon, and react with, physical bodies, radiated light and color possess certain dynamic qualities. For one thing, according to Alhacen's rather convoluted argument in II, 3.60-62 (see pp. 445-447 below), both take time, albeit an imperceptibly short time, to traverse space. For another, both continually lose intensity as they radiate ever farther from their source. For yet another, the intensity with which they illuminate physical bodies depends upon how directly they impinge upon those bodies: the more direct the impingement, the more intense the effect. Radiated light and color can therefore be understood by analogy to projectiles shot at great speed from their source, the intensity of their impact upon opaque or transparent surfaces varying inversely with the distance and directly with the angle at which they strike those surfaces.¹⁶⁴

Under these conditions, the basic function of the eye is obvious enough: to be affected by the forms of light and color that strike it. To

establish this point, Alhacen is at pains in the first five chapters of book 1 in the Latin text to show by common experience how light and color affect sight in various ways depending upon ambient circumstances. An overly bright light or color, for instance, can impair the eye's proper functioning by creating an after-image that overshadows the effect of fainter light- or color-forms upon the eye. Strong colors seen in faint light will not be properly revealed to the eye. The transparency of diaphanous objects that are deeply colored may not be seen in faint light, whereas in stronger light it will become apparent. A firefly seen in daylight will not appear luminous. Every one of these examples is meant to show not only how light and color affect the eye in various ways, but perhaps more important that in order to see, the eye must be affected by them. The eye, in short, does not reach out toward objects to see them. They reach in to it, manifesting themselves through their radiated light and color.¹⁶⁵

Before going on to the next subsection, let us pause briefly to consider the similarities and differences between Alhacen's account of the physical grounds of sight and the accounts of Aristotle, Ptolemy, and Galen. To start with, there is no question that Alhacen's account lends itself to Aristotelian analysis in terms not only of potency and act, but of the four causes as well. As conceived by Alhacen, for example, color on its own is no more than potentially visible. Only with the addition of light, which gives it the power to replicate itself formally, does it become actually so. The eye, for its part, has the potential to see, but that potential remains unrealized until the eye is properly affected by the illuminated color-forms that strike its surface. Those color-forms, meanwhile, play formal cause to the medium's material cause, their visual effect in the eye constituting the final cause. The color-form also serves as the efficient cause, its natural propensity toward self-replication moving it to act. Now whether Alhacen (or, more properly in this case, Ibn al-Haytham) actually thought in such causal terms, even implicitly, as he framed his account of radiation and sight is subject to debate. There is certainly nothing explicit in that account to indicate that he did. Yet, as we shall see, his Scholastic followers, particularly Roger Bacon, seized upon the Aristotelian implications in (or perhaps read them into) Alhacen's account and brought them to the fore as they sought to give it firmer theoretical underpinnings.¹⁶⁶

There are, in addition, several specific points of agreement among Alhacen, Aristotle, Ptolemy, and Galen. All four concur that color is the proper object of sight. All four concur that it is a real, objective property of physical bodies. All four concur that without light color cannot be seen. All four concur that, properly speaking, the act of visual percep-

tion begins at (or quite near) the anterior surface of the eye. At least three of them—Alhacen, Aristotle, and Galen—concur that sight requires a properly disposed, continuous medium between eye and object. And, finally, like Ptolemy (as well, by the way, as al-Kindi), Alhacen conceives of the ray as a virtual rather than an actual entity, an analytic convention rather than a physical reality. Like Ptolemy, moreover, Alhacen vests his rays with certain dynamic properties in order to explain how they interact with physical bodies.¹⁶⁷

As to points of disagreement, at least between Alhacen, on the one hand, and Ptolemy and Galen, on the other, the most obvious lies in Alhacen's unequivocal intromissionism. Indeed, Alhacen expends considerable effort to invalidate the theory of visual rays, not by refuting it outright but by showing that it is redundant. After all, even the proponents of visual radiation are forced to suppose that once the rays make contact with external objects, they must somehow convey the information garnered from that contact back to the eye. Why then, he concludes, posit both an outward and an inward reach when a single inward one suffices? To posit visual rays is therefore otiose.¹⁶⁸

Another point of disagreement between Alhacen and his Greek predecessors has to do with the status of light. For Galen and Aristotle, light is a mediating entity that renders the air between eye and object open to sight. For Alhacen, on the other hand, such media as air and water are actually and inherently transparent. They have no need of light to dispose them to that state. Rather than mediating vision, then, light is *per se* visible for Alhacen. Nonetheless, as for Ptolemy, so for Alhacen, the primary function of light is not to be seen but to render color visible.

The Anatomical and Physiological Structure of the Eye: In its overall form and structure, the eye described by Alhacen in book 1, chapter 6 of the *De aspectibus* is essentially, though not precisely, the same as that described by Galen and Hunayn. Its wellspring lies at the forefront of the brain where the two hollow optic nerves take form, the inner sheath arising from the softer *pia mater*, the outer sheath from the harder *dura mater*. Meeting at the optic chiasma (*nervus communis*), they subsequently diverge to reach their respective eyesockets, which they enter through a foramen in the bony hollow. They then expand outward, the outer sheath forming the scleral tunic (*consolidativa*) that encloses most of the eyeball. The transparent anterior portion of this outer tunic forms the cornea. For its part, the inner sheath forms the uveal tunic (Galen's *chiton chorooides*), which encompasses a smaller sphere than the scleral tunic and is attached to the sclera toward the front. The uveal tunic continues

beyond the circle created by the intersection of the sclera and the cornea, but it falls short of completion by the amount occupied by the circular opening of the pupil. Unlike Galen and Hunayn, Alhacen makes no mention of the retina.¹⁶⁹

Inside the uveal tunic is the glacial sphere (*glacialis*). The anterior segment of this sphere is filled with glacial humor (Galen's *krystalloiedes*), its posterior segment being filled with vitreous humor (Galen's *hyaloeides*). The space between the glacial sphere and the inner surface of the cornea is filled with albugineus humor (Galen's *ooeides*). The glacial sphere itself is enclosed by an exquisitely thin integument, the aranea ("cobweb-like"), which allows it to hold its shape while separating it from the elements of the eye that surround it. This integument also extends through the body of the sphere to separate the glacial and vitreous humors. So isolated, the anterior portion of the glacial sphere constitutes the crystalline lens, although Alhacen never refers to it as such, preferring instead the general designation *glacialis*.¹⁷⁰

As an outgrowth of the brain, each eye is linked to it through the hollow optic nerve that originates at its forefront. After crossing with its mate at the optic chiasma, each nerve enters its respective eyesocket where it funnels out to form the two key tunics--sclera and uvea--that enclose the eyeball and the glacial sphere within it. Being hollow (i.e., *obticus*), the optic nerve serves as a conduit for visual spirit, which is passed through it from the brain. Flowing into and through the eye, the visual spirit eventually reaches the anterior portion of the *glacialis* (i.e., the crystalline lens) which it suffuses and, in the process, endows with sensitive power. Like Galen and Hunayn, then, Alhacen locates the seat of visual sensitivity in the crystalline lens rather than at the outer surface of the cornea, as seems to be the case for Ptolemy. It is, of course, tempting to identify Alhacen's visual spirit with Galen's *pneuma psychikon*, but it bears noting that, unlike Galen (and Hunayn), Alhacen has nothing to say about the ultimate source or production of the visual spirit in the brain. Nor, for that matter, does he ever mention the ventricular structure of the brain.¹⁷¹

Connected to the optic nerve at its rear, the eyeball as a whole is attached at the face by small muscles to each side. Aside from these attachments, the eye floats freely within the eyesocket so that it can move smoothly and swiftly in both a lateral and up-and-down direction at the behest of its guiding muscles. The nerve at the back, for its part, is supple enough to flex easily with such motion so as not to impede it. This capacity to move freely allows the eye to scan the visual field continually and effortlessly, thereby taking it in to the fullest possible extent.¹⁷²

So far, the physical and physiological structure described by Alhacen

accords fairly well with that described by Galen and Hunayn. Yet, when it comes to the eye's geometrical structure, the accord is much poorer. Alhacen agrees that the eyeball as a whole is absolutely spherical, at least at its frontal portion. But he goes on to claim that as an integral part of this greater sphere, the cornea forms a perfect extension of the sclera instead of bulging outward, as Galen (and perhaps Hunayn) would have it. The smaller glacial sphere, he continues, lies inside and somewhat toward the front of the eyeball, so its centerpoint is anterior to that of the eyeball as a whole. However, the front portion of the glacial sphere is flattened in just such a way that its curvature is precisely the same as that of the cornea ahead of it. The anterior surface of the glacial sphere is therefore concentric with the surface of the eyeball as a whole. Its posterior surface, on the other hand, remains eccentric to the eyeball.¹⁷³

The centerpoints of the eyeball and of the uveal sphere are connected by an axial line, which runs straight through the middle of the pupil to the middle of the hollow optic nerve at the back of the eyeball. According to this disposition, every line that is orthogonal to the surface of the cornea will be orthogonal to the anterior surface of the *glacialis* and, on that account, will converge at the center of the eye.¹⁷⁴ Figure 8 represents the geometry of Alhacen's eye as described to this point. The outer circle represents the eyeball, with its center at **A**, the arc to the far right being the cornea. The inner circle, with its flattened anterior surface, represents the glacial sphere. Its centerpoint, overall, is **B**, although its flattened anterior surface shares centerpoint **A** with the cornea. The line running through centerpoints **A** and **B** and continuing to the middle of the optic nerve is the axial line. Since the anterior surface of the glacial

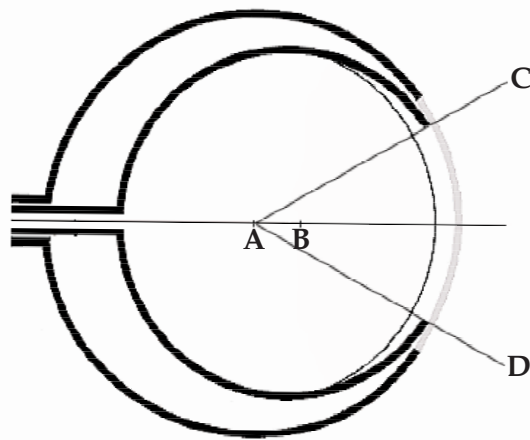


figure 8

sphere is concentric with the surface of the cornea, all of the lines passing orthogonally through those surfaces, as represented by **CA**, **DA**, and axis **AB**, will converge at the center of the eye.

In terms of its geometry, the eye described by Alhacen is significantly different from the eye as we know it now or from the eye as understood by Galen and Hunayn. For a start, in supposing the cornea to be perfectly concentric with the eye as a whole, Alhacen dismisses the fact, known to Galen, although perhaps not to Hunayn, that the cornea actually bulges outward from the eyeball's surface.¹⁷⁵ For another, in supposing the glacial sphere to be smaller than the ocular sphere enclosing it, Alhacen is forced to leave an unaccountably large space between the two, especially toward the rear. Why make these two counterfactual suppositions? As will become evident in the following subsection, they are absolutely necessary to Alhacen's account of how visual images are selected by the eye. Thus, like Hunayn, who locates the lens at the very center of the eye despite clear evidence to the contrary, Alhacen accommodates the structure of the eye to the demands of his theory, rather than the converse. Because the eye, given its visual function, *ought* to be structured in the way Alhacen describes it, then it *must* be structured in that way.¹⁷⁶

Sensation and the Selection of Visual Images: As we saw earlier, Alhacen's model of radiation assumes that every point (or spot) on a luminous, colored surface radiates its form in every direction transparency permits. As a result, the surface of the cornea, and thence the *glacialis* or lens, is bombarded by radiation from all angles, each point on it receiving the form of every point on the facing object, and every point on it receiving the form of each point on that object. Take points **A**, **B**, and **C** on the visible surface represented by line **ABC** in figure 9 on the following page. Each of these points will radiate its form to all points on the surface of the corneal arc between **E** and **F**. Consequently, points **E**, **D**, and **F** on the cornea will receive forms simultaneously from every point on the visible surface. Given this model of indifferent punctiform radiation, how does the eye make coherent sense of such an incoherent battery of visible impressions?¹⁷⁷

Simplicity itself, Alhacen's response is based on the dynamic properties of the ray and the sensitive capacity of the lens. Only those rays that strike the lens orthogonally make an adequately strong impression to be felt by it. The rest, impinging at an angle, are simply ignored because of their relative weakness. Moreover, as a refractive body, the glacial humor allows only the orthogonal rays to pass through unbent; the rest are deflected out of consideration. The lens, therefore, filters the

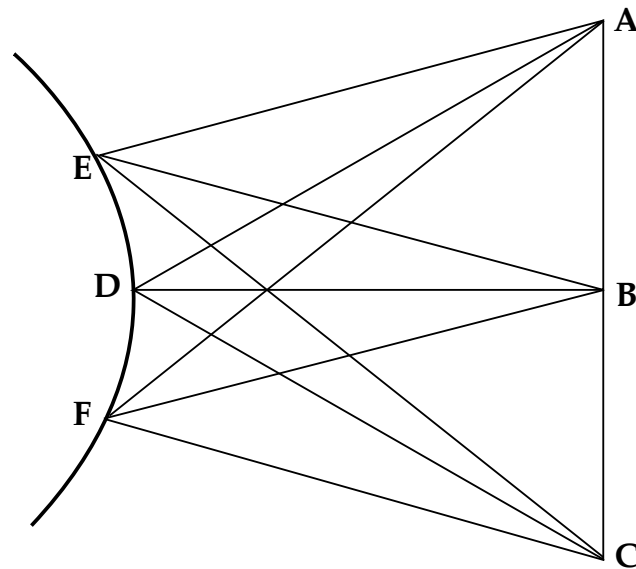


figure 9

chaos of impressions that reach it, selecting only those that form a cone of radiation with its vertex at the centerpoint of the eye and its base at the surface of radiation. Mathematically equivalent to the visual cone of Euclidean-Ptolemaic optics, Alhacen's cone of radiation ensures that the eye will abstract a point-by-point representation of the visible object that takes form as a mosaic of individual color-forms at the anterior surface of the lens

This formal depiction (*forma*) constitutes the visible image, and its ultimate apprehension by the visual faculty depends on its being transmitted in proper order through the eye and the optic nerve to the brain.¹⁷⁸ If the constituent points of the visible form abstracted by the lens were allowed to continue unrefracted through the *glacialis* along the orthogonal rays from which they were initially abstracted, then the form as a whole would be inverted by the crossing of those rays at the center of the eye. Transmitted to the optic nerve in such an inverted order, the resulting image would represent the object upside down, not upright. Yet we see things upright. Therefore, there must be some way to prevent such crossing.¹⁷⁹ Here the interface between glacial and vitreous humors comes into play. Three assumptions are necessary. First of all, that interface must lie ahead of the eye's center so that the rays never intersect. Second, the vitreous humor must be more refractive than the glacial humor. And, finally, the curvature of the interface must be less sharp than that of the anterior surface of the lens. If these conditions are

met, Alhacen concludes, the rays bearing the visible form will never intersect, so the form they convey will be channeled upright and in proper order along the visual axis into the hollow optic nerve. Upon entering the nerve, the visible form will then be conveyed through it in proper order to the optic chiasma, the visual spirit serving as the medium of transmission throughout. It is here, at the optic chiasma, that the images conveyed from both eyes are fused. The resulting unified form is presented to the final sensor (*ultimum sentiens*), whose basic function is to make perceptual sense of it—but more on that later.¹⁸⁰

We must not lose sight of the fact that, according to Alhacen, the selection and transmission of visible forms by the eye involves physiology as well as physics. Indeed, as soon as the impinging color-forms make contact with the surface of the lens, the contact is felt by the lens in the form of pain (*dolor*), which generally goes unnoticed. It can, however, become acute if the impression is too intense, as happens when we stare directly at the sun. Conveyed neurologically to the brain through the visual spirit that infuses the optic complex, this pain alerts us to the fact that we are seeing something (and presumably induces us to attend to what we are seeing). Without the mediation of visual spirit, moreover, visible forms would not be properly channeled through the internal humors of the eye to the optic nerve. Nor, for that matter, would they maintain their proper order as they wound through the optic nerve itself unless the visual spirit pervading the hollow of the nerve forced them to do so. Hence, the physical receptivity of the eye and the optic nerve is complemented by a sensitive receptivity granted them by their charge of visual spirit. Without this double receptivity, the optic complex would be incapable of transmitting the visible form intact to the final sensor.¹⁸¹

Simple Perception: Strictly speaking, Alhacen's eye senses only color and light, and it invariably senses them commingled. Furthermore, it senses only the fact, not the quality or type, of the color and light impinging upon it. The eye makes no judgment whatever about the color and light it senses. Less strictly speaking, Alhacen acknowledges that we see a total of twenty-two visible characteristics or "intentions" (*intentiones*) possessed by physical objects. Two of these intentions, light and color, are *per se* visible—or, in Aristotelian terms, they constitute the proper object of sight. The remaining twenty are mediately visible in that they derive from the primal apprehension of light and color that arises from brute sensation (*solo sensu*). In order of Alhacen's analysis, they are as follows: distance (*remotio*), spatial disposition (*situs*), corporeity (*corporeitas*), shape (*figura*), size (*magnitudo*), continuity

(*continuitas*), discontinuity or separation (*discretio vel separatio*), number (*numerus*), motion (*motus*), rest (*quies*), roughness (*asperitas*), smoothness (*lenitas*), transparency (*diafonitas*), opacity (*spissitudo*), shadow (*umbra*), darkness (*obscuritas*), beauty (*pulcritudo*), ugliness (*turpitudine*), similarity (*consimilitudo*), and difference (*diversitas*).¹⁸²

That we do not actually “see” these intentions is obvious, given that the visible color-form presented to the final sensor provides the sole basis for visual perception. Being merely representational, that form does not possess the actual physical qualities—such as size, corporeity, or beauty—of the object it represents. After all, as presented to the final sensor at the optic chiasma, the visible form of a six-foot-tall man cannot itself be six feet tall, nor can it have his corporeal bulk, his spatial disposition, or any of his other objective qualities. Such qualities must therefore be implicit, not explicit, in the visible form. Consequently, the final sensor must somehow infer them. This it accomplishes through the faculty of discrimination (*virtus distinctiva*), which enables it to distinguish among the various visible intentions and to determine them perceptually.¹⁸³

The process of discrimination is essentially inferential or deductive (*sillogistica*) and usually involves comparison or correlation (*comparatio*). Take the perception of transparency as an example. That we have no direct visual access to it is evident, since transparency is, by definition, the absence of opacity. Our perception of transparency must therefore be mediate—i.e., in relation to other perceptions. Consequently, when we see a given object and perceive its remoteness from us, we deduce that the air-filled space between it and us is transparent. This holds even in the case of diaphanous bodies, such as translucent gems, whose color or consistency (*spissitudo*) renders them actually visible. For as soon as we see a light-source or illuminated body shining through them, we perceive their transparency. So, too, corporeity is perceived not in itself but by inference from the fact, known through repeated experience, that the light and color we see originate from surfaces. Experience also teaches us that surfaces are embodied. Thus, at the moment we see something, we automatically deduce that it is corporeal.¹⁸⁴

Although by Alhacen’s account we are all naturally endowed with the capacity to discriminate and deduce, we are otherwise *tabulae rasae* at birth, possessing no innate notions of “red” or “triangle” according to which we might pigeonhole our sensations or perceptions as they occur to us. Such notions are learned, formed through repeated experience of the given quality along with repeated realizations that this particular quality is not some other, such as green or yellow. So learned and generalized, these notions are eventually committed to memory—or, to use

Alhacen's own phrasing, they are "ensconced in the soul" (*quieverunt in anima*). In that form they are subject to recall in the imagination. Hence, repeated experiences of red or triangular things eventually yield the notions of redness or triangularity by virtue of which we recognize subsequent instances of redness or triangularity.¹⁸⁵

Alhacen's account of distance- and size-perception is particularly instructive as an example of the experiential and deductive nature of visual perception. Now, according to Alhacen, distance, or remoteness (*remotio*), can be understood in two ways: as the *fact* of remoteness (i.e., the outwardness of external objects) or as the *amount* of remoteness (i.e., how far those objects lie away from us). Let us start with the fact of remoteness.¹⁸⁶ At first blush our perception of the outwardness of external objects might strike us as absolutely intuitive, a natural and immediate concomitant of the visual act itself. According to Alhacen, however, this perception involves a deductive process that starts with the recognition that objects disappear from sight when the eye turns away or when the eyelids are closed. "Now it is intuitively obvious" (*Et in natura intellectus est*), Alhacen concludes from this,

... that what affects the eye in a given situation but disappears when it is removed is not fixed in the eye. . . . It is also intuitively obvious that what appears when the eyelids are opened and disappears when they are closed is not fixed in the eye, nor does the thing creating this effect lie within the eye. Now when the faculty of discrimination perceives that the effect occurring in the eye . . . is not something fixed within the eye, nor is the thing creating that effect within the eye, then it immediately perceives that what occurs in the eye comes from outside And when the faculty of discrimination perceives that what is seen neither lies within the eye nor is placed directly upon the eye, it immediately perceives that there is distance between that thing and the eye.¹⁸⁷

In contrast to Ptolemy's account, in which the very outward reach of the rays to external objects informs us immediately of their outwardness, Alhacen's account emphasizes the mediate and inferential nature of such information.¹⁸⁸

Not surprisingly, the process by which we perceive the amount of distance is considerably more involved than that by which we perceive mere outwardness. First, we must establish some basic gauge. We do so according to the measure of our own bodies, in terms of arms-lengths or paces. On that basis, we begin by determining distances that are near us, for example a pace-length's distance from where we are standing. We then extend that measure outward, pace-length by pace-length, un-

til we get a determinate sense of intermediate distances in terms of multiple pace-lengths. Through constant repetition, we eventually come to recognize such measures unconsciously, a fact that misleads us into thinking we determine them immediately and intuitively. But there is a limit to our ability to perceive, and therefore to determine, distances in this way. In order to gauge longer distances, we must have convenient landmarks along the way, or, as Alhacen puts it, there must be “a continuous, ordered range of bodies” (*corpora ordinata continuata*) spanning the distance to be measured. More often than not, this span consists of determinate portions of the ground lying between the eye and the object, but a range of uniformly disposed objects, such as trees, along the line-of-sight will do as well. Staked out in this way, moderately large eye-to-object distances can be perceptually determined with fairly high accuracy. Vast distances without intermediate landmarks (celestial distances, for example) can only be estimated, and such estimation is naturally subject to error, often significant error.¹⁸⁹

As is clear from this analysis, distance- and size-perception are inextricably linked, because our ability to perceive long distances determinately depends upon our recognition of landmarks, such as trees or houses ranged along the way. Yet, without some grasp of the size of those landmarks, we cannot accurately correlate them to the distances at which they lie. The perception of size therefore depends in great part upon the perception of distance. It starts with the perception of how much of the visual field, and thus its projection upon the surface of the lens, is occupied by the object under scrutiny. With that determined, Alhacen continues, we can imagine the visual angle subtended by the object itself. Then, if we have a determinate sense of how far away the object is, we can correlate that distance to the imagined angle in order to arrive at a determination of size. Altogether, then, size-perception depends upon a threefold correlation among: (1) the relative extent of the portion of the visual field occupied by the object, (2) the size of the imagined visual angle subtended by that portion, and (3) the distance that is perceived between eye and object.¹⁹⁰

Increasing familiarity with specific distances and objects leads not only to their automatic recognition, but also to an almost automatic determination of the object's size as correlated to such distances. Hence, once the general notion of a given size—e.g., that of a man or a horse—is committed to memory, we will almost invariably perceive such objects to be the same size no matter the distance or the variation in visual angle that comes with it, at least within reasonable limits. That is why, if we place our hand directly in front of our eyes, we immediately realize that it is far smaller than the distant wall it occludes, even though the

visual angle it subtends is greater. Alhacen, in short, is well aware of the size-distance invariance principle.¹⁹¹

Compared with Ptolemy's account of distance- and size-perception, Alhacen's might, at first glance, appear unduly complex, even unwieldy. But Ptolemy had one signal advantage over Alhacen. He could explain the perception of outwardness, as well as of distance, in terms of a virtually immediate apprehension of both according to our supposedly innate sense of the outward reach and length of the mediating ray. Size-perception follows almost automatically, depending as it does upon the correlation of visual angle and distance.¹⁹² In rejecting the visual-ray theory out of hand, though, Alhacen left himself no option but to reject the quasi-immediatist explanation of distance- and size-perception that is based upon it. After all, in reaching to the eye from outside, Alhacen's ray provides an objective rather than a subjective perspective on things. Unable, therefore, to appeal to the self-referential radiation of Euclid and Ptolemy, Alhacen had to take an entirely different tack. Given this imperative, the resulting inferential account of distance- and size-perception is as reasonable as it is bold. More to the point, it is, as far as we know, one of the few truly original parts of Alhacen's general theory of visual perception.

Equally striking, though less original, is Alhacen's account of aesthetics. It, too, is inferential, insofar as it depends upon correlations. However, while Alhacen's approach to aesthetics is relational, it is not relativistic.¹⁹³ Beauty is not in the eye of the beholder for Alhacen; it is in the object that possesses it. By virtue of its light, for instance, the full moon is inherently beautiful, as is a rose by virtue of its color, or a silken fabric by virtue of its smoothness. Indeed, all of the visible intentions can, in one way or another, confer beauty upon things. The very size of the moon, Alhacen points out by way of example, makes it inherently more beautiful than a star, a large star being more beautiful than a smaller one by virtue of its greater size. For the most part, however, beauty depends upon a combination of characteristics and their interrelationships. That is why a large star, given both its luminosity and its size, is more beautiful than a smaller one, whose diminished size detracts from the inherent beauty of its luminosity. Likewise, an almond-shaped eye of moderate size is more beautiful than an almond-shaped eye of immoderately large or small size. Even two things that are intrinsically beautiful in their own right can combine to create ugliness. An almond-shaped eye of moderate size but of a rose-red color, for example, would be exquisitely ugly. And, to draw upon an example from the Arabic version of the text, so would the combination of blond hair and blue eyes.¹⁹⁴

The relational emphasis of Alhacen's aesthetics becomes crystal-clear in his discussion of harmony or proportion as an overarching principle of beauty. Indeed, almost all aesthetic judgments are based upon this principle, for, as Alhacen concludes, "when you examine the beautiful forms of every kind of visible object, you will find that proportionality creates beauty more than any other characteristic on its own or, for that matter, any conjunction [of characteristics] on its own."¹⁹⁵ To illustrate, Alhacen offers the example of a face and the composition of its members. Accordingly,

... large eyes having a beautiful shape, along with a moderately flat nose whose size is proportionate to that of the eyes, are beautiful. So, too, even if they are small, eyes of an almond shape, having a charming and delicate shape, will be beautiful when they occur along with a narrow nose of moderate shape and size. Likewise, slim lips along with a delicate mouth are beautiful when the delicacy of the mouth is proportionate to the slimness of the lips—i.e., when the lips are not inordinately slim, nor the mouth inordinately small, but the mouth must be moderately small while the lips are slim and, moreover, proportionate to the size of the mouth. So, too, when the width of the face is proportionate to the size of the facial members, it will be beautiful—i.e., when the face is not inordinately broad, and when the facial members are proportionate [in size] to the size of the whole face. For when the face is inordinately broad, but its members are too small to be proportionate in size to it, the face will not be beautiful, even though the size of the members may be proportionate [among each other], and even though they are beautifully shaped.¹⁹⁶

Conversely, Alhacen concludes, "if the members are proportionate among each other as well as to the breadth of the face, the form will be beautiful, even if the members are not beautiful by themselves."¹⁹⁷ In other words, proportion or harmony overrides every other aesthetic consideration in the final judgment of beauty or ugliness.¹⁹⁸

There is little or nothing really new or remarkable in this account of aesthetics. For one thing, the emphasis upon harmony or proportionality is essentially Greek in origin.¹⁹⁹ For another, by stressing the objective nature of beauty over its subjective appreciation, Alhacen ignores psychological or cultural factors that obviously do influence aesthetic judgments. After all, as Shakespeare observes with such poignancy in sonnet CXXX, love can pervert aesthetic judgment beyond reasonable measure.²⁰⁰ Moreover, Ibn al-Haytham's judgment that blue eyes and blond hair are ugly is culturally, not objectively, determined. What is,

or at least seems to be, new in Alhacen's aesthetic analysis is the analysis itself. For with Alhacen we have the first known effort to subject aesthetics to a relatively full and systematic scrutiny in the broader context of visual theory.

We need spend little time discussing the remaining visible intentions beyond making the following observations. First, many of them are naturally paired, one positive, the other negative (e.g., opacity vs transparency, continuity vs discontinuity, motion vs rest, roughness vs smoothness, similarity vs difference). To perceive the negative (e.g., transparency) is therefore to perceive that it is not the positive (i.e., opacity).²⁰¹ Second, these intentions, and their perceptions, tend to be interlinked. Similarity, for instance, must be similarity in virtue of something else, such as shape, color, size, or the like. And, finally, all of the visible intentions are inferred through correlation. Thus, to take lateral motion as an example, it is deduced from a correlation of the moving object with its changing spatial dispositions *vis-à-vis* surrounding objects.²⁰²

Certification and the Perception of Individuals and Types: No visible intention is ever perceived in isolation, because no object is defined by a single visible attribute. The moon, by way of example, is initially perceived in terms not just of its light, but of its circularity, its corporeity, its disposition in the night sky, and its relative immobility. When we perceive any object through sight, then, we perceive it according to the totality of the visible features that define it. Only after sight has perceived that totality does the faculty of discrimination isolate the object's individual features analytically. With familiar objects, such as the moon, we do not need to consider all of their visible features in order to perceive them as such. A few of the more salient ones will do. With unfamiliar objects, on the other hand, we need to take a fuller accounting if we are to pigeonhole them satisfactorily. This full accounting, which constitutes what Alhacen calls "accurate determination" or "certification" (*certificatio*), results from a close, definitive visual scrutiny (*intuitio*).²⁰³

The accuracy of this scrutiny depends upon several factors, the first of which is visual acuity. Since the eye is naturally disposed to see most clearly and accurately along the axial line, then the farther away from that axial line a given line-of-sight falls within the cone of radiation, the weaker and more indefinite the visual impression along it. Consequently, that portion of the object that is viewed directly along, or in close proximity to, the axial ray will be perceived most definitely and accurately. In addition, since vision is generally binocular, and since the eyes are naturally disposed to work in concert, the clearest, most accurate visual

impression under normal circumstances will be of that spot on the object-surface that is intersected by the two visual axes.²⁰⁴

The spatial disposition (*situs*), or orientation, of the object is yet another factor. An object will be most accurately perceived when it faces the eye directly (*in directam oppositionem*) so that the so-called common axis is perpendicular to the object's surface at roughly the midpoint and, in addition, so that the two visual axes intersect at that same point.²⁰⁵ Now the common axis, according to Alhacen, is the perpendicular line that bisects the line connecting the midpoints of the openings in the eyesockets where the optic nerves enter.²⁰⁶ To illustrate, let the circles centered on **A** and **B** in figure 10 represent the two eyeballs. Let **D** and **E** be the midpoints of the openings in the eyesockets where the two optic nerves enter, and let **DC** and **EC** represent the continuation of these nerves toward the brain. Point **C**, where they cross, thus represents the optic chiasma, or "common nerve." Finally, let the two visual axes, **AG** and **BG** focus at midpoint **G** on the object's surface. Accordingly, line **CFG**, which bisects **DE** and is perpendicular to it, as well as to the surface of the object at its midpoint, represents the common axis.²⁰⁷ If this

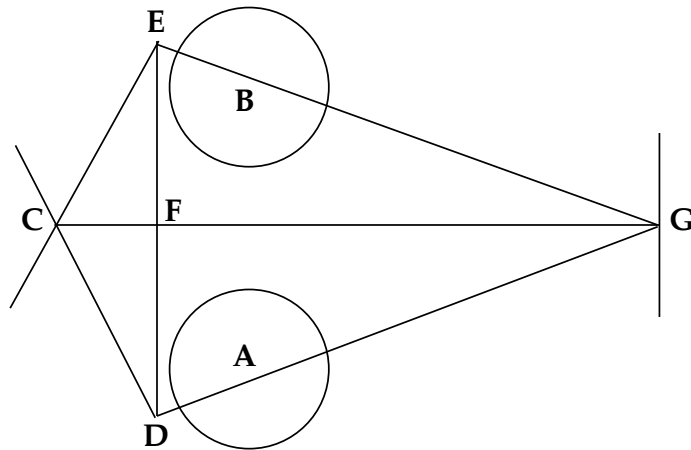


figure 10

axis fails to intersect the object-surface at its midpoint, or if it fails to intersect the object-surface at all, or if the object-surface is slanted with respect to it, then, even though the two visual axes may intersect upon the object-surface, it will be perceived less clearly and accurately than it would be under a directly facing disposition. The farther from the common axis the object-surface's midpoint lies, the less clearly and accurately that object will be perceived.²⁰⁸

Granted these conditions, the process of certification involves, first,

turning the head and eyes so as to bring the three axes to bear as closely as possible upon the midpoint of the object-surface under scrutiny and then scanning it as thoroughly as possible by passing the two eyes over every cross-section (*dyiameter*) of it. Each time the eyes take in a clear and accurate impression of the spot where the three axes intersect on the object's surface, they also take in a less clear, but more general, impression of the object as a whole. Thus, at each reprise, the object is perceived according to both part and whole. Once the scan is complete and the object has been definitively perceived according to as many of its visible characteristics as possible, the resulting form is committed to memory. The more often the object is scrutinized, the more definite and firmly planted its form becomes in memory, much as a speech is learned by heart through continual rehearsal.²⁰⁹

The ultimate goal of vision is not to determine the visible features of things as accurately as possible, though. It is to establish what those things are by means of the visible features that define them. This we do primarily through correlation and assimilation (*assimulatio*), by which Alhacen means the process of matching a given visible form to its closest notional exemplar in memory.²¹⁰ For instance, when I see a color I have never seen before, I scrutinize it carefully and, while doing so, attempt to find its closest notional counterpart in memory. Ultimately, I will correlate it to that notional counterpart, and, having thus found a perceptual niche for it, I will memorize it for subsequent recall in case I ever see its like again. The more often I see such a color, the more definite and memorable its notional representation becomes.²¹¹

With repeated perceptual experiences we acquire a vast array of notional representations in memory. These representations exist at two basic levels. The most general level is that of the universal form (*forma universalis*), which represents things by type or kind (*quiditas*). Repeated experiences of individual humans or horses eventually yield a universal form of "human" or "horse" that is a sort of confused composite of each specific instance. As such, it represents its object according to a limited set of defining features that are common to all, or at least the vast majority, of its specific instances. The universal form of "human," for example, should include such general features as uprightness of posture, a certain configuration of members, and a certain size. Specific features, such as eye-color or complexion, should not be included. Those belong by rights to the the second sort of form, the individual form (*forma individuorum*). This form, of course, is specific to particular instances, so it is through the individual form that I remember my old friend Martin, with his flaming-red hair, rubicund face, and upturned nose. I might even remember him according to specific circumstances, such as the place

and time I first met him.²¹² Memory and recognition thus play a crucial role in how we make sense of what we see, according either to general type or to specific individual. For it is by correlating the appropriate notional form ensconced in memory to whatever form we are seeing at the time, that we determine what that visible form actually represents.

As we have already noted, the visible form presented to the final sensor represents its object in its totality, as both type and individual, according to all of the object's visible intentions. Theoretically then, if we are to determine what it represents, we must go through the process of certification, scanning the object completely and correlating it feature by feature to its notional counterparts in memory. But that would be inordinately time-consuming and laborious. More often than not, we save ourselves the trouble by making perceptual determinations on the basis of key defining features, or "signs" (*signa*). That way we recognize things on the spur of the moment without having to peruse them at length.²¹³

This sort of visual apprehension is, in Alhacen's parlance, "vision at first glance" (*visio in primo aspectu*), and it can occur along with recognition (*cum cognitione precedente*) or without it (*fantastica*). In either case, it is limited to the most obvious features (*intentiones manifeste*) of the object seen. Without the correlative process of recognition, it constitutes a mere passing glance that yields the most indefinite of perceptual impressions. With the correlative process of recognition, such a glancing scrutiny enables us to make perceptual sense of things with minimal effort. Thus, when I note the bipedal stance of a given object and take this stance as a "sign," I immediately perceive that object as human. However, what vision at first glance makes up for in ease and temporal efficiency, it loses in certitude. The human I just thought I saw may turn out, on closer inspection, to be an ape. To perceive as accurately as possible, therefore, we must subject what we see to the close visual scrutiny (*intuitio*) that yields certification. Like vision at first glance, close visual scrutiny can occur along with recognition or without it.²¹⁴

All perceptual determinations, no matter how cursory, require time, and the more complete and complex the determination, the greater the time required. Perceptual determinations that occur along with recognition, however, take less time than those that do not. Hence, we perceptually determine familiar objects more quickly than we do unfamiliar ones, because we do not need to scrutinize familiar objects as carefully to identify them, having their notional representations as firmly planted in memory as we do. By the same token, when we see familiar objects, we perceive their universal forms sooner than we do their individual forms, because we need to consider fewer defining features for

such a determination. Thus, when I see my good friend Martin, I perceive him as human before I perceive him as Martin, the key defining features of his type, humanity, being fewer and more manifest than those of his personal individuality. The most time-consuming and difficult perceptual determination of all involves objects, such as mules and horses, or identical twins, that closely resemble one another. Hence, the more subtle the key differentiating features, the more extensive and intensive the visual scrutiny must be if they are to be accurately perceived and noted.²¹⁵

It should be clear by now that, specific details aside, the account of perception just described links Alhacen fairly closely at the conceptual level with both Aristotle and Ptolemy. There is fundamental agreement among all three that vision unfolds in stages, starting with the primal sensation of color (Aristotle's "proper object," Ptolemy's "primary visible," Alhacen's "brute sensible"). All three find in the resulting sense-impression the basis for subsequent perceptions of ulterior features—many of them spatial—that are implicitly conveyed by the initial sense-impression (Aristotle's "common sensibles," Ptolemy's "secondary visibles," Alhacen's "visible intentions"). The result, at least for Alhacen and Aristotle, is a perceptible representation of the object that, in turn, gives rise to a conceptual representation according to individual ("Diores' son" for Aristotle, "Martin" for Alhacen) or type (the "universal" for Aristotle, the "universal form" for Alhacen).²¹⁶

Moreover, there are several indications in Alhacen's account that it was informed, at least to some extent, by the model of Aristotelian faculties-psychology developed by his Arabic predecessors.²¹⁷ For a start, Alhacen breaks the perceptual process down into a hierarchical order, starting at the bottom with brute sensation (*comprehensio solo sensu*), passing upward to perception proper (i.e., of particular intentions), and culminating with apperception (i.e., of individual and universal forms). Furthermore, Alhacen more or less explicitly locates the perceptual process in the brain, where the soul (*anima*) has ultimate control over it.²¹⁸ In addition, Alhacen's visual spirit is a cerebral agent, serving as material support for the formal entities that are central not only to perception, but to apperception. Furthermore, although he usually attributes perceptual and apperceptual functions *grosso modo* to the soul (*anima*), Alhacen makes occasional mention of specific faculties within the soul. Most often cited is the final sensor, which functions in much the same way as the Aristotelian common sense. Like the common sense, moreover, it seems to be located toward the front of the brain, where it can be in close communication with its proper object—the visible form—at the optic chiasma.²¹⁹ Alhacen also refers explicitly to the imagination

(*ymaginatio*) as the place where the forms abstracted by the final sensor are delineated, or impressed (*figuntur*), and eventually stored for recall during correlation and assimilation.²²⁰ Finally, Alhacen emphasizes not only the psychological, but also the epistemological foundations of visual perception. In many respects seeing is knowing for Alhacen, entailing the same sorts of syllogistic associations and culminating in the same sorts of conclusive realizations.²²¹

Visual Illusions: Some pages back we observed that, like Ptolemy, Alhacen divides the science of optics under three heads according to the three basic modes of vision: *optics* proper, which is the study of sight by unbroken rays; *catoptrics*, which is the study of sight by reflected rays; and *dioptrics*, which is the study of sight by refracted rays. We also observed that, by both Ptolemy's and Alhacen's lights, these latter two types of vision (i.e., reflected and refracted) are inherently deceptive inasmuch as they distort our perception of the actual place, and sometimes of the proper shape and size, of things. Since the subject of books 1-3 of the *De aspectibus* is *optics* proper, we will ignore the other two modes of vision and concentrate on the illusions that arise in the case of vision by unimpeded radiation, or, as Alhacen phrases it, "direct vision" (*visus directus*).²²²

The point was made toward the beginning of this overview that, according to Alhacen, eight preconditions must be met if sight is to occur at all (see p. liii above). Furthermore, we pointed out that these preconditions are normative, that if each and every one of them falls within an appropriate range, the ensuing visual perception will be veridical.²²³ Hence, if the object is of appreciable size and opacity, and if it lies at an appropriate distance in front of the eye for an adequate amount of time, then as long as the light is right, the ambient air clear, and the eye healthy, that object will be correctly perceived. On the other hand, if any one or more of these conditions falls outside the appropriate range—e.g., if the light is too poor, the ambient air too hazy, or the eye unsound—the object will be misperceived. Such misperceptions can range in severity, from gross (e.g., mistaking a dog for a cow) to mild (e.g., mistaking a slightly warped plank for a straight one). All visual illusions can be reduced to misperceptions of this sort.

Alhacen opens his discussion with an examination of diplopia, or double vision. The first point he establishes is that *all* binocular vision, even under optimal conditions, is diplopic to some extent. To convince us, he invites us to consider the situation in which an object faces the eye directly, so that the common axis and the two visual axes converge dead center upon its facing surface. By way of illustration, let the two

circles centered on **A** and **B** in figure 11 represent the eyes, **HK** the visible object, **F** the midpoint of its facing surface, and **XY** the line connecting the midpoints of the openings in the eyesockets where the nerves enter. Thus, **ZF**, which falls orthogonally to **XY** and bisects it, represents the common axis. Under the specified conditions **ZF** also falls orthogonally to point **F**. Finally, let the two visual axes, **AF** and **BF**, converge upon the common axis at point **F**. Accordingly, the form of point **F** will reach the two eyes at points **C1** and **C2**, which lie precisely at the midpoints of the corneas. Their respective locations on the cornea will thus correspond as perfectly as possible (*erunt magis consimiles*). That being so, when the two forms impressed at those locations reach the optic chiasma to be fused, they will overlap as perfectly as possible.

Meanwhile, the form of point **G** will reach points **D1** and **D2** on the two corneas. In this case the locations of the two points do not correspond perfectly. **D1** will lie somewhat closer to **C1** than will **D2** to **C2**, because angle **FBG** is slightly smaller than angle **FAG**. Therefore, when the forms at **D1** and **D2** reach the optic chiasma to be fused, they will not overlap as perfectly as possible because of the disparity in their re-

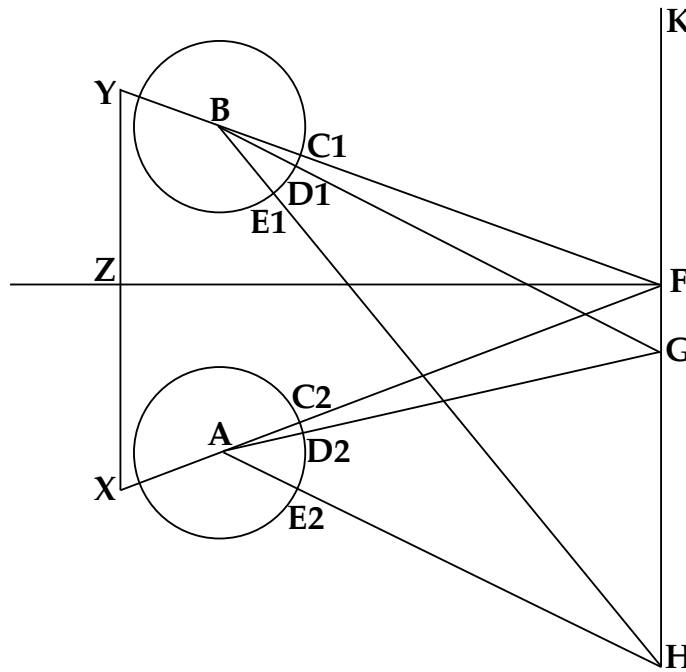


figure 11

spective locations. In reality, though, these forms are not mathematical points; they exist as tiny spots both upon the corneal surface and within

the optic chiasma. Hence, although they may not overlap perfectly, they will do so to such an overwhelming extent that the disparity in their locations after fusion goes almost unnoticed, the only perceptible effect being a slight blurring or indefiniteness of the resulting image. Not so with point **H**, which lies far to the side of **F**. Its form is projected upon points **E1** and **E2** of the respective corneas, but those two points lie at significantly different distances from **C1** and **C2**, because angle **FBH** is appreciably smaller than angle **FAH**. Consequently, when the forms at **E1** and **E2** reach the optic chiasma for fusion, they will fail to overlap entirely. They will therefore be perceived double rather than single.²²⁴

As this analysis indicates, of all the points on segment **FH** of the object's surface, point **F** will be perceived most clearly and definitely because the fusion of its two forms at the optic chiasma will be virtually perfect. The farther to the side of **F** the point that is perceived lies, the more imperfect the fusion and, therefore, the more indefinite the perceptual impression until, finally, indefiniteness yields to diplopia. The same holds, to some extent, for perception along the visual axes when they intersect at a point to the side of the common axis. Thus, if **AH** and **BH** in figure 11 are taken to represent the two visual axes, then even though the form of **H** will be impressed at perfectly corresponding locations on the corneas and will, in turn, be perfectly fused at the optic chiasma, **H** will appear less definite than **F** did with all three axes converging upon it. The primary reason is that, in focusing on lateral portions of the surface, we are viewing them at a slant. As a result, we cannot discern the minute details of that portion of the surface as clearly as we can when we look at it face-on.²²⁵ That is why, when we want to scrutinize something as clearly and carefully as possible, we try to bring all three axes to bear upon it. Suffice to say, nothing seen at the intersection of the two visual axes, no matter how far to the side of the common axis, will ever appear double.

Normally, of course, we do not see double, even at the lateral fringes of the visual field. Why we do not is due to a combination of factors. First, in almost all cases, the effective portion of the visual field is narrow enough that the forms of objects viewed within it will occupy locations on the eye that correspond closely enough not to cause diplopia. Furthermore, since each spot-form on the lens' surface constitutes part of a continuum of spot-forms, we tend to perceive their continuity in favor of their discontinuity. Thus, even when the given form is projected double in the optic chiasma, its two images are perceptually melded, so that what is perceived is not a double image but an inordinately blurred or indefinite one. In addition, the natural weakness of monocular vision toward the lateral edges of each visual cone renders

objects at or near those edges so indistinct as to be almost beyond perceptual notice. Add to that the diplopic effect of binocular vision, and our failure to notice, much less discern, things lying far to the edges of the visual field becomes all the more understandable. Finally, our natural tendency to scan the visual field rather than simply take it in as a whole gives us a more-or-less unified perception that overrides whatever diplopic effect is created by any single snapshot-glance at that field²²⁶

True diplopia—i.e., a clearly recognized doubling of images—occurs when the object's spatial disposition (*situs*) with respect to the axes surpasses normal limits. If, for instance, I focus on a relatively distant point and then place my finger directly before my nose, my finger will appear double. So too, if I focus on a relatively near point and place my finger directly behind and at some distance from it, my finger will appear double. And, finally, if I focus on a point straight ahead and place my finger relatively close to my face but in line with only one of the visual axes, or to either side of both axes, my finger will appear double. In all of these cases, the underlying reason for the doubling is the displacement of the object from the natural axial focus of the eyes. The more acute that displacement, the more pronounced the doubling.²²⁷

Having analyzed diplopia in all its aspects, whether inherent or forced, Alhacen concludes his discussion by offering a series of experimental verifications of the phenomena described. The apparatus for these experiments consists of a plaque that is roughly a foot-and-a-half long and four inches wide, this latter distance corresponding roughly to the separation between the midpoints of the pupils when the eyes stare straight ahead. A notch is cut for the nose at one end of the plaque so that the plaque can be nested against the face with its outer corners nearly touching the eyes. Diagonals are inscribed from corner to corner on the face of the plaque, and two lines are drawn through the plaque's centerpoint, where the diagonals intersect. One of these lines is drawn across the width and parallel to the top and bottom edges, the other lengthwise and parallel to the edges along the sides. Placing this apparatus up to the eyes, we can then position various objects, such as wax pegs or small strips of parchment, at various points on or beyond its face in order to validate the descriptive account given earlier. The actual experiments need not detain us, since most of them are as simple as they are obvious.²²⁸

Diplopia illustrates how objects can be misperceived when one of the eight preconditions for sight—spatial disposition, in this case—transgresses its normative limits. Indeed, all of these preconditions have normative limits which, if transgressed, will lead to misperception. If the illumination is too bright or too dim, a given object may not be properly

perceived, but between the prohibitive extremes there is a range of light-intensities according to which the object will be properly perceived. Likewise, if an object is too distant or too near, if it is too large or too small, if it is inadequately opaque, or if it is snatched away too soon, it may not be properly perceived. However, as Alhacen is quick to point out, the normative limits of these preconditions are interdependent. A small object may be misperceived at a distance, or under lighting conditions, or during a limited time-interval, in which a larger one would be properly perceived. Thus, the normative range for any of the eight preconditions is relative, each range being proportionate to some or all of the others.²²⁹ In this regard, Alhacen's account of visual illusions is much like his account of aesthetics, which is governed by the proportionality of the elements that arouse the perception of beauty.

Visual illusions occur at three basic levels, according to Alhacen. The first and lowest of these involves brute sensation. At this level the misperception reduces to no perception whatever. An object may be too distant, too far off to the side, too small, too short-lived, too dim, or too tenuous to be seen at all. Or the eye may be too weak to see it.²³⁰ The second level of illusion involves misrecognition. Accordingly, if the conditions are not right (e.g., if the light is inadequate or the time of scrutiny too brief), then we can easily mistake one individual or type for another. Perceiving Peter to be Martin or mistaking a horse for a mule are obvious examples.²³¹ The final level of illusion involves deduction. Alhacen subjects this sort of misperception to an exhaustive analysis, showing how, as each of the eight preconditions falls out of its normative range, we can be led to misperceive each of the twenty-two visible intentions. If, for example, an object lies too far away or too close, we can misperceive its proper distance from other objects, or its shape, or its size, and so forth. And the same holds if the light is too bright or too dim, the air too hazy, or the object too slanted, or too far to the edge of the visual field.²³²

Alhacen's account of visual illusions (and here I limit my remarks to the Latin text only) strikes me as the least compelling portion of his entire theory of visual perception, in part because, by overemphasizing objective causation, it underplays subjective factors, and in part because it is too rigidly confined within its analytic framework. For every impropriety in a given precondition, there must be a corresponding impropriety in our perception of each visible intention. The resulting case-by-case analysis often reads like a litany, repeated *pro forma* for the sake of systematic completeness rather than for the sake of theoretical import. This is not to say that the analysis is an outright failure, only that it is failure relative to the more original and inspired portions of Alhacen's

overall theory of vision (e.g., his account of image-selection at the surface of the lens or his analysis of distance- and size-perception). There is, however, at least one bright spot in Alhacen's analysis of illusions: his account of the diplopic tendency of binocular vision. For, granted the theoretical constraints under which he framed it, his account is remarkably astute in explaining both why and how perceptual acuity varies within the visual field.

As to possible sources for Alhacen's account of visual illusions, the most obvious is Ptolemy. Alhacen's approach to the problem of true diplopia, for instance, is Ptolemaic to the core, and, in fact, he adds little or nothing to what Ptolemy has to say on the subject. Also, Alhacen's categorization of visual illusions according to perceptual level (i.e., brute sensation, recognition, and deduction) is strongly reminiscent of Ptolemy's threefold categorization according to undue physical conditions, anomalies in the visual faculty itself, and interpretive or inferential misperceptions.²³³ Still, Alhacen's analysis differs markedly in tenor and purport from that of Ptolemy. Not only is it more exhaustive and systematic, but it is organized in a fundamentally different way. Thus, while there is little or no doubt that Alhacen drew upon Ptolemy in his analysis of illusions, the extent to which he did so is far from clear. Equally unclear is how much of the non-Ptolemaic remainder of Alhacen's analysis is original, and how much of it is rooted in earlier sources, particularly those falling within the skeptical traditions of Greek philosophy and Islamic theology.²³⁴

Conclusion: As I remarked earlier, no mere survey can do justice to the remarkable subtlety, complexity, and elegance of Ibn al-Haytham's account of visual perception in the first three books of the *Kitab al-Manazir*.²³⁵ The best I can hope for is to have distilled that account, insofar as possible, to its essence. In the process, I have adverted to various points of convergence, at both the conceptual level and the level of specific ideas, between Ibn al-Haytham and his core sources in optics, anatomy and physiology, and natural philosophy. I have also noted that such convergences may be more apparent than real, a matter of coincidence rather than of essential linkage. Especially problematic in this regard are the conceptual convergences that seem to place Ibn al-Haytham within the Peripatetic tradition of physics and psychology. That Ibn al-Haytham's account of radiation may have been informed to some extent by Aristotle's theory of physical causation seems clear enough. No less clear is that, in framing his account of perceptual and apperceptual functions, Ibn al-Haytham may have been drawing upon the Galenized model of Aristotelian faculties-psychology that was developed during

late antiquity and the early Arabic Middle Ages. This model, as we have seen, located such faculties within the brain according to a succession of functions, ranging in hierarchical order from mere sense-perception to true cognition.

The problem is that whatever traces of Aristotelianism we may find in Ibn al-Haytham's account are implicit, not overt. We noted earlier, for instance, that Ibn al-Haytham makes no mention whatever of the ventricular structure of the brain, much less associating specific perceptual or apperceptual functions with specific ventricles. Hence, without explicit evidence, any claims we might make about the influence of Aristotelianism upon Ibn al-Haytham will perforce be tentative. Still, to deny such influence categorically would be rash. For one thing, Ibn al-Haytham's approach to optics tends to be phenomenal rather than theoretical. Consequently, his failure to articulate theoretical principles more sharply and explicitly indicates not so much that he lacked such principles as that his concern with them was tangential. Much like Newton, then, Ibn al-Haytham saw no reason to "feign" hypotheses unnecessarily when his analytic focus was so sharply directed to the phenomenal level. It is difficult to believe, moreover, that Ibn al-Haytham, with his lively mind and wide-ranging interests, would have been impervious to the intellectual currents, Peripatetic or otherwise, of his day. To deny any Aristotelian influences upon his optical thought would therefore be, quite literally, to take that thought out of context.

When we turn from Aristotle to Galen, we are on considerably firmer ground in the assessment of influence. Ibn al-Haytham's description of the anatomy and physiology of the eye—with its cerebral origins, its neurological pathway, its several tunics, its succession of humors, its charge of spirit, its sense-specific lens—is so obviously Galenic that the point needs no elaboration. True, Ibn al-Haytham's description departs from Galen's in certain key respects, Ibn al-Haytham ignoring the retina and proposing a somewhat different geometrical model. Still, there is no denying its Galenic basis at the general level, the specific differences arising from a variety of sources, including possible Arabic intermediaries and the theoretical imperatives that drove Ibn al-Haytham to revise the geometrical model as he did.²³⁶

The clearest, most definite, and most pervasive influence upon Ibn al-Haytham's account comes from Ptolemy's *Optics*. Indeed, I would go—and in fact have already gone—so far as to claim not only that Ptolemy's *Optics* was the cardinal source for the *De aspectibus*, but that, as such, the *Optics* served as a sort of blueprint or model for it.²³⁷ In other words, Ibn al-Haytham constructed the *De aspectibus* upon Ptolemaic foundations. In saying this I do not mean to imply that he simply

modified or elaborated upon those foundations. I mean, rather, that Ptolemy's account was instrumental, as both inspiration and foil, to Ibn al-Haytham. To a great extent, therefore, the *De aspectibus* can be regarded as a carefully considered and critical response to Ptolemy's *Optics*, much of it negative but much of it also positive.

A good case in point is Ibn al-Haytham's account of physical radiation and sense-impression. Having rejected Ptolemy's theory of visual flux for good reason, Ibn al-Haytham was compelled to formulate an effective alternative. The result was his theory of punctiform radiation, which entails the sensitive selection of point-forms arriving orthogonally at the lens. There is no denying the ingenuity and originality of this response. Nor is there denying its absolute centrality to the account of perception and apperception that follows. Nevertheless, in formulating his counter-theory, all Ibn al-Haytham did in the end was to translate Ptolemy's cone of visual radiation into a mathematically equivalent cone of visible radiation. Everything else remains the same, right down to the vertex of the cone, which still serves as the reference-point for spatial perception.²³⁸ So Ibn al-Haytham simply turned Ptolemy on his head. Perhaps it would be an exaggeration, then, to say that without Ptolemy's *Optics* Ibn al-Haytham's *Kitab al-Manazir* would have been inconceivable, but it would not, I think, be much of an exaggeration.

6. *Alhacen and the Latin West: Lines of Influence*

General Intellectual Background: With the increasing contacts between Muslims and Christians during the Reconquista in Spain and the Norman takeover of Arab Sicily during the first half of the twelfth century came a flood of Latin translations based upon Arabic texts (both original sources and translations) that had been inaccessible to northern European scholars up to that time.²³⁹ By the middle decades of the thirteenth century, when the Latin version of Ibn al-Haytham's *Kitab al-Manazir* began to attract serious notice in Europe, most of the core Greek sources known to Ibn al-Haytham were available in Latin. Aristotle's *De sensu et sensato* had been translated by at least the late twelfth century, and so had Euclid's *Optics* and *Catoptrics*. The same holds for Ptolemy's *Optics*, which was rendered from Arabic into Latin sometime in the second half of the twelfth century. Although Galen's *De usu partium* appeared in Latin only toward the end of the thirteenth century, several of his shorter treatises were translated during the course of the twelfth century. Aristotle's *De anima* first appeared in Latin around the middle of the twelfth century, this version being based upon a Greek text. A second

translation, drawn from the Arabic, was produced by Michael Scot sometime in the early thirteenth century, perhaps as early as 1220.²⁴⁰

Many of the Arabic and Greek sources available to, if not actually used by, Ibn al-Haytham also existed in Latin translation. A sampling includes al-Kindi's *De intellectu*, *De aspectibus*, and, perhaps most significant, *De radiis stellarum*. We can also include the *Ten Treatises* and the *De intellectu et intellecto* of Hunayn ibn Ishaq ("Johannitius" in Latin), the *Liber ad Almansorem* of al-Razi ("Razes" in Latin), the *De ortu scientiarum* of al-Farabi, the *Shifa* and *Canon* of Avicenna, as well as the *De speculis* of Tideus and Pseudo-Euclid. A number of relevant works by Arab scholars who wrote after Ibn al-Haytham, foremost among them al-Ghazali and Averroes, should be added to this list.²⁴¹

Meanwhile, as these newly translated works filtered into the Latin West, European scholars sought increasingly to incorporate what they learned from them into their own thinking about natural philosophy, metaphysics, and theology. Their own thinking, of course, was rooted in various indigenous traditions of thought that evolved over the eleventh and twelfth centuries. As far as the subsequent development of optics is concerned, the Platonic (or Neoplatonic) tradition looms especially large. Perhaps best represented by Robert Grosseteste (c. 1168-1253), this particular tradition was manifested in the evolution of what is commonly called light metaphysics. Thus, as Grosseteste himself understood it, physical light and its physical manifestations (e.g., rectilinear propagation) are reflective of divine light and its spiritual manifestations.²⁴²

All of this is to say that, as Ibn al-Haytham's treatise entered Europe in its Latin form, the intellectual context within which it came to be read was far different—and in some ways far richer and more variegated—than the intellectual context within which it was written. As an earnest of this fact, we need look no farther than Roger Bacon's *De multiplicatione specierum* and the remarkable variety of authors and works that are explicitly cited or easily identifiable there.²⁴³ Textual and cultural differences aside, however, Scholastic and early Arabic thinkers were much alike in their eclecticism. Wherever logically and doctrinally possible, textual reconciliation or synthesis was the goal. It follows, then, that the way in which Alhacen's *De aspectibus* was interpreted and understood by medieval and Renaissance European thinkers was shaped by, and to some extent also shaped, the intellectual context within which it was read.

This reciprocal relationship between text and context will become clear as we examine the fate both of the *De aspectibus* and of Alhacen's model of vision as they were assimilated by Latin thinkers from around

1260 on. We will start by looking at how that model was accepted within the “scientific” community, our focus being upon the development of mathematical optics, or *perspectiva*, as it came to be known. We will then turn to the philosophical and theological context of the later Middle Ages in order to examine how such seminal thinkers as Peter of Limoges, John Wyclif, and William of Ockham drew upon or reacted to Alhacen’s optical analysis as they grappled with certain basic epistemological and theological issues. We will then conclude by discussing the ways in which Alhacen’s ideas about light, perception, and aesthetics may have affected certain developments in Renaissance art.

Alhacen and Perspectivist Optics: The extent and depth to which Alhacen’s *De aspectibus* affected the development of optics in the Latin West between roughly 1260 and 1650 is so well known by now that it needs no establishing.²⁴⁴ The force of Alhacen’s impact upon early Scholastic thought is clear from the relatively sudden emergence of the so-called Perspectivist tradition during the second half of the thirteenth century. At the core of this tradition are four works that drew heavily from, or were based entirely upon, the *De aspectibus*: Roger Bacon’s *Perspectiva* (which formed part of his *Opus majus*) and *De multiplicatione specierum*, both probably written in the 1260s; Witelo’s *Perspectiva*, which was composed around 1275; and John Pecham’s *Perspectiva communis*, which was completed around 1280. A brief look at the dissemination of these works in manuscript form indicates the critical role they played in diffusing Alhacen’s ideas about light and sight into the wider intellectual arena of medieval and Renaissance Europe.

Of Bacon’s *Perspectiva*, whether in isolation or as part of the *Opus majus*, 39 manuscripts are currently known to exist, 34 of them in more-or-less complete form. Three date from the thirteenth century, 18 from the fourteenth, 11 from the fifteenth, and seven from the sixteenth.²⁴⁵ Bacon’s *De multiplicatione specierum*, on the other hand, survives in some 24 manuscript-versions, 18 of them complete or virtually complete. Three date from the thirteenth century, seven from the fourteenth, nine from the fifteenth, one from the sixteenth, and four from the seventeenth.²⁴⁶ By far the longest and most technically demanding of the four derivative works, Witelo’s *Perspectiva* is currently known to exist in 29 manuscript-exemplars, 22 of them complete. Among the 24 versions I have been able to place chronologically, one dates from the thirteenth century, 12 from the fourteenth, seven from the fifteenth, and four from the sixteenth.²⁴⁷ John Pecham’s brief *Perspectiva communis*, finally, is represented in at least 64 (perhaps 66) manuscripts, all but one of which have been placed chronologically. Two of the resulting 63 date to the thir-

teenth century, 30 to the fourteenth, 29 to the fifteenth, and two to the sixteenth.²⁴⁸ Add to these the 22 known exemplars of the *De aspectibus* itself, and the total number of manuscripts devoted explicitly to Perspectivist optics rises to just under 180.

The number and chronological distribution of these manuscripts serve as one gauge of the continuing interest that Perspectivist optics held for European scholars between the very late thirteenth century and the beginning of the Early Modern period. The early publication-record of the four core treatises serves as another. The Latin text of Pecham's *Perspectiva communis*, for instance, appeared in print eleven times between 1482 and 1665. It was also published in Italian translation in 1593.²⁴⁹ The evident popularity of this treatise is understandable, given that it was intended as an introductory epitome rather than as a comprehensive study. The same cannot be said of Witelo's *Perspectiva*, which is half again as long and at least as technically daunting as the *De aspectibus* upon which it was closely modeled. Yet even so, it saw print three times in the sixteenth century, first in 1535, then in 1551, and finally in 1572, when it appeared in tandem with Alhacen's *De aspectibus* in Risner's *Opticae thesaurus*.²⁵⁰ Roger Bacon's *Perspectiva* and *De multiplicatione specierum* did not fare as well as the others, the former remaining unpublished until 1614, the latter not committed to print until 1733, when it was published by Samuel Jebb along with the *Opus majus*.²⁵¹

The extent to which Perspectivist optics influenced ideas about light and vision during the later Middle Ages and Renaissance is indicated in a variety of other ways. For example, Alhacen's *De aspectibus*, Witelo's *Perspectiva*, and John Pecham's *Perspectiva communis* all served as university texts, primarily for the instruction of mathematics within the Arts curriculum.²⁵² Both students and masters were therefore exposed not only to the analytic techniques, but also to the theoretical underpinnings of Perspectivist optics. The resulting pedagogical tradition is surely reflected, to some extent at least, in the dozens of brief commentaries and synoptic studies—most of them anonymous—that still survive in manuscript form.²⁵³

Perspectivist works were also read extracurricularly, as witness their use by such non-Scholastic thinkers as Leonardo da Vinci (1452-1519) and Lorenzo Ghiberti (1381-1455).²⁵⁴ Likewise, educated but nonacademic thinkers, such as Francesco Maurolyco (1494-1575) and Giambattista della Porta (1535-1615), were well versed in, although somewhat critical of, Perspectivist theory.²⁵⁵ Indeed, so firmly rooted did Perspectivist ideas about light and vision become within the intellectual community of late medieval and Renaissance Europe that, even as those ideas came under attack during the early seventeenth century,

Perspectivist optics provided the very means of its own undoing.

Kepler's account of the eye in the *Ad Vitellionem paralipomena* ("Emendations to Witelo") of 1604 serves as not only a good example, but one that has become canonical since the publication of Lindberg's *Theories of Vision*.²⁵⁶ The purport of Kepler's account was to show that, instead of being a sensitive selector of orthogonal impressions, the lens is nothing but a refractive instrument, devoid of all perceptual functions. On that basis, Kepler re-formed the eye as a camera, the lens merely serving to focus incoming rays at specific spots on the retinal screen at the back, the result being an inverted point-by-point representation of the visual field. However, as Lindberg rightly observes, the analytic tools Kepler used to undermine Alhacen's model of image-selection were provided by Alhacen himself. Thus, to let Lindberg speak for himself, "Kepler presented a new solution (but not a new kind of solution) to a medieval problem, defined some six hundred years earlier by Alhazen." For, "by taking the medieval tradition seriously, by accepting its most basic assumptions but insisting upon more rigor and consistency than the medieval Perspectivists themselves, . . . [Kepler] was able to perfect it."²⁵⁷ Kepler, in short, was the last and best of the Perspectivists.²⁵⁸

Descartes's attempt to justify the sine-law of refraction in the *Dioptrique* of 1637 serves as another example. Descartes's disdain for the "Schoolmen" and all they stood for intellectually is a matter of record, as is his self-imposed mission of reconstructing natural philosophy on entirely new, non-Scholastic foundations. As far as optics is concerned, that meant recasting medieval light-theory in mechanistic terms. The resulting model reduced light to centrifugal impulses transmitted radially in all directions through a perfectly inelastic ethereal medium. One warrant of the validity of this new model, according to Descartes, is that when it is applied to the problem of refraction, it yields the sine-law. As has long been recognized, however, Descartes' attempted demonstration of this principle is anything but convincing. True, it does yield the right result—i.e., the sine-law—but its suppositional foundations are so flawed as to render it logically incoherent.²⁵⁹ What led (or misled) a thinker of Descartes's caliber to offer a "proof" of such dubious merit? The simplest, most plausible explanation is that, in formulating his analysis of refraction, Descartes followed out the logical implications of Alhacen's account of light and its dynamic interactions with physical bodies. Hence, in attempting to undercut the theoretical foundations of Perspectivist optics, Descartes relied so heavily upon them that he undercut himself.²⁶⁰

That Alhacen's account of light and vision did not pass unalloyed into and through Scholastic circles during the later Middle Ages should

come as no surprise, given both the critical and eclectic propensities of Scholastic thinkers. The most significant modifications to that account occurred through elaboration of its theoretical foundations. The central figure in this elaborative process was Roger Bacon. Like Grosseteste, whom he took as both mentor and model, Bacon was convinced that optics provides a window into the creative and providential workings of God. For Bacon, therefore, a complete understanding of physical vision and its ultimate cause in physical light was a necessary step toward understanding spiritual vision and its ultimate cause in divine illumination.²⁶¹ To achieve such an understanding required a more comprehensive approach to light and sight than Alhacen had taken in his account, which is relatively innocent of physical and metaphysical content or implications. Bacon thus took it upon himself to round out Alhacen's account by supplying that content and, in the process, making the implications explicit.

The starting-point for Bacon's elaboration is the physics of light. According to Bacon, all physical entities in the universe are bound together through a network of influences or forces (*virtutes*).²⁶² Each entity radiates its influence outward to surrounding entities in the form of "species." Every entity that is receptive of such influence is affected and, in a sense, transformed by it. The exercise of power is therefore reciprocal. To be acted upon by something is as much an expression of power as to act upon something, the recipient exerting "passive power" (*potentia passiva* or *potentia receptiva*), the agent "active power" (*potentia activa*).²⁶³

Luminosity (*lux*) is an active power. As an inherent property of certain bodies, it has the capacity to express itself through its species, *lumen*. Transparent bodies, for their part, have the capacity to accept and transmit such species. The process of transmission involves multiplication (*multiplicatio*), wherein each spot of *lux* on a luminous surface replicates itself as *lumen* in each part of the transparent medium adjacent to it. What results is a spot-thick shell of *lumen* in the medium surrounding the original spot of *lux*. So actualized, each spot of *lumen* within that shell replicates itself in the adjacent parts of the medium, thus creating a second shell of *lumen*, and so on *seriatim*. The result is a sphere of propagation that can be broken down into individual lines along which the species of *lux* is multiplied spot-by-spot through the medium in a continual passage from potency to act. Throughout this passage, the species serves as both formal and efficient cause, while the medium provides the material cause to support that passage.²⁶⁴

Under its obvious Aristotelian cloak, Bacon's account of light-radiation is essentially the same as Alhacen's, and so is his account of visual perception. Like Alhacen, Bacon conceives of every visible surface as a

mosaic of illuminated color, each spot multiplying its species everywhere transparency permits. Out of all the species that reach it, the lens accepts only those that strike it orthogonally. In that way it selects a point-by-point visible representation of the generating object. Channeled in proper order through the optic complex—and supported in its passage by the visual spirit that pervades the eye and nerve—this representation eventually reaches the optic chiasma. There it is presented to the final sensor, which makes perceptual sense of it as well as of the object it represents.²⁶⁵

Perception occurs at three levels. The lowest is that of brute sensation (*solo sensu*), which is limited to light and color. True perception occurs either by means of previous knowledge (*per scientiam*) or by means of deduction (*per sillogismum*). This latter sort of perception enables us to distinguish and determine the twenty-two characteristics that define the object visibly—i.e., Alhacen's visible intentions. Perception by means of previous knowledge, on the other hand, involves universal and individual forms, so it is through this sort of perception that we recognize not only general types (e.g., "horse" or "human"), but also specific individuals (e.g., Martin or Peter).²⁶⁶

Citing Avicenna as his primary authority,²⁶⁷ Bacon goes on to locate these perceptual and apperceptual functions according to specific faculties or internal senses (*virtutes interiores*) that are distributed among the three cells (*cellulae*) of the brain.²⁶⁸ So located, these faculties constitute what Bacon calls the sensitive soul (*anima sensitiva*). The anterior cell houses the common sense (*sensus communis*) and imagination (*ymaginatio*), which are ranged in that order from front to back. The common sense receives the visible representation passed to it by the final sensor and completes the perceptual judgment of that representative species. The resulting perceptible species is then passed to the imagination for short-term retention. The common sense and imagination together constitute the faculty of fantasy (*fantasia*), "which differs from [its two constituents] as the whole differs from the part."²⁶⁹ Fantasy makes the final and most general perceptual judgment of the object represented by the perceptible species.

The brain's middle cell houses two apperceptual faculties, the estimative (*estimativa*) and the cogitative (*cogitativa*), both of which receive the perceptible species from the first cell and make apperceptual judgments about it. It is through the estimative faculty, for instance, that a sheep judges the malignant intentions of a wolf, even though those intentions are neither sensible nor perceptible.²⁷⁰ The cogitative faculty does much the same thing at an intellectual level, judging the intelligible intentions of sensible objects (e.g., that the internal angles of any

triangle, as represented by all perceptible triangles, sum up to two right angles). The resulting species is remanded to the third cell of the brain, which houses the memorative faculty (*memorativa*). There the final species is stored for recall. According to this model, then, sensation, perception, and apperception unfold in stages, starting at the physical level and passing upward to the intellectual level, each species in turn representing something more general and abstract than its predecessors along the line of multiplication.

Aside from adding Aristotelian flesh to the relatively bare bones of Alhacen's account, Bacon imported certain terminological changes into it. Foremost among these is his replacement of *forma* with *species*. As used by Alhacen, *forma* is best understood in a general sense as "similitude" or "likeness." Accordingly, the form by means of which we see any given object is somehow like that object. However, as we have noted earlier, the form constitutes likeness in several ways. First, it is a likeness according to the light and color radiated from that object to the eye (e.g., a reddish-white blob). Second, it is a likeness according to all of the visible characteristics that define the object physically (e.g., a fairly tall reddish-white featherless biped standing thirty feet away). Third, it is a likeness according to the object's individual identity (i.e., my old friend Martin). Fourth, it is a likeness according to that individual's general type (i.e., human being).²⁷¹

But how are all these subforms contained in the single comprehensive form (*forma tota*) upon which visual perception is based? Do they somehow exist at different levels? Does the universal form, for instance, lie deeper in the comprehensive form than the individual form? What sorts of likenesses are these forms? Does the universal form of "human" actually look human? These questions are never directly addressed by Alhacen, but all indications are that he understood the form to be a depiction of sorts.²⁷² Much like a portrait, then, Alhacen's comprehensive form conveys all sorts of information that is not actually in the form itself. It is there only implicitly.

Bacon's species is similar to Alhacen's form in that it constitutes a likeness of sorts,²⁷³ but it is a likeness with two crucial differences. For one thing, Bacon's species is far more comprehensive than Alhacen's form because it is not so firmly tied to the mere visible expression of things. On the contrary, Bacon's species expresses the object's nature to the fullest extent, from its visible accidents to its very essence. Thus, as Bacon sums it up in *De multiplicatione specierum*, I, 2:

... it is evident that when it is inquired universally concerning every species in the medium, whether it is substance or accident, the answer

is obvious, and likewise whether a species is simple or a certain composite, and whether it is universal or singular. For the species of substance is substance, the species of accident is accident, the species of a composite is composite, and the species of a simple is simple, just as the species of matter is matter, of a form is form, of a universal is universal, and of a singular is singular; for it is to be said, in brief, that as accident is to substance and form to matter and universal to singular, namely, that none of these is without its companion, so is the species of accident to the species of substance and the species of matter to the species of form and the species of a universal to the species of a singular, because none of these is without its companion.²⁷⁴

The key to understanding this passage lies in Bacon's notion of what, for lack of a better word, I will call incorporation. By this I mean both the embodiment and the unification of defining attributes. Accordingly, every physical object is what it is (i.e., a substance) by virtue of incorporating all its defining attributes, from accidents (e.g., color and shape) to essence (e.g., being a rational, mortal animal). Altogether, these attributes constitute the object's nature. All objects express their nature through their species, but when those species exist outside their generating object, they must be incorporated as well.²⁷⁵ What the species actually expresses depends upon what it is incorporated in. When multiplied through transparent media, for instance, species express only the colored luminosity of the object's surface. When incorporated in the crystalline lens, they express the visibility of that surface. When incorporated in the spirit pervading the anterior cell of the brain, they express the object's perceptibility, and so forth, until the essence itself of the object (i.e., its universal nature) is expressed. Thus, every species incorporates the full range of its object's attributes and has the power at any time to express that range. But this power can only be realized if the species is incorporated in something that can actually bring it out.²⁷⁶ That is why the eye, given its peculiar sensitive capacity, cannot perceive essences, whereas the intellect, given its peculiar rational capacity, can. That is also why, in being provided with the capacity to discern them, a sheep can perceive the malignant intentions of a wolf, even though those intentions transcend the wolf's mere physical appearance.

The second crucial difference has to do with Bacon's notion of intentionality, a notion that can be traced back at least to Avicenna.²⁷⁷ Every species, according to Bacon, exists intentionally. By the same token, everything that a given species can possibly express exists in it intentionally. Intentionality, however, is only potential until it is realized. Thus, until it is able to express itself in one way or another, every species exists

at the level of almost pure possibility. I say “almost pure,” because no species can exist without being incorporated, even if only in a transparent medium. As a likeness, therefore, the intentional species in its barest state is almost wholly unlike its generating object because it expresses almost nothing about it. Only when its intentionality is realized does it become like its object, and then only insofar as it is realized. Thus, for instance, when the visible intentions of the species are properly incorporated (and therefore realized), the resulting visual species will be like the object according to its superficial physical attributes. Yet it will be nothing like the object according to its deeper, nonphysical attributes (e.g., the ability to reason or the capacity for moral judgment).²⁷⁸

By construing species in this way, Bacon not only tied visual perception more tightly to intellectual conception than had Alhacen; he also exposed its philosophical implications more clearly. As a result, later Perspectivists, such as Witelo and Pecham, adopted the language of species and species-multiplication not only to describe the radiation of light, but also to describe the visible manifestations of objects. The various stages of perception were increasingly understood in terms of intentional species and their abstraction by the appropriate organ or faculty. From the impinging rays, the crystalline lens abstracts the “visual species” (*species visibilis*). From this the common sense and imagination abstract the “perceptual species” (*species sensibilis*). And out of this, finally, the reasoning faculty abstracts the “intellectual species” (*species intelligibilis*). Each species, in turn, constitutes the proper object of the faculty or internal sense that operates upon it in an effort to realize its next level of intentionality. The entire process from seeing to knowing therefore follows a train of abstractions, at each stage of which the given species is more general and informative. Moreover, since each species in the train of abstractions constitutes a likeness, at one level or other, of the object that generates it, we can be sure that there is an essential correspondence between objective reality and our subjective “picture” of it.²⁷⁹

Thus brought into the framework of Aristotelian physics and psychology, Perspectivist theory provided nothing less than a scientific paradigm of sense-induction. As such, it had enormous appeal among Scholastic thinkers, particularly those of a philosophical bent, who were concerned with epistemological issues. But it also appealed at the level of what today we call physical optics. Particularly noteworthy in this regard is the Perspectivist analysis of reflection and refraction, which is based upon books 4-7 of the *De aspectibus*. In terms of elegance and mathematical sophistication, that analysis is so overwhelmingly superior that its closest rival at the time, Ptolemy’s account of mirrors and

refracting media in books 3-5 of the *Optics*, pales by comparison.²⁸⁰ Small wonder, then, that Perspectivist optics emerged triumphant during the later Middle Ages and Renaissance. Yet we should not be misled into supposing that this triumph was complete. That in fact it was not, and why it was not, merit some discussion.

As we saw earlier, several Greek and Greco-Arabic optical treatises entered Europe in Latin translation during the twelfth century. Thus, long before Alhacen's *De aspectibus* came to the fore in the mid-thirteenth century, European scholars had a significant stock of texts from which to draw in learning the basic principles of ray-analysis. Grosseteste, for example, was familiar not only with Euclid's *Optics* and *Catoptrics*, but also with al-Kindi's *De aspectibus*, and his enthusiasm for ray-analysis was certainly inspired by these works.²⁸¹ Yet, despite his ringing endorsement of ray-analysis, Grosseteste did little or nothing to fulfill its promise at the technical level. That task was left to Roger Bacon.²⁸²

While these early optical texts provide a fairly solid grounding in the geometry of sight, they suffer from one serious defect by comparison with the *De aspectibus*: they are all based on the extramission of visual rays. One would therefore expect that, as Scholastic thinkers became increasingly conversant with Alhacen's intromissionist scheme and realized its explanatory force, they would have rejected the visual-ray theory out of hand. In fact, they did not. The extramissionist analysis of sight was never fully abandoned during the Middle Ages and Renaissance. Even Roger Bacon, persuaded as he was by Alhacen's overall account of light and vision, insisted that the eye must radiate its species out to objects in order to complete the visual act. Throughout the *Perspectiva*, moreover, he appeals indifferently to the authority not only of Alhacen, but also of such extramissionists as Euclid, Tideus, al-Kindi, and Ptolemy. Indeed, at one point, Bacon goes so far as to characterize Alhacen's *De aspectibus* as a mere commentary on Ptolemy's *Optics*.²⁸³ Bacon therefore failed to see any fundamental conflict between the two sources or the theoretical principles upon which they were grounded. To him they were complementary rather than contradictory.

That Bacon was not alone in this view is evident not only from the survival, but also the continued dissemination of Euclid's *Optics* and *Catoptrics*, Ptolemy's *Optics*, Tideus' and Pseudo-Euclid's *De speculis*, and al-Kindi's *De aspectibus* throughout the Middle Ages and Renaissance.²⁸⁴ Admittedly, only one of these treatises, Euclid's *Catoptrics*, was published before the modern era, but publication of Ptolemy's *Optics* was contemplated at least twice during the later Renaissance.²⁸⁵ Why did these works continue to be copied and presumably studied at the same time Alhacen's theory became ever more entrenched within Scholastic circles? The most

obvious explanation is that they were used as introductory texts for the study of “pure” mathematical (i.e., geometrical) optics. In that context, the direction of radiation makes no real difference. Whether the analysis is based upon the Euclidean-Ptolemaic visual cone or upon Alhacen’s cone of radiation is immaterial; the result will be the same, because both cones are mathematically equivalent.²⁸⁶ Still, it is reasonable to suppose that anyone learning mathematical optics on a Euclidean-Ptolemaic basis would have adopted both the analytic perspective and the language of visual radiation. Accordingly, the discourse of visual radiation would be more than a mere *façon de parler*. It would also represent a way of thinking about optical problems. Just as we speak today of the sun’s setting in the west, Renaissance thinkers could speak meaningfully of rays passing out from the eye without taking it literally.

The sixteenth-century Sicilian monk Francesco Maurolyco serves to illustrate this point. That he had a thorough understanding of Perspectivist optics is evident from his general analysis of light in the *Photismi de lumine et umbra* (“Light on light and shadow”), which was published posthumously in 1611 but written much earlier.²⁸⁷ Toward the end of that work, he undertakes an analysis of the eye in order to explain the correction by lenses of two types of visual impairment. The first type—presbyopia or farsightedness—is corrected by double convex lenses, whereas the second type—myopia or nearsightedness—is corrected by double concave lenses.²⁸⁸

At the outset, Maurolyco takes issue with Bacon and Peckham over the claim that the crystalline lens selects only the orthogonal rays and then channels them in proper order to the hollow optic nerve. On the contrary, he insists, since all but one of the rays (i.e., the axial ray) that emerge from the back of the lens are oblique, then all but one of the rays accepted by the lens at its anterior surface must be equivalently oblique. When the lens is properly shaped, the symmetry between incoming and continuing radiation will be such as to bring the rays emerging from the back of the lens to proper convergence (*coincidentia*) at the nerve.²⁸⁹ When the lens is misshapen, though, the rays will not converge properly. If the lens is too flat, the convergence will occur too late, the result being presbyopia. If, on the other hand, the lens is too sharply curved, the convergence will occur too soon, the result being myopia. Since a double concave lens tends to disperse the rays that pass through it, then placing such a lens in front of a myopic eye will keep the rays from converging prematurely by forcing the incoming ones to strike the lens less obliquely than they otherwise would. A double convex lens, on the other hand, will correct presbyopia by gathering the rays and making them come to convergence sooner than they otherwise would.

As described to this point, Maurolyco's account appears to be essentially Perspectivist in tenor, even though he parts ways with the Perspectivists over the cone of visible radiation. But a look at the actual language in which Maurolyco couches that account reveals an even more fundamental parting of the ways. For example, as he explains it in his own words, what actually causes myopia is that, "in hastening to convergence, the visual rays fail to reach the more distant objects that are to be discerned." This happens, he continues, because the rays are too tightly bundled, whereas, under normal circumstances, "being more spread out because of delayed convergence, [they] are extended out to see farther." Hence, in the case of presbyopia, the rays converge so late that only distant objects can be properly seen. So it is "because concave lenses spread out compressed rays, whereas convex lenses compress ones that are spread out [that] short sight is lengthened by concave lenses, and long sight is shortened by convex lenses."²⁹⁰ The implications are clear. The radial convergence that Maurolyco describes in these passages occurs not inward toward the optic nerve but outward toward the visible object. Maurolyco, in short, was basing his explanation upon visual rather than visible radiation.

What prompted Maurolyco to break the rules of Perspectivist analysis with such apparently reckless abandon? I suggest, first, that, by his own lights, Maurolyco was not so much breaking the rules as bending them. In falling back upon the discourse of visual radiation he was offering not a contradictory way, but a complementary way of accounting for the phenomena. I suggest, second, that he took this tack because the phenomena themselves could not be adequately explained along strict Perspectivist lines. The problem is that, according to the Perspectivist account, there are only two ways in which vision can be impaired. One way is by introducing an opaque body, such as cataracts, into the line-of-sight so as to occlude it. The other is by disrupting the proper flow of visual spirit so as to diminish the visual sensitivity of the crystalline lens. In this latter case, sight can be improved by magnifying the image selected at the anterior surface of the crystalline lens. That way the viewer gets what amounts to a closer look at what he is seeing. This, of course, can be achieved by placing a double convex lens in front of the eye. But what about myopia? Its correction depends upon a double concave lens, which not only does not magnify, but in fact *reduces* the resulting image. Perhaps this problem could be resolved along strict Perspectivist lines, but even if it could, the resulting explanation would be inordinately complex. It was because he was casting about for a simpler way of resolving the problem that Maurolyco lapsed into the discourse of visual radiation.²⁹¹

A brief look at Galileo's attempt to explain the working of his new telescope at the beginning of the *Siderius Nuncius* of 1610 may shed some light upon this point. As Galileo describes it, his telescope consists of two lenses encased at either end of a tube, one plano-convex (the objective lens), the other plano-concave (the eyepiece). The optics of this system of lenses is fairly complex, involving the focusing properties of both kinds of lenses. Galileo's explanation, however, is simplicity itself:

For the sake of easy comprehension, let ABCD be the tube and E the eye of the observer. When there are no lenses in the tube, the rays proceed [from the eye] to the object FG along the straight lines ECF and EDG, but with the lenses inserted they proceed along the refracted lines ECH and EDI. They are indeed squeezed together, and where before, free, they were directed to the object FG, now they only grasp the part HI.²⁹²

Galileo, of course, knew better than to believe that vision is actually due to the emission of visual rays from the eye. A mere glance at his discussion of light and reflection in the rest of the *Siderius Nuncius*, as well as in the "First Day" of the *Dialogue* of 1632, shows that he fully understood and accepted the principles of light-radiation and their application to sight.²⁹³ Why, then, did he cast his explanation of the telescope in the language of visual rays? Again, I suggest that, faced with an extraordinarily complex phenomenon, Galileo, like Maurolyco, chose the simplest, most convenient mode of analysis in order to make sense of that phenomenon. The resulting explanation may not have been technically "correct," but, as far as Galileo was concerned, it was adequate for his readers. Otherwise, he would never have dared publish it for fear of damaging his precious reputation.²⁹⁴

The evident willingness not only of Maurolyco and Galileo, but of their intended audience, to view the theories of visual radiation and visible radiation as complementary rather than contradictory may strike us as puzzling today. But it will strike us as far less puzzling if we bear the following four points in mind. First, the two theories are not actually contradictory, Alhacen's refutation of the visual-ray theory notwithstanding. All he actually demonstrated in that refutation was the logical inferiority, not the impossibility of the visual-ray theory.²⁹⁵ Second, as we noted earlier, Scholastic thinkers inclined toward eclecticism and, on that account, tended to be conciliatory in their approach to ideas. Third, there was at least some tendency to compartmentalize theoretical knowledge during the Middle Ages and Renaissance. Medieval and Renaissance medical thinkers, for instance, overwhelmingly favored Hunayn's model of the eye—with the crystalline lens located dead-cen-

ter in the ocular globe—even though that model is wholly incompatible with the Perspectivist analysis of image-selection and image-transmission through the eye.²⁹⁶ Finally, as the later Middle Ages and Renaissance wore on, thinkers became increasingly instrumentalist in their approach to theory. Theories were therefore judged to be more or less probable according to their ability to “save the appearances.” But probability was no gauge of truth, only of effectiveness.²⁹⁷ It is for all or most of these reasons, I think, that, although it achieved authoritative status, Alhacen’s theory of light and sight never fully swept the field during the Middle Ages and Renaissance.

Alhacen and Scholastic Philosophy and Theology: According to Lindberg, the study of optics by Scholastic thinkers during the later Middle Ages can be classified according to three basic traditions, each defined by curricular context.²⁹⁸ The first of these, the so-called Perspectivist tradition, focused upon technical issues. Theodoric of Freiberg (d. 1311), who wrote a path-breaking study of the rainbow (*De iride et radialibus impressionibus*) falls within this tradition. So do Domenico de Clavasio (d. c. 1360), Henry of Langenstein (d. 1397), and Blasius of Parma (d. 1416), all of whom commented specifically upon the science of *perspectiva*.²⁹⁹ The second tradition, which Lindberg defines as “Aristotelian” (and thus centered on the study of natural philosophy) is represented by such thinkers as Jean Buridan (d. c. 1358) and his disciple, Nicole Oresme (d. 1382), both of whom brought Perspectivist theory to bear in their analyses of Aristotle’s *De anima* and *Meteorology*.³⁰⁰ The third and final tradition is defined by Lindberg as “theological,” its primary focus being upon Bible-commentaries (especially on the book of “Genesis”) and *Sentences*-commentaries. Lindberg cites William of Ockham as a prime example.³⁰¹

This threefold classification makes sense at a superficial level, but in actuality the distinction among traditions—particularly the distinction between the Aristotelian (or philosophical) and theological traditions—is more analytic than real. As part of God’s revelation, nature was worth studying only for the insights it could give us into His higher providential purposes. Accordingly, the “book” of nature was generally regarded as ancillary to the book of scripture—hence the oft-repeated characterization of philosophy as the handmaiden of theology. It was certainly with this point in mind that Bacon undertook his analysis of vision in the *Perspectiva*, not because he was concerned with sight *per se* but because he believed that to understand physical vision was instrumental to understanding spiritual vision. The biblical warrant for such an understanding is undeniable. Scripture is rife with visual imagery, none

perhaps more telling than Christ's repeated declaration, "I am the light of the world" (John, 8:12, 9:5, and 12:46). Yet, however bright that light may be, we are still condemned in this world to see "in a mirror dimly" (I Corinthians, 13:12)

As we noted earlier, Alhacen's account of sight offers the possibility of visual certitude. If the ambient conditions are right and the eye scans the object with due care and attention, we get a veridical view of that object. Even in the case of visual illusion or misperception, we can intellectually rectify the deception by understanding precisely how it is produced. Thus, when we see an object behind a plane mirror, we are able to rectify the deception according to our knowledge of the rules of reflection, particularly the law of equal-angles. Why, then, might the same sort of rectification not work for weak or deformed spiritual vision?

In response to this sort of question Peter of Limoges (d. 1306) composed the *De oculo morali* ("On the Moral Eye"), a handbook of spirituality that was enormously popular throughout the Middle Ages.³⁰² Like Bacon (and perhaps under his influence), Peter seems to have believed in a fairly strict analogy between physical and spiritual vision. On that basis, he classified spiritual vision according to three basic types. The first, which corresponds to direct vision, can only be attained in the beatific state after resurrection. It is in this state, which yields an absolutely unhampered and veridical view of things, that the saved will see God "face to face" (I Corinthians, 13:12). The second type of spiritual vision corresponds to refracted sight. This mode of seeing is reserved to the soul when it is detached from the body and awaits the final resurrection. The third type of spiritual vision corresponds to sight through reflection. The only type available to us in this life, this mirror-vision—the kind through which we see dimly—is the weakest and most subject to misperception. Hence, what we see (and therefore misperceive) through the moral eye must be rectified through inner judgment. For instance, a rich man, immersed as he is in a pool of wealth, will appear unduly magnified to a poor man, just as objects submerged in water appear larger than they really are. Only when the moral viewer realizes this does he also realize how distorted his view of worldly goods and their worth really is. Only then, as well, can he attempt to rectify that view through a deeper spiritual awareness of self.³⁰³

John Wyclif (c. 1328-1384) was also convinced that spiritual vision could be understood through its physical counterpart and, like Peter of Limoges, drew upon Perspectivist lore to illuminate theological matters.³⁰⁴ As might be expected, therefore, Wyclif classified spiritual vision according to the threefold scheme of direct (i.e., beatific), refracted (i.e., before the final resurrection), and reflected (i.e., in this world). He

even went so far as to liken the seven deadly sins to the seven types of mirror analyzed by Alhacen—plane, cylindrical convex and concave, conical convex and concave, and spherical convex and concave—each distorting moral vision in a particular way.³⁰⁵

Surely the most interesting application of optical notions to theology, however, involves Wyclif's doctrine of the Eucharist, one of several of his teachings that were condemned at several reprises between 1380 and 1414. At the core of Wyclif's eucharistic theology is the denial of transubstantiation: Christ simply could not be bodily present in the host everywhere the Eucharist was celebrated. Yet Wyclif did not deny Christ's presence altogether; he simply reduced it to virtual or intentional status. Like an image in a mirror, Wyclif explained, Christ's presence is reflected in the host, so He can be imaged everywhere without himself being somehow bodily distributed among the elements of the host. If the spiritual eye of the communicant is healthy and adequately perceptive, then it can "see" that presence in the consecrated host. The ultimate effect of the sacrament would thus seem to be contingent upon the grace-full rectification of the communicant's spiritual sight, not the physical infusion of divinity into the host itself.

Suffice to say, the effectiveness of such analogies depends upon the assumption that, under the proper physical circumstances, direct vision really is veridical. But what if it is not? What if the actual certitude of direct vision can be called into doubt? On the face of it, this would seem to be a purely philosophical question demanding a purely philosophical response. Within the context of its raising, however, its theological import is evident. Equally evident is the theological need to respond to it with a critical evaluation of the Perspectivist account of sight. It should therefore come as no surprise that it was primarily theologians who undertook this critical evaluation during the first half of the fourteenth century.

Among the issues that informed this critique, two are of particular concern here. The first, and simpler, involves the question of precisely what it is we are seeing when we look at a given object. At first blush, the answer is self-evident: we see the object itself. But if, as the Perspectivists would have it, we see every object by means of intentional species passed through the transparent medium to the eye and thence through the optic complex to the brain, then might it not be the case that we are actually seeing not the objects themselves but the species that represent them? In other words, the real object of vision may be the representational form, not what it represents. If so, then in mediating our visual apprehension of things, species actually stand in the way of that apprehension, even in the etiolated state in which Bacon left

them.³⁰⁶ To make matters worse, Perspectivist theory assumes that our final intellectual grasp of things is mediated by a succession of different, albeit related, species, each abstracted from the other. How, then, could we possibly reach through such a thick screen of intervening entities to the things themselves?

The second issue has to do with our intellectual apprehension of things, what is called “abstractive cognition” in later Scholastic parlance. The central problem here is to explain how we grasp the essential natures of things from the sensible forms—Bacon’s “diffuse particulars”³⁰⁷—that represent them in the sensitive soul. On the one hand, our intellectual realization of those natures seems to be inextricably tied to sensible representations, which are material and corruptible. On the other hand, intellect and its objects are immaterial and incorruptible. So how can true cognition, whose object is absolutely general and unchanging, subsist in the incorporated soul, which is both particular and changeable? Is intellect somehow distributive, whole and complete in each and every soul, or is it common to all and therefore transcendent?

Over the century that separated Gundissalinus’ *De anima* (“On the Soul,” c. 1170) from St. Thomas Aquinas’ *De unitate intellectus* (“On the Unity of Intellect,” 1269), a number of Latin thinkers grappled with these questions in an effort to establish a meaningful relationship between pure intellect (spirit) and the sensitive soul (matter).³⁰⁸ Several of these thinkers appealed to an ulterior intellectual power that not only helps us realize the true intellectual intent of the species abstracted by the material soul, but also validates that realization, thus guaranteeing its certitude.³⁰⁹ For a variety of reasons, primarily theological, this position was abandoned toward the end of the thirteenth century.³¹⁰ Intellect, as well as its objects, would thenceforth be treated as distributive rather than common and, therefore, as an integral part of each particular soul. In addition, if the theological demand for personal immortality was to be met in a meaningful way, intellect had to be able to subsist in all its particularity when separated from the body at death. Hence, by the turn of the fourteenth century the incorporated soul had been endowed not only with the potential to know, but also with the capacity to bring that potential to fulfillment. No longer would appeal be made to extrinsic agents either to complete or to validate the act of cognition. The human intellect was on its own.

The issue of certitude thus loomed large for early-fourteenth-century thinkers. After all, if the act of cognition is personal, then perhaps the general conclusions it yields are personal as well. If so, then what is to guarantee the universality or commonality of those conclusions? Furthermore, if the incorporated intellect acts independently of any ulte-

rior agent, then it has access to knowledge only through the sensible particulars about which it reasons. The objects of knowledge would therefore be as particular as the sensible objects from which they arise. In short, all we can really know or know about is individuals—this man or that horse, not Man or Horse. Furthermore, if our access to such individuals is mediated by species, then we cannot even be sure that we can know the individuals themselves.

In response to such issues, several fourteenth-century thinkers—William of Ockham (d. 1349) best-known among them—undertook to construct an appropriate epistemology.³¹¹ One of the first casualties of this effort was the intentional species. For, as we have seen, one could argue that such species actually mask rather than reveal the sensible particulars they supposedly represent. Also, it is difficult to understand how species can “intend” such things as distance that are not intrinsic properties of physical objects, a point that is reinforced by Alhacen’s deductive account of distance-perception.³¹² Why not, then, make our intellectual access to external objects as immediate as possible? The theory of intuitive cognition was, of course, designed to do just that, to strip away the stagings of sense-apprehension mandated by Perspectivist theory in order to make it as direct and primal as possible.

Another casualty of the early-fourteenth-century epistemological critique—one that was already badly damaged—was the universal. If sensible particulars are the only things to which we have intellectual access, and if cognition is truly personal, then perhaps the universal (e.g., Man or Horse) is nothing more than a taxonomical category. If so, then “Man” or “Horse” exists in name only, an expression of the way we mentally group individuals for the sake of convenience. Accordingly, the “universal” may no longer be common or general except by convention. Likewise, the abstractive generalizations we make about those “universals” may be as personal and particular as the terms (and the signification of those terms) in which they are couched.

If nothing else, this simplified (perhaps even simplistic) account makes it evident that the epistemological critique carried out during the first half of the fourteenth century by the likes of Peter Aureol, William of Ockham, and Nicholas of Autrecourt threatened the Perspectivist model of sight to its deepest underpinnings. This it did at a practical level by calling into question the doctrine of intentional species upon which the Perspectivist account of perception depends. More to the point, by demonstrating the utter inconclusiveness of that account, it openly subverted the promise of visual certitude offered by Perspectivist theory. On the other hand, the theory of intuitive cognition carried its own train of difficulties, not the least of which was that it made little or

no sense at the physical level.³¹³ Nor, for that matter, could it offer any better hope of intellectual certitude than its Perspectivist counterpart. The best we could achieve in either case was probability, and probability at this time was determined by social convention: what most men of sound intellect agreed upon was to be assented to until a more persuasive alternative was found.³¹⁴

In this sense, of course, probability is a weak reed upon which to lean, because its warrant is internal and subjective (albeit social) rather than external and objective. That, no doubt, is why the theory of intuitive cognition was essentially a dead end. Few at the time, or afterward, were convinced by, much less truly understood, the theory in all its complexity.³¹⁵ Fewer yet were persuaded by it to jettison the Perspectivist account of visual perception or the doctrine of species-multiplication that underpinned it. Still, it is difficult to believe that Perspectivist theory emerged unscathed from the epistemological critique discussed above and, therefore, that it was accepted as unreservedly after 1350 as it was before 1300—hence the failure of Perspectivist optics to win unqualified assent during the Middle Ages and Renaissance. Hence, too, the persistence of visual-ray theory during that period. Moreover, as we pointed out earlier, late-medieval and Renaissance thinkers inclined toward instrumentalism in their approach to natural philosophy. They reasoned that since there is no way to establish the absolute truth of any scientific hypothesis, the only reason to prefer one over another is its superior ability to “save the appearances.” Logically speaking then, it was not truth or falsity but explanatory power that determined theory-choice. Every such choice was therefore *faute de mieux*, not definitive.³¹⁶

The resulting sea change in philosophical attitude during the later Middle Ages and Renaissance has been the subject of much discussion since the early decades of this century. Some have viewed it negatively, in terms of a corrosive skepticism that destroyed the philosophical and theological synthesis so carefully wrought during the thirteenth century.³¹⁷ Others have viewed it positively, in terms of a critical open-mindedness that pointed the way toward modern philosophy and science.³¹⁸ Value-judgments aside, though, there is general agreement among scholars that traditional philosophical and theological ideas underwent a critical re-examination during the fourteenth and succeeding centuries.

In science, or natural philosophy, it was Aristotle who bore the brunt of this re-examination. Nevertheless, as Marshall Clagett, Anneliese Maier, and a long train of successors have shown, the assault they mounted against Aristotle was piecemeal rather than wholesale.³¹⁹ Specific Aristotelian tenets were carefully scrutinized and rejected if found

logically problematic; but the general framework of Aristotelian analysis was never really in jeopardy. As far as optics is concerned, Maurolyco's willingness to bend the rules of Perspectivist analysis in order to explain lenticular correction exemplifies this piecemeal approach. On the one hand, he felt free to deny that the crystalline lens selects only orthogonal rays, choosing instead the more "probable" supposition that the lens selects a certain set of oblique rays. On the other hand, his critique did not extend to Perspectivist analysis as a whole; indeed, it is clear that he accepted most of the key tenets upon which the Perspectivist model was founded.³²⁰

This brings us back to the issue of certitude. To accept the Perspectivist model of visual perception on a provisional basis was not merely to acknowledge its diminished certitude or probability but also to invite close, critical scrutiny of every aspect of that model. Viewed in this light, Kepler's analysis of vision in the *Ad Vitellionem Paralipomena* of 1604 takes on new meaning and significance.

As we noted earlier, what Kepler achieved in this analysis was to transform the crystalline lens from a sensitive selector of orthogonal rays into a mere refractive body projecting real images upon the retinal screen at the back of the eye.³²¹ We also noted that, by Lindberg's account, Kepler's analysis of the lens and its focusing properties was firmly rooted in Perspectivist principles. All Kepler really did, Lindberg concludes, was to follow out the logical implications of Perspectivist ray-analysis with unprecedented rigor.³²² Accordingly, at the level of physics and geometry, Kepler can be understood as having done little more than move the visual image from the front to the back of the eye.

In emphasizing the continuity between Perspectivist and Keplerian optics at the physical and mathematical level, however, we risk losing sight of a more profound and significant discontinuity between the two. For, by recasting the physical model of vision as he did, Kepler not only moved the visual image to the retina; he also rendered the epistemological foundations of Perspectivist optics moot. For one thing, the image formed on the retina according to Kepler's analysis is inverted. For another, it is real, not virtual, a physical rather than a psychological construct. For yet another, it is far too large to pass into and through the optic nerve to the brain. How, then, does this image represent its object to the faculty of perception? Does the brain send something out to the image in order to scrutinize it? If so, then why do things appear upright rather than inverted? Worse yet, if the retinal image is perceived by some cerebral emissary, then the image itself, not what it represents, must be the proper object of perception. Acceptance of Kepler's model of visual imaging therefore demands a wholesale rejection not only of

the theory of intentional species, but of the entire epistemological structure built upon it.³²³ According to Kepler's model, there is no longer any meaningful correspondence between physical cause (the formation of real images on the retina) and cognitive effect (the formation of concepts and ideas in the brain).

But why was Kepler willing to sacrifice the epistemology of species, so integral to the Perspectivist analysis of sight, for the sake of a more "probable" physical model of vision? I suggest that he was making a trade-off of sorts, rejecting a theory of sense-cognition whose uncertainty was already well established in favor of a physical theory whose probability seemed clearer. In the process, he severed the perceptual link between eye and brain that Alhacen and his Perspectivist followers had constructed with such elaborate care. Kepler therefore did not merely bend the rules of Perspectivist analysis; he shattered them and, in so doing, opened the way toward a complete disintegration of Alhacen's synthesis.

That Kepler seems to have been unfazed by the potential destructiveness of his visual model is remarkable enough. More remarkable yet is that so many of his contemporaries and near-contemporaries followed him in adopting that model despite its epistemological consequences. And herein lies the real significance of Kepler's analysis of the eye and its function: namely, that it found a receptive audience of sufficient size and sufficient willingness to abandon the Perspectivist model in its entirety. Among this group, Descartes assumes especial importance not only because he subverted the Perspectivist theory of light and sight with such alacrity, but also because he attempted to construct an alternative on its ruins.

As might be expected, Descartes singled out two issues for critical scrutiny. The first involves the purported correspondence between physical cause and perceptual effect in our visual apprehension of things. Do we really need to assume such correspondence? Not at all, responds Descartes; it is wholly unnecessary, he asserts confidently in the *Dioptrique* of 1637, "to assume . . . that there is anything in [external] objects that is similar to the ideas or sensations we have of them." What about "those tiny images fluttering through the air, called *intentional species*, which exercise the imagination of Philosophers so much?"³²⁴ Are they necessary? Again, the answer is "no." The doctrine of intentional species merely obfuscates things.

There is, of course, nothing new in Descartes's critique of intentional species and the assumption of correspondence that follows from their acceptance. The same issues were raised in the fourteenth century. But, unlike his fourteenth-century predecessors, Descartes had a clear alter-

native in mind. That alternative was grounded in his mechanistic theory of light. All light-sources, Descartes claims in the *Dioptrique*, are to be thought of as agglomerations of extremely tiny particles of Fire.³²⁵ As a whole, these agglomerations rotate swiftly in place, each constituent particle rotating with the whole and thereby striving to fly out centrifugally, just as the stone in a whirling sling seeks to pull away from the hand that constrains it. What keeps these light-sources from flying apart is the tight press of Air, which forms an enveloping continuum throughout what we take to be space. Accordingly, light consists of centrifugal pressure exerted against the aerial envelope by the particles of fire swirling at the surface of any given light-source. This pressure is passed radially through the Air in the form of continuous impulses that are transmitted instantaneously. Those that reach the eye create a subjective impression that we call "light."³²⁶ Color, for its part, consists in the spin imparted to the spherical Air-particles by such impulses. The faster the spin, the more vivid the color.

The disjunction between objective cause and subjective effect implied by this account is as evident as it is stark. Our internal impressions of "light" or "red" are obviously incongruent with the mechanical impulses or spins that somehow give rise to them. But if objective cause and subjective effect are so radically different, then the planes within which they operate must be radically different as well. That, of course, is the point of the distinction between mind (*res cogitans*) and body (*res extensa*) that Descartes draws so sharply in the *Meditations on First Philosophy* of 1641. The one operates on a purely spiritual plane, the other on a purely material plane. Thus, like so many of his medieval antecedents, Descartes was faced with explaining how extended substance (matter) could interact meaningfully with thinking substance (spirit).

Now, according to Descartes, sensible impressions are utterly deceptive, because they lead us to believe that light and color, as well as a host of other sensible qualities, are real and inherent properties of things, not mere psychological states. If, therefore, we take such sensible impressions at face value, we will invariably be misled. Yet, as subjective entities, we have no other way of apprehending the objective world than through such sensible impressions. How, then, is it possible for us to make intelligible sense of that world? Descartes's answer rests on the notorious "cogito" argument in *Meditations* II. However doubtful I may be about what I think, Descartes asserts in that argument, I cannot possibly doubt that it is I who am entertaining my thoughts. The fact of self-existence is therefore absolutely certain and veridical. Furthermore, once realized, this fact is absolutely clear and distinct to all of us. It follows therefore that whatever is equally clear and distinct must be as

certain and veridical as the fact of self-existence. What is it about external objects that is clear and distinct? Surely not color, nor brightness, nor heat, nor any other sensible quality. All that is left, Descartes concludes in *Meditations* IV, is the fact of extension. Whatever else we may doubt about external objects, we cannot doubt that they occupy extension. That, at bottom, is what is real about them and therefore what makes them truly intelligible. Accordingly, we can make real sense of the external world only in extensional terms, in terms, that is, of geometrical qualities and relations, such as shape and size. These are the true visible intentions of things, not color or light.

For Descartes, then, vision *can* be veridical, but only when it is subject to the rectification of clarity and distinctness, and this rectifying principle is as intuitive as the grasp of self-existence that yields it. In short, we have an innate capacity to perceive directly *through* the sensible appearances to the things themselves, as they actually exist in Euclidean “space.” Sense-cognition for Descartes is therefore essentially intuitive and immediate, not abstractive. It depends upon, but it is not abstractively derived from, physical sensation. To establish this point at a physical level, Descartes draws on an analogy between light-radiation and the cane of a blind man. It is by means of this cane that the blind-man feels his way about the world, the impulses passed through it to his hand allowing him to judge the various spatial dispositions (e.g., size, shape, or position) of the bodies it strikes. The pain or shock we may experience from such contact is irrelevant to that judgment, so the blind man’s apprehension of “space” is virtually immediate. Seeing is like this. Accordingly, the sensations of light and color that arise when we apprehend things visually have nothing to do with what the light-impulses passed to us from those things tell us about their inherent and real extensional properties. Such sensations are concomitant with, not causally prior to, the perception of those properties.³²⁷

This point is crucial. As we have seen, Alhacen and his Perspectivist followers predicated their account of sight upon the assumption that light and color are real, intrinsic properties of physical objects and therefore that we apprehend those objects solely by means of the light and color in them. Light and color, in short, are truly definitive for visual perception and cognition. The remaining visible properties, or intentions, are perceived incidentally inasmuch as they are abstracted from the primal apprehension of light and color. Hence, according to the Alhacenian account, the extensional or spatial properties of things are secondary to light and color, at least at the perceptual and cognitive level. For Descartes, on the other hand, being no more than subjective states arising from more fundamental mechanistic causes, light and color

are reduced to secondary status, the extensional properties of objects assuming primacy insofar as they occur to us immediately (or virtually so) through the mechanical impulses that expose them.

At the broad conceptual level, Descartes's account of vision was not particularly original. We saw earlier that most of the key issues addressed in that account—i.e., the vexed relationship between sense-perception and cognition, the problematic link between mind and body, the questionable status of intentional species, and the fundamental uncertainty of sense-perception—had been dealt with at length and in depth by his medieval predecessors, particularly those of the early fourteenth century. Likewise, Descartes's attempt to place cognition upon an intuitive basis was hardly novel. Nor, for that matter, was his effort to reduce physical reality to purely geometrical terms. What is new, however, is the precision and clarity with which he analyzed and highlighted the aforementioned issues in an effort to dismantle the entire framework of Perspectivist analysis and then reconstruct the science of optics from the ground up on the basis of his mechanistic model of light and sight. Central to this reconstruction was a radical disjunction between objective and subjective worlds and a consequent dichotomy between primary (i.e., geometrically determined) and secondary (i.e., perceptually determined) qualities. To accept such a dichotomy, of course, was to reject outright the Perspectivist analysis of sight, which was expressly designed to link the two worlds, physical and perceptual, as tightly as possible. Perhaps more than anything else, it was the breaking of that link and the resulting disintegration of Alhacen's synthesis by Kepler, Descartes, and their seventeenth-century successors that opened the way for the development of modern optics according to its current physical, physiological, and psychological divisions.

Alhacen and Renaissance Art: For most art historians since Vasari, the transition from medieval to Renaissance art is marked by the development of naturalism in painting, a development that began roughly with Giotto (d. c. 1337) and culminated with Michelangelo (d. 1564).³²⁸ Among the many facets that characterize this development, particularly in its later phases, is a fascination with various modes of image-distortion. Examples abound, but perhaps the two best-known are Jan van Eyck's depiction of a convex mirror, with its distended image, in the background of *The Marriage of Arnolfini* (1434)³²⁹ and Hans Holbein the Younger's anamorphic representation of a skull in the foreground of *The French Ambassadors* (1533).³³⁰

At a somewhat superficial level, this connection between art and optics makes sense in the light of certain technical developments over

the period in question. The quality of mirrors, for instance, had improved considerably over the sixteenth century with the invention of the true looking glass, backed by an amalgam of tin and mercury. Not only did such looking glasses provide clearer images than even the best silver mirrors, but they had the added advantage of being cheaper. At the same time, metal mirrors were being manufactured from various alloys in an effort to provide the image-quality of polished silver at a lower price. Well before the invention of looking glasses, moreover, concave mirrors, presumably of well-polished steel or silver, were in use as magnifying aids for scribes and illuminators doing close work. One of the earliest examples is represented in a fourteenth-century portrait of Pietro Isnardo of Vicenza, the mirror standing on a shelf directly above his writing desk.³³¹ No less common at the time were corrective lenses, whose manufacture had become so standardized in Florence by the second half of the fifteenth century that eyeglasses were produced there virtually to specification for the improvement of presbyopia and myopia.³³² Indeed, if Francesco Maurolyco is to be credited, such eyeglasses were more-or-less routinely available by no later than the early sixteenth century.³³³

While the proliferation of such devices over the fifteenth and sixteenth centuries must have made artists ever more acutely aware of the ways in which optical effects can skew what we see and how we see it, the awareness itself was hardly new. The effort among early Renaissance artists to import illusionism in their paintings bespeaks it clearly. Giotto attempted to naturalize the visual space he represented not only by framing his scenes as if they were viewed through a window, but by ordering them according to the convergence of parallels and the foreshortening of objects seen at increasing distances. In thus applying "empirical perspective," Giotto took a major step toward what Samuel Edgerton characterizes as "the geometrization of pictorial space."³³⁴ Another means that Renaissance artists used to naturalize the representation of visual space was the technique of *chiaroscuro*, which was brought to relative perfection by Leonardo da Vinci. The point of *chiaroscuro*, of course, is to emphasize the depth of the visual field by representing the play of light and shadow upon various objects within that field and thereby "modeling" them in space.³³⁵

That such illusionistic techniques were employed in Greco-Roman paintings and mosaics was well known to Renaissance artists, who looked to classical models for guidance and inspiration, much like their humanist counterparts in literature.³³⁶ However, what set these Renaissance artists apart from their classical forebears, at least to some extent, was the firm belief that, in order to depict what they saw (or could imag-

ine to see) with appropriate fidelity, they had to understand as precisely as possible *how* the things they painted were visually presented to them.³³⁷ It therefore became incumbent upon Renaissance artists to understand both the objective world they represented (hence, for example, Leonardo's forays into anatomy) and the visual system that ultimately determined how that world was represented to them.³³⁸ To this end, they had a variety of authoritative optical sources available, and among these sources, Alhacen's *De aspectibus* and the various Perspectivist texts and commentaries based upon it figure prominently.

That many Renaissance artists actually did read, or were at least conversant with, these sources is beyond question. Surely the most ostensible case is Lorenzo Ghiberti (d. 1455), whose "Commentario terzo"—the third book of *I commentarii*—on art contains extensive quotations or paraphrases from the fourteenth-century Italian translation of Alhacen's *De aspectibus* mentioned earlier.³³⁹ Somewhat more problematic is Leonardo da Vinci. On the one hand, we have good reason to believe that he at least consulted Witelo's *Perspectiva*, and we know for a fact that he read at least the beginning of John Pecham's *Perspectiva communis*.³⁴⁰ On the other hand, as Bruce Eastwood has shown, Leonardo's discussion of image-inversion in *On the Eye* (c.1508?) reveals a fairly limited understanding of Perspectivist concepts.³⁴¹ Still, there is no question that Leonardo's thinking about image-inversion, as well as other optical matters, was formed to a great extent by the Perspectivist tradition within which he worked. Resist it though at times he might, Leonardo could never really escape the hold of that tradition.³⁴²

To demonstrate that Renaissance artists read, or knew of, the relevant optical sources is not, however, to demonstrate how their understanding of those sources may have influenced their art. The clearest case of such influence is to be found in the invention (or reinvention) of linear perspective in the early fifteenth century. This is traditionally ascribed to Filippo Brunelleschi (d. 1446), who is said by his biographer, Antonio Manetti, to have painted two depictions—one of the baptistery in front of the Florentine cathedral, the other of the Piazza della Signoria in the heart of Florence—according to the rules of "what painters today call perspective."³⁴³ These two scenes, Manetti contends, were so true-to-life that viewers had difficulty in distinguishing the painted version from the real thing. Unfortunately, Brunelleschi himself left no written account of the technique with which he is credited, so any attempt to reconstruct it or to isolate the sources upon which it may have been based is at best speculative.³⁴⁴

The earliest known written description of linear perspective occurs in the first book of Leon Battista Alberti's brief three-book treatise, *Della*

pittura (c. 1436), which, tellingly enough, is dedicated to Brunelleschi.³⁴⁵ The technique that Alberti outlines there is easily understood in geometrical terms, even though he himself provides no diagrams to help us visualize it. We start, according to Alberti, by delineating a quadrangle on the panel to be painted, this quadrangle representing “an open window through which [we] see what [we] want to paint.”³⁴⁶ Having determined how large we want to figure a man within the foreground of this quadrangle, we take a third of that amount as a measure. We then divide the bottom edge of the quadrangle into as many equal segments as we can according to that measure.

With this done, we choose a centric point within the quadrangle. This point, which should lie as high above the lower edge of the quadrangle as the top of the man figured in the foreground, is where the central ray extending from the painter’s or viewer’s eye (i.e., the visual axis) strikes the panel. It therefore marks the level at which “the beholder and the painted things he sees will appear to be on the same plane.”³⁴⁷ We then connect all the points of division on the lower edge of the quadrangle to the centric point, which thus serves as the vanishing point upon which all the parallels represented by the lines just drawn converge. Next, we cut these convergent parallels with horizontal lines in such a way that the distances between the selected horizontals become proportionately smaller as they approach the centric point. Finally, we draw the centric line (i.e., the horizon-line), which is parallel to the top and bottom edges of the quadrangle and passes through the centric point. This last line, Alberti concludes, “is a limit above which no visible quantity is allowed unless it is higher than the eye of the beholder.”³⁴⁸

Where might Alberti have gotten the idea for such a scheme? Here we are on relatively sure ground. For a start, the projection-device Alberti describes, with its centric point, its central ray, and its various planar cuts along the horizontal, is nothing more than the Euclidean-Ptolemaic visual cone or *mutatis mutandis* Alhacen’s cone of vision. Furthermore, Alberti is quite explicit in acknowledging the optical basis of his technique. He spends considerable time at the beginning of book 1 explaining how the visual cone (or cone of vision) is formed at the center of the eye, how its constituent rays pick out the shapes of external objects, how those same rays determine the appearance of size among such objects, and so forth.³⁴⁹ In the process, he makes three things abundantly clear. First, if the artist is to master his skill properly, he must have some understanding of the relevant optical principles. Second, although “among the ancients there was no little dispute whether these rays came from the eye or the plane [of the visual field],” the direction of radiation is

immaterial.³⁵⁰ The geometry of radiation is all that concerns the artist. Third, the fact that Alberti was aware of the dispute between extramissionists and intromissionists suggests that he either knew, or knew of, Perspectivist theory, a suggestion strengthened by his refusal "to discuss whether vision, as it is called, resides at the juncture of the inner nerve or whether images are formed on the surface of the eye as a living mirror."³⁵¹

It has long been argued, and quite plausibly, that the development of linear perspective in art was based upon Perspectivist ray-analysis and its perceptual entailments.³⁵² While this may be the case, though, it is not necessarily so. It could as easily be maintained that Euclidean (or Ptolemaic) ray-theory provided the analytic basis for this development.³⁵³ Or, for that matter, linear perspective may have had its primary source in the surveying techniques known to anyone of a practical bent in Renaissance Florence. Such, of course, was Brunelleschi.³⁵⁴ Whatever the case, the fact remains that, from its inception, linear perspective and optics were intertwined. The fact also remains that, soon after the appearance of Alberti's *Della pittura*, linear perspective was well on its way to becoming an artistic convention throughout Europe, and a succession of eminent painters from Piero della Francesca (d. 1492) to Albrecht Dürer (d. 1528) undertook to perfect the technique, as well as to extend it to the casting of light and shadow in *chiaroscuro*.³⁵⁵

Likewise, between 1500 and 1600 a spate of handbooks on linear perspective appeared in print, many of them devoted to architectural rather than pure artistic concerns. One of the earliest and best known of these, the *De artificiali perspectiva* of Viator (Jean Pélerin), was first published in 1503 and republished in 1509. As expected, Viator opens with a brief exposition of the optical principles that underlie his projection-scheme:

For in fact (as has been ascertained by speculative philosophers), all objects are seen as if [they were apprehended] by lines passing out from the eye: i.e., by means of a triangle, whose base is the visible object and whose axis passes over the parts of this visible object. But light does not pass out from the eye; on the contrary, from the exterior light shining on the eye, a radial breaking [*reflexio*], like that in a burning mirror, occurs; and through this radial breaking the forms of things are grasped [by sight].³⁵⁶

In other words, while sight may seem to be due to the extramission of visual rays, it is actually due to the intromission of light-rays, which are broken (i.e., refracted) at the eye and thereby grasped, presumably after

being brought toward the center of sight, just as they are brought to convergence in concave mirrors. Like Alberti, Viator concedes that, as far as the geometry of sight is concerned, the visual process can be adequately understood in terms of visual rays. Unlike Brunelleschi, he takes a definite stand in favor of intromissionism at the theoretical level. It is, incidentally, worth noting the implicit distinction drawn in the title of Viator's treatise between "artificial perspective" (i.e., linear perspective) and "natural perspective" (i.e., the subject-matter of the science of *perspectiva*) from which it derives by imitation.

In the case of linear perspective, the influence of geometrical optics (in whichever form) upon Renaissance art is as patent as it is specific. Less patent or specific, though no less important in the long run, was the way in which Perspectivist theory redounded on Renaissance art at other levels, particularly the aesthetic level. Edgerton, for example, makes a fairly good case for supposing that, in the London *Annunciation* (c. 1455), Fra Filippo Lippi was drawing directly upon Roger Bacon's theory of species-multiplication in an attempt to render Mary's impregnation by God visually palpable. Accordingly, as Edgerton describes the painting's relevant portions, the succession of overlapping circles (themselves representing spheres) that extend from God's hand to the dove poised directly in front of Mary's womb represents the multiplication of the Holy Spirit downward from heaven. The "dual sprays of golden dots [that] fan out reciprocally from the head of the dove and Mary's womb"³⁵⁷ represent the radiation of the impregnating spirit into Mary and the complementary radiation that flows out from her to complete the act of reception. And the slight aperture in Mary's dress, through which both radiations pass, represents the "pupil" through which Christ is ultimately figured in Mary's eye-like womb.³⁵⁸ Admittedly, this analysis is both conjectural and impressionistic, but it is nonetheless highly suggestive. For, if true, it indicates not only how soon, but how deeply, Perspectivist ideas became entrenched among Renaissance artists.

Even more suggestive is the thesis proposed by David Summers in *The Judgment of Sense*, because it strikes to the motivational core of Renaissance naturalism.³⁵⁹ The pivotal issue for Summers is whether the aesthetic foundations of Renaissance art are quintessentially Platonic and therefore whether Renaissance artists were conceptually driven to idealize what they portrayed according to transcendental principles of beauty.³⁶⁰ Summers responds not by denying that Renaissance art manifests Platonic ideals but by affirming that "other traditions of meaning shaped the discussion of the art of the period at its deepest levels."³⁶¹ Whatever "other traditions of meaning" may be at play here, the one

Summers has in mind is the Aristotelian tradition.

Characteristic of Aristotelianism, Summers explains in his background sketch, is a deep-seated conviction that knowledge is inductive, that it has its ultimate wellsprings in sense-experience. Sensation and its representations are therefore not to be deprecated as the bearers of falsehood (Platonism) but rather to be prized as the bearers of truth. Viewed in this way, the naturalist impulse in Renaissance art, the impulse to portray what one sees (or could imagine to see) as faithfully as possible, is fundamentally Aristotelian, not Platonist, in spirit. More to the point, according to Summers, the aesthetic foundations of Renaissance naturalism were *self-consciously* Aristotelian and therefore "deeply bound up with the Aristotelian notion that the human soul, from sensation upward, is suited to its world, and with the further notion that the beautiful itself is conformity to human sense before it is evidence of transcendental value."³⁶²

Having staked this claim, Summers devotes the remainder of his study not merely to defending it but to mining it as deeply as he can. In the process, he uncovers a wealth of pertinent sources; but his real aim is to show how those sources led the Renaissance artists who read them to an increasingly firm belief that aesthetic judgment belongs more properly to sense than to intellect. This brings us to two key questions: what did these artists mean by "sense," and how did they understand its function in aesthetic judgment? The answer to both questions is to be sought in what these artists learned from the complex of sources, including Perspectivist texts, that they read and pondered. First, it is clear that, by "sense," Renaissance artists intended something far more comprehensive than any particular sense-organ, such as the eye, or any specific sense-datum, such as color or light. What they meant was the full array of perceptual faculties incorporated into the Perspectivist account of sight, an array that includes not only the "external senses," the eye in particular, but also the succession of higher "internal senses," ranging from common sense through fantasy and imagination to reason and memory.³⁶³

Renaissance artists thus learned that "seeing" is a deeply perceptual act. They learned, as well, that it is complex act, entailing many subrational processes, such as comparison, recognition, assimilation, discrimination, and certification. They also learned that, subrational though they may be, these processes are not *irrational*; on the contrary, they are entirely logical, or "syllogistic," in form, if not in content. On this basis, finally, they learned not only that "seeing" is judgmental to the core, because it entails discrimination and adjudication at every stage, but also that, when the judgments to which it is subject are properly

carried out, “seeing” is veridical.

So taught, Renaissance artists understood full well what they needed to accomplish as painters: to portray the “truth” of what they saw (or could imagine to see) as accurately as possible according to how it was (or would be) presented to the perceiving “eye.” The closer they could get to that truth, the more aesthetically pleasing the result, precisely because of its fidelity to what the thing painted actually looks like. But to achieve such a result, much less appreciate it properly, requires a discriminating eye, an eye that sees clearly and judges what it sees with unerring rectitude—the eye, in short, of the true artist. This, in a nutshell, is “the judgment of sense.”

Such judgment is not merely subjective, Summers continues. Even though the artist necessarily paints from a particular point of view, we are all capable of sharing that point of view. Endowed with identical perceptual faculties and, therefore, with the capacity to see things in precisely the same way, we all have the power to see what the artist sees in his portrayal—provided, of course, that he portrays it aright and we judge it aright. Thus, the judgment of sense and its attendant aesthetic are “universal” insofar as they are common to all who are gifted with sight. That, according to Summers, is why “the union of painting and optics in one-point perspective would yield what was understood to be a most perfectly universal art, fully adapted to the structure of human vision and perception.”³⁶⁴

While the judgment of sense may not be *merely* subjective, Summers cautions, it is still subjective. The “image” we have of external reality is a perceptual representation of that reality, not the reality itself. Likewise, the painted portrayal of that perceptual “image” is a representation of it, not the image itself. In order to make the portrayal adequate to its object—i.e., the perceptual image and its inherent beauty—the artist must adapt his technique to the demands of sense-judgment. Artistic technique, therefore, cannot be properly governed by rigidly followed intellectual schemes, such as linear perspective or chiaroscuro. These schemes provide useful guidelines only; they are not absolutely prescriptive. “Sometimes,” Raffaele Borghini assures us in *Il riposo* of 1584, “in order to give a figure more grace it is necessary in some places to extend the measures and in others to diminish them.” Moreover, he continues, “this cannot be taught; rather the artist must learn it with natural judgment.”³⁶⁵ Leonardo makes much the same point in his discussion of chiaroscuro and the tonal quality of color in *On Painting*.³⁶⁶ To achieve the proper “sensible” effect in his painting, the artist must modulate, or temper, the color-contrasts he uses to convey that effect. Otherwise, in lacking appropriate harmony, the result will offend the

viewer's sensibility. Here, according to Summers, we have "good Aristotelian principles, now lifted away to [become] a principle of painting as basic as the practice of toning grounds and painting from shadow to light."³⁶⁷ Suffice to say, these Aristotelian principles show clear traces in Alhacen's analysis of beauty on the basis of proportionality, or harmony, as well as in his account of how ambient circumstances can affect the perception of both the quality and intensity of light and color.

However superficial it may be, this brief outline should nonetheless be adequate to convey the depth to which Perspectivist optics was implicated in the development of Renaissance art. Just how deeply it was implicated is still open to question, to be sure, but Summers makes a strong case for supposing that Perspectivist influence extended far beyond the application of linear perspective, that in fact it reached to the very aesthetic core of Renaissance art, and even beyond to the painterly techniques employed by Renaissance artists. At bottom, then, the representation of visual space in Renaissance art was the expression of a world-view implicit in the Perspectivist analysis of sight, a world-view based upon the "geometrization" of visual space. If, however, Alhacen and his Perspectivist followers taught Renaissance artists to "see" the world in such spatial terms, those artists in turn taught early modern thinkers to see the world in those same terms and thus to conceive of it as a Euclidean continuum. As far as the development of optics in particular, and science in general, are concerned, this way of viewing the world had crucial ramifications that have only begun to be explored.³⁶⁸ But the telling of that story lies outside the scope of this introduction.

7. Ibn al-Haytham: A Tentative Reappraisal

To evaluate Ibn al-Haytham's achievement in optics objectively, or at least dispassionately, is no easy task, in great part because of the iconic stature he has assumed in the history of science. The result has been a tendency among scholars not only to emphasize the innovative character of his theory at both the conceptual and methodological level, but also to modernize that theory, or aspects of it, out of all proportion. Much therefore that has been claimed in Ibn al-Haytham's behalf, though not necessarily untrue at the factual level, is nonetheless misleading at the interpretive level.

A particularly egregious example can be found in a recent issue of *The New York Times Magazine* devoted to "The Best Ideas, Stories and Inventions of the Last Thousand Years." According to the lead article in that issue, "Eyes Wide Open," by Richard Powers,³⁶⁹ Ibn al-Haytham

deserves credit for the millennium's best idea, an idea whose significance is trumpeted in the article's header: "When an obscure Arab scientist solved the riddle of light, the universe no longer belonged to God." By Powers' reckoning, what Ibn al-Haytham did (and herein lies the force of his idea) was usher in a new age of scientific empiricism, an age in which truth would be observationally, not theoretically, determined. Or as Powers sums it up, "the idea of looking had begun to shake the foundations of authority as the basis of thought." How did Ibn al-Haytham achieve this? By resolving "a scientific dispute [between extramissionists and intromissionists] that had remained deadlocked for more than 800 years." He reached this resolution, Powers asserts, through a set of "remarkable observations," the simplest and most remarkable of which is as follows:

He invited observers to stare at the sun, which proved the point: when you looked at a sufficiently bright object, it burned the eye. He made no appeal to geometry or theoretical necessity. Instead, he demolished a whole mountain of systematic theory with a single appeal to data. Light started outside the eye and reflected into it. No other explanation was consistent with the evidence.

Granted, this account has the twin virtues of simplicity and comprehensiveness, but these are its worst vices as well. Ibn al-Haytham did point out that looking at the sun can impair vision (not, however, by burning the eye), but he cited this as evidence that light affects sight, not as disproof that the eye emits visual rays. Nor did any of the supposed beneficiaries of Ibn al-Haytham's insight mentioned by Powers (e.g., Roger Bacon, Witelo, William of Ockham, and Kepler) take it that way. Furthermore, much of the appeal of Ibn al-Haytham's account of vision lay not in its observational core but in its systematic features—i.e., the idealized geometry of the eye, the selection of orthogonal rays by the lens, the sensitive function of the visual spirit, and so forth. It was on the basis of this appeal, in fact, that Ibn al-Haytham assumed the very status of authority that Powers would have us believe he taught western thinkers to reject.

In all fairness, I should point out that Powers is a novelist by profession, not a historian, so I do not pretend that his assessment of Ibn al-Haytham represents the scholarly consensus. But it does, I think, represent an interpretive extreme based upon the assumption, held either explicitly or implicitly by many scholars, that Ibn al-Haytham's *Kitab al-Manazir* was truly revolutionary in terms not only of its purport, but also of its import. On the one hand, in formulating his model of sight

and light, Ibn al-Haytham is supposed to have broken radically with the past. On the other, the appropriation of that model by Western thinkers is supposed to have led more-or-less inexorably to the development of modern optics. While these suppositions are not entirely groundless, they are problematic enough to warrant scrutiny before we assent to them. With that in mind, let us first address the issue of originality. Just how original was Ibn al-Haytham's theory of vision and therefore how radically might he have broken with the past in formulating it?

Take the problem of radiation. At first blush, the differences between Ibn al-Haytham's account of radiation and that of his visual-ray antecedents appear to be so sharp as to be irreconcilable. Ibn al-Haytham was unequivocal in his support of intromissionism, maintaining that visual contact between viewer and visible objects is established through the propagation of luminous color from those objects into the eye. Equally unequivocal in their support of extramissionism, his visual-ray opponents maintained that the eye establishes visual contact with external objects by propagating visual flux to them. Yet, as we noted earlier, these two positions are far from irreconcilable. For one thing, despite his disagreement with the extramissionists over the direction and type of radiation, Ibn al-Haytham preserved the basic analytic device of extramissionist optics, the visual cone, by transmuting it into a cone of vision. For another thing, according to the visual-ray theorists, Ptolemy in particular, vision is completed only when the passion of coloring is conveyed back through the visual flux to the eye. Thus, for Ptolemy, as for Ibn al-Haytham, visual perception ultimately depends upon the transmission of illuminated color from object to eye in the form of a cone. Indeed, Ibn al-Haytham's refutation of visual radiation pivots upon this point. Even for the visual-ray theorists, he contends, it is unnecessary to posit such radiation, because the complementary transmission of visual information back to the eye is perfectly sufficient. For yet another thing, Ibn al-Haytham himself did not consider the two positions to be irreconcilable. He freely acknowledged that both the intromissionists ("philosophers") and extramissionists ("mathematicians") "have something true to say and that both opinions are correct and compatible." Since, however, "neither is wholly satisfactory without the other [to complement it], . . . vision [cannot] be properly accounted for without drawing upon what both have to say."³⁷⁰ Ibn al-Haytham, of course, viewed his account as a proper melding of the two.

Still, to concede that the two models of radiation are equivalent at the mathematical level is not necessarily to deny their fundamental opposition at the physical level. Ibn al-Haytham's conception of light and color is a good case in point. Virtually all of his classical predecessors

treated light as a catalytic agent rather than as a direct object of sight. Its primary function was thus to render color visible, not to be seen in its own right. For Ibn al-Haytham, on the other hand, light was *per se* visible, seen in its own right rather than through its effect on color. The contrast between these two conceptions of light could hardly be clearer—at least in principle. In practice, though, it dwindles to virtual indistinction when we consider how Ibn al-Haytham understood the relationship between light and color. That he viewed the two as ontologically distinct is beyond question, yet, by his own account, it is in the very nature of light to mingle with color. To be physically actualized, moreover, light must shine upon, or from, an opaque body; otherwise it cannot possibly be seen. But color is what renders such bodies visible. For all practical purposes, in fact, opacity *is* color. It therefore follows that light cannot manifest itself visibly unless it alloyed with color. Nor, for that matter, can color manifest itself visibly unless it is alloyed with light, because light gives color the capacity to be seen. Thus reduced to a theoretical abstraction, pure light becomes “visible” only by inference from its effect on embodied color. Effectively denied visibility in its own right, light thus assumes the role of catalytic agent in the visual process, its primary function being to render color visible. This is precisely the same function it has for Ibn al-Haytham’s classical antecedents.

Let us turn, finally, to the issue of methodology. One of the most persistent claims in behalf of Ibn al-Haytham’s originality is that, unlike his classical predecessors, he took an overwhelmingly empirical, or inductive, tack in analyzing light and vision. That this claim has a strong basis in fact needs no belaboring. We need only call to mind the plethora of experiments adduced throughout the *Kitab al-Manazir*. Time and again Ibn al-Haytham invites us to test his assertions by isolating the phenomena in question and submitting them to confirmation (or disconfirmation) according to carefully controlled circumstances. The appropriate apparatus is generally simple (e.g., a room with one window through which light shines on selected objects), but not always, as witness the elaborate device described in book 4 for verifying that light reflects at equal angles.³⁷¹ All things considered, then, we would be hard pressed to deny not only that Ibn al-Haytham had strong empiricist leanings, but that his approach was essentially hypothetico-deductive.

So much is beyond dispute, but the real issue is whether, in following his particular path of induction, Ibn al-Haytham steered the science of optics in a new methodological direction. It is difficult to take this claim seriously in the face of Ptolemy’s relatively heavy reliance upon

empirical examples and experiment in the *Optics*. It is even more difficult in the face of Ibn al-Haytham's intimate familiarity with that work. In at least two instances, key experiments described by Ibn al-Haytham are strikingly similar to those outlined in Ptolemy's *Optics*, so similar, in fact, that there is little doubt that they are organically related. In addition, Ibn al-Haytham and Ptolemy use the very same empirical examples (e.g., a spinning top or the oculogyral illusion) to illustrate the very same points. This is not to deny that there are differences, sometimes significant ones, between Ibn al-Haytham's and Ptolemy's use of induction. Ibn al-Haytham adduced many more experiments than Ptolemy, and in those cases where the experiments are parallel, Ibn al-Haytham's are more elegant and elaborate than Ptolemy's. At bottom, though, these are differences in degree, not in kind. Ibn al-Haytham may have been more inductive than Ptolemy at the quantitative level, but certainly not at the qualitative level.

By now it should be evident that, if analyzed in terms of its conceptual elements, idea by individual idea, Ibn al-Haytham's theory of light and vision reveals very little that is new or original.³⁷² Indeed, far from breaking with the past, the *Kitab al-Manazir* seems to be deeply imbedded in it. And so it is, especially when viewed in piecemeal fashion. But the *Kitab al-Manazir* is not a mere agglomeration of past ideas; it is a *synthesis* and should be evaluated as such. The originality of the *Kitab al-Manazir* thus lies in the way Ibn al-Haytham reformulated and honed the ideas of the past and, on that basis, incorporated them into a seamless whole. The result is a grand reconciliation of nominally disparate, often conflicting, theoretical positions, a reconciliation moreover that comes across as perfectly natural and unforced. In a sense, then, Ibn al-Haytham did transcend his past, not by overturning it but by reconfiguring and perfecting it. This is no small achievement, and the fact that it is not "revolutionary" in any meaningful way cannot detract from its underlying importance or ingenuity.³⁷³

What, then, of the subsequent impact of Ibn al-Haytham's visual theory in the Latin West; was it revolutionary? Again, I think the answer is a somewhat guarded "no." It could certainly be argued—and indeed I have argued elsewhere—that, with various Baconian elaborations, Ibn al-Haytham's model served as a sort of paradigm of visual perception for later medieval and Renaissance thinkers.³⁷⁴ Yet this model did not constitute a paradigm in the strict Kuhnian sense, because, as we know from earlier discussion, it never fully supplanted the visual-ray alternative. Furthermore, unlike the archetypal Kuhnian paradigm, Ibn al-Haytham's model of light and sight was welcomed by medieval Scholastic thinkers not in spite of its dissonance with their theoretical

preconceptions but precisely because of its consonance with them. In short, its acceptance required no suspension of deeply held belief. Not only did Ibn al-Haytham not “shake the foundations of authority” in the Latin West (as Powers would have it); he went a long way toward establishing and bolstering them.

There is of course no gainsaying the depth and breadth to which Ibn al-Haytham and his Perspectivist followers influenced medieval and Renaissance thought, not just in natural philosophy but also in theology and art. Nor is there gainsaying the fact that, without the theoretical groundwork laid by Ibn al-Haytham and his Perspectivist disciples, the revolution in optics inaugurated by Kepler and completed by Newton would have been, if not inconceivable, at least difficult to imagine. And herein lies the true significance of Ibn al-Haytham’s achievement: not that he overturned past optical tradition but that he brought it to logical perfection and, in doing so, inadvertently laid bare its vulnerability. For, as it turns out, his model of vision was flawed in at least two crucial respects. First, in supposing that the crystalline lens selects only orthogonal rays, Ibn al-Haytham misconstrued the lens’ real function, which is to bring all incoming radiation to focus on the retina. It took Kepler to correct this mistake at the beginning of the seventeenth century. Second, in supposing that light and color are ontologically distinct, Ibn al-Haytham failed to realize that, in essence, *light is color*. It took Newton to correct this mistake toward the end of the seventeenth century.

To distill Ibn al-Haytham’s achievement down to the perpetuation of these two erroneous assumptions could easily be taken as a disparagement of that achievement; so central are these assumptions to his visual model that it would be no exaggeration to say that it stands or falls upon them. No doubt it is cold comfort to point out that, within their appropriate context, both assumptions are eminently reasonable, even necessary. Cold comfort, as well, to point out that the visual model arising from them is truly awesome in its coherence, comprehensiveness, and elegance. No matter the mitigation, the fact remains that, at least in retrospect, Ibn al-Haytham was flat wrong. But if the history of science teaches us anything, it teaches us this: being wrong is not necessarily a bad thing. Quite the contrary, being wrong in the right way can be extraordinarily illuminating and, as such, can lead to extraordinarily fruitful consequences.³⁷⁵ Looked at in this way, Ibn al-Haytham’s model of vision takes on an entirely new aspect, not just as a springboard but as an all-important foil for the development of modern optics. On the one hand, in providing the key attack-points for later thinkers, such as Kepler, Descartes, Huygens, and Newton, Ibn al-Haytham dictated the

strategic lines of the ensuing battle. On the other hand, by sharpening the analytic tools of classical optics, Ibn al-Haytham supplied his attackers with the weapons they needed to destroy his synthesis to its very foundations. The irony is inescapable. In giving seventeenth-century theorists virtually everything they needed, Ibn al-Haytham can be said to have fathered the optical revolution of the seventeenth century. Yet, in doing so, he was fated, like the titans of Greek mythology, to be undone by his thankless offspring.

NOTES

¹For the most recent and most definitive account of Ibn al-Haytham's life and works, see Sabra, *Optics*, vol. 2, pp. xix-lxxiii. See also Sabra, "Ibn al-Haytham," in C. C. Gillispie, ed., *Dictionary of Scientific Biography*, vol. 6 (New York: Scribners, 1972), pp. 189-210. A German translation of Ibn Abi Usaybi'a's biographical account can be found in Eilhard Wiedemann, "Ibn al-Haitam, ein arabischer Gelehrter," *Festschrift J. Rosenthal* (Leipzig, 1906), pt. 1, pp. 147-178—also to be found in Dorothea Girke, ed., *Eilhard Wiedemann: Gesammelte Schriften zur arabisch-islamischen Wissenschaftsgeschichte*, vol. 1 (Frankfurt am Main: Institut für Geschichte der Arabisch-Islamischen Wissenschaften an der Johann Wolfgang Goethe-Universität, 1984), pp. 117-146. Unlike Ibn al-Qifti's account, that of Ibn Abi Usaybi'a contains references to a certain Abu 'Ali Muhammed ibn al-Hasan ibn al-Haytham, whom he conflates with Abu 'Ali al-Hasan ibn al-Hasan ibn al-Haytham. Until now, no one seriously questioned this conflation, but in his recent study of Ibn al-Haytham's mathematical thought, Roshdi Rashed has argued forcefully that al-Hasan and Muhammed were in fact two different but roughly contemporaneous figures. Much of Rashed's argument rests on distinguishing among the works credited to al-Hasan and Muhammed according to focus: those of al-Hasan slanted specifically toward mathematical, astronomical, and optical subjects, those of Muhammed slanted more generally toward philosophical subjects. For details, see Roshdi Rashed, *Les mathématiques infinitésimales du IXe au XIe siècle*, vol. 2 (London: Al-Furqan, 1993), pp. 1-19. For Sabra's response to Rashed, however, see "One Ibn al-Haytham or Two? An Exercise in Reading the Bio-Bibliographic Sources," *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* 12 (1998): 1-40.

²See Sabra, "One Ibn al-Haytham or Two?," pp. 9-10.

³This story originates with Ibn al-Qifti, who fails to cite its source. Ibn Abi Usaybi'a repeats it, giving due credit to Ibn al-Qifti as the source; see Sabra, *Optics*, vol. 2, pp. xix-xxi for details.

⁴These details of Ibn al-Haytham's life as a scholar during his waning years are given by Ibn al-Qifti on the basis of hearsay; see Sabra, *Optics*, vol. 2, pp. xx-xxi.

⁵Also based on hearsay, this alternative account of Ibn al-Haytham's quest for scholarly independence is provided by Ibn Abi Usaybi'a; see Sabra, *Optics*, vol. 2, p. xxii.

⁶The *terminus a quo* of 1021 is based upon the death of al-Hakim and is therefore only as credible as the account of Ibn al-Haytham's acceptance of al-Hakim's invitation to supervise the project for regulating the Nile's flow. To complicate matters, there is yet a third account of Ibn al-Haytham's trip to Egypt. According to this account, when Ibn al-Haytham presented his plan to al-Hakim

upon their first meeting, the latter rejected it out of hand in an apparent fit of anger. Realizing that his life was in jeopardy, Ibn al-Haytham immediately fled to Syria. As Sabra observes, this story lacks credibility because it implies that Ibn al-Haytham did not settle in Egypt, a conclusion that flies in the face of rather compelling evidence that he did; see Sabra, *Optics*, vol. 2, p. xxxi. Rashed, however, contends that the apparent inconsistency here is due to Ibn Abi Usaybi'a's confusion of al-Hasan, who indeed settled in Cairo, and Muhammed, who passed his scholarly career in Baghdad; see Rashed, *Les mathématiques infinitésimales*, pp. 11-12.

⁷Both Ibn al-Qifti and Ibn Abi Usaybi'a provide lists of Ibn al-Haytham's works, but Ibn Abi Usaybi'a's is the more extensive. His list is included in Wiedemann's 1906 study, which is cited in note 1 above. For a complete catalogue of the works listed by the two biographers, see Giorgio Nebbia, "Ibn al-Haytham nel millesimo anniversario della nascita," *Physis* 9 (1967): 165-214. Nebbia cites a total of 212 works according to three groupings, but there is clearly overlap among those groupings, so some entries are repeated. For updates to Nebbia's list, see Sabra's biographical entry, "Ibn al-Haytham," pp. 205-208. It is in the brief autobiographical account provided by Ibn Abi Usaybi'a that Ibn al-Haytham mentions the loss of certain of his works; see Sabra, *Optics*, vol. 2, p. xxiv. According to Rashed's account, however, al-Hasan was responsible for only about half of the works credited to him by Ibn Abi Usaybi'a, the rest having been produced by Muhammed. For Rashed's list of works properly ascribed to al-Hasan, see *Les mathématiques infinitésimales*, pp. 511-535.

⁸See Sabra, *Optics*, vol. 2, pp. xxiv-xxxii for a discussion of these works and their basic chronological order.

⁹Aside from commentaries on Aristotle's *De anima* and *Poetics*, Ibn al-Haytham is credited with two commentaries on Porphyry, whose *Isagoge* ("Introduction") to Aristotle's logical works (late fourth century) was translated into Latin by Boethius (d. 525) and, in that form, was enormously influential in the Latin West during the early Middle Ages. Several additional commentaries attributed to Ibn al-Haytham bear on issues that come to focus in Aristotle. See, e.g., entries I.b.1-4, I.b.11-12, I.b.20, I.b.22, I.b.42, II.1, II.2, and II.16-17 in Nebbia, "Ibn al-Haytham," pp. 176-182.

¹⁰See Sabra, *Optics*, vol. 2, pp. xxxii-liii, for a full accounting of these nineteen works.

¹¹For this and the following two titles, see Sabra, *Optics*, vol. 2, pp. xxxii-xxxiii. The loss of this particular work is especially unfortunate, since Ptolemy's *Optics* was a crucial formative source for Ibn al-Haytham. The title of this missing work indicates that the Arabic version of the *Optics* available to Ibn al-Haytham by the early eleventh century was already defective in the same way as the version available to its Latin translator, Eugene of Sicily, around the mid-twelfth century; see A. Mark Smith, *Ptolemy's Theory of Visual Perception*, Transactions of the American Philosophical Society, 86.2 (Philadelphia: American Philosophical Society, 1986), pp. 5-8.

¹²Ptolemy alludes to the Moon Illusion in at least three works, all of which

could have been known to Ibn al-Haytham. The earliest of these allusions occurs in the *Almagest*, where Ptolemy imputes the apparent enlargement of celestial objects at the horizon to the magnification caused by refraction through atmospheric vapors. Later, in the *Planetary Hypotheses* and *Optics*, he seems to accept that this apparent enlargement is merely apparent, being rooted in the psychology of misperception rather than in physics. See Sabra, "Psychology versus mathematics: Ptolemy and Alhazen on the moon illusion," in Edward Grant and John Murdoch, eds., *Mathematics and its applications to science and natural philosophy in the Middle Ages* (Cambridge: Cambridge University Press, 1987), pp. 217-247.

¹³For a discussion of how Ibn al-Haytham's explains the Moon Illusion in his "Commentary and Summary of the *Almagest*," see Sabra, *Optics*, vol. 2, pp. xxxiv-xxxvii. Not only does Ibn al-Haytham revisit the Moon Illusion in the *Kitab al-Manazir*, but several of his subsequent works are devoted to it as well; see, e.g., entries 10-12 in the listings on p. xvii above.

¹⁴Entry 1 has been translated into German by Eilhard Wiedemann in "Ibn al-Haitams Schrift über die sphärischen Hohlspiegel," *Bibliotheca Mathematica*, ser. 3, 10 (1909-1910): 293-307—also to be found in *Gesammelte Schriften*, vol. 1, pp. 354-368. It has since been translated into English by H. J. J. Winter and W. 'Arafat in "A Discourse on the Concave Spherical Mirror of Ibn al-Haitham," *Journal of the Royal Asiatic Society of Bengal*, ser. 3, 16 (1950): 1-16. Entry 2 has been translated into German by J. L. Heiberg and Eilhard Wiedemann in "Ibn al-Haitams Schrift über parabolische Hohlspiegel," *Bibliotheca Mathematica*, ser. 3, 10 (1909-1910): 201-218—also to be found in *Gesammelte Schriften*, vol. 1, pp. 369-405. It has since been translated by H. J. J. Winter and W. 'Arafat in "Ibn al-Haitham on the Paraboloidal Focussing Mirror," *Journal of the Royal Asiatic Society of Bengal*, ser. 3, 15 (1949): 25-40. Entry 3 is extant in manuscript form but as yet remains unedited and untranslated.

¹⁵Entry 4 has been translated into German by Karl Kohl, "Über das Licht des Mondes, eine Untersuchung von Ibn al-Haitham," *Sitzungsberichte der Physikalisch-medizinischen Sozietät in Erlangen* 56-57 (1924-25): 305-398. Entry 5 exists in a German translation by Eilhard Wiedemann, "Über das Licht der Sterne nach Ibn Al Haitham," *Wochenschrift für Astronomie, Meteorologie und Geographie*, ns, 33 (1890): 129-133—also to be found in *Gesammelte Schriften*, vol. 1, pp. 80-84. An Arabic edition of entry 6 has been published by A. I. Sabra in *Journal for the History of Arabic Science* 1 (1977): 5-19.

¹⁶Entry 7 is currently lost. A German translation of entry 9 can be found in J. Baarmann, "Abhandlung über das Licht von Ibn al-Haitam," *Zeitschrift der Deutschen Morgenländischen Gesellschaft* 36 (1882): 195-237. An English rendering of Baarmann's German translation is to be found in Thomas Shastid, "History of Ophthalmology," in Casey A. Wood, ed., *The American Encyclopedia and Dictionary of Ophthalmology*, vol. 11 (Chicago, 1917), pp. 8701-8717. A recent French translation by Roshdi Rashed is to be found in "Le 'Discours de la Lumière' d'Ibn al-Haytham (Alhazen)," *Revue d'histoire des sciences et de leurs applications* 21 (1968): 197-224.

¹⁷Entry 10 remains unedited and untranslated. Only a small part at the end of entry 11 is devoted to Ptolemy's optical thought. The relevant passages have been published in English translation by A. I. Sabra in "Ibn al-Haytham's Criticisms of Ptolemy's *Optics*," *Journal of the History of Philosophy* 4 (1966): 145-149; the Arabic text of the entire treatise has been edited by A. I. Sabra and N. Shehabi, *"Ibn al-Haytham, Al-Shukuk Ala Ballamiya* (Cairo: National Library Press, 1971), and an English translation of the whole treatise is to be found in Don L. Voss, "Ibn al-Haytham's Doubts Concerning Ptolemy: A Translation and Commentary" (PhD dissertation, University of Chicago, 1985). For an edition and English translation of part of entry 12, see Sabra, "On Seeing the Stars, II: Ibn al-Haytham's 'Answers' to the 'Doubts' Raised by Ibn Ma'dan," *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* 10 (1995/96): 1-59.

¹⁸Extant in Arabic but unedited and untranslated, Ibn al-Haytham's "Treatise on the Rainbow and Halos" also exists in a recension by Kamal al-Din al-Farisi in his *Tanqih al-Manazir*. For a paraphrase of this recension, see Eilhard Wiedemann, "Theorie des Regensbogens von Ibn al-Haitam," *Sitzungsberichte der Physikalisch-medizinischen Sozietät in Erlangen* 46 (1914): 39-56—also found in Wiedemann, *Aufsätze zur arabischen Wissenschafts-Geschichte*, vol. 2 (Hildesheim: Georg Olms, 1970), pp. 69-86. Ibn al-Haytham's "Treatise on the Quality of Shadows" also exists in a recension by Kamal al-Din al-Farisi in his *Tanqih*. For a German translation of this recension, see Eilhard Wiedemann, "Über ein Schrift von Ibn al-Haitam 'Über die Beschaffenheit der Schatten,'" *Sitzungsberichte der Physikalisch-medizinischen Sozietät in Erlangen* 39 (1907): 226-248—also to be found in *Aufsätze*, vol. 1, pp. 377-399. Like the previous two works, Ibn al-Haytham's "Treatise on the Form of the Eclipse" exists in a recension by Kamal al-Din al-Farisi in his *Tanqih*. For a German translation of this recension, see Eilhard Wiedemann, "Über die *Camera obscura* bei Ibn al-Haitam," *Sitzungsberichte der Physikalisch-medizinischen Sozietät in Erlangen* 46 (1914): 155-169—also to be found in *Aufsätze* II, pp. 85-101.

¹⁹For specifics, see Sabra, *Optics*, vol. 2, p. xxvi.

²⁰This assumption would follow in any case from the mature nature of the *Kitab al-Manazir*.

²¹Of particular interest in Ibn al-Haytham's treatment of mirrors is his solution of what came to be known as "Alhazen's Problem" in the seventeenth century. As posed by Christiaan Huygens, the problem boils down to finding the point of reflection on the surface of a spherical mirror when a center of sight and an object-point are given. For further discussion, see A. I. Sabra, "Ibn al-Haytham's Lemmas for Solving 'Alhazen's Problem,'" *Archive for History of Exact Sciences* 26 (1982): 299-324.

²²It is at the very end of the seventh book that Ibn al-Haytham revisits the problem of the Moon Illusion; for an English translation of this section of the Arabic text, see Sabra, "Psychology versus mathematics," pp. 237-243.

²³See items 1, and 2 on p. xvii above.

²⁴See item 13 on p. xvii above.

²⁵See Sabra, *Optics*, vol. 2, pp. xxxii, liii, and lx-lxi.

²⁶See Smith, *Ptolemy's Theory*, pp. 49-55.

²⁷Kamal al-Din is perhaps best known in the West for his analysis of the rainbow, which was roughly contemporary with, and certainly independent of, that of Theodoric of Freiberg; see Carl B. Boyer, *The Rainbow: From Myth to Mathematics* (New York: Yoseloff, 1959), pp. 127-130. For a general discussion of the *Tanqih* and its role in bringing Ibn al-Haytham to general scholarly attention within the Arab world, see Sabra, *Optics*, vol. 2, pp. lxiv-lxxiii. As Sabra observes, the importance of the *Tanqih* as mediator for the *Kitab al-Manazir* is witnessed by the relative numbers of surviving manuscripts of each: at least twelve for the *Tanqih* as opposed to only five (of which four are incomplete) for the *Kitab al-Manazir*.

²⁸See Sabra, *Optics*, vol. 2, p. xxv.

²⁹A critical Latin edition of this text is to be found in Heiberg and Wiedemann, "Ibn al-Haitham's Schrift über parabolische Hohlspiegel," pp. 218-237.

³⁰For a Latin text drawn from one manuscript, see José Maria Millás Vallicrosa, *Las traducciones orientales en los manuscritos de la Biblioteca Catedral de Toledo* (Madrid, 1942), appendix 2, pp. 285-312. A German translation from an Arabic version can be found in Karl Kohl, "Über den Aufbau der Welt nach Ibn al-Haitham," *Sitzungsberichte der Physikalisch-medizinischen Sozietät in Erlangen*, 54-55 (1922-1923): 140-179. An Arabic edition with English translation is to be found in Y. Tzvi Langermann, *Ibn al-Haytham's On the Configuration of the World* (New York: Garland, 1990). Rashed, *Les mathématiques infinitésimales*, pp. 490-491, argues that this work should be attributed not to al-Hasan but rather to Muhammed Ibn al-Haytham; see note 1 above.

³¹In proposition IV.20 of the *De triangulis*, Jordanus of Nemore adverts to "19 quinti perspective," which Marshall Clagett takes by context to be a somewhat mangled reference to proposition 34 (not 19) of the fifth book of the *De aspectibus*. If this conclusion is correct, and assuming that the *De triangulis* is an authentic work of Jordanus, then it may date to before the 1230s, although there is no certainty about Jordanus' actual dates. For Jordanus' actual citation, see Clagett, *Archimedes in the Middle Ages*, vol. 1 (Madison: University of Wisconsin Press, 1964), pp. 668-669 and 674; for later reservations about Jordanus' dates, see Clagett, *Archimedes in the Middle Ages*, vol. 5 (Philadelphia: American Philosophical Society, 1984), pp. 297-301.

³²See R. James Long, ed., *Bartholomaeus Anglicus, De proprietatibus rerum, Books 3-4: On the Properties of Soul and Body* (Toronto: Pontifical Institute of Mediaeval Studies, 1979). Long suggests a twenty-year span, between 1230 and 1250, within which Bartholomaeus may have been occupied in compiling the *De proprietatibus rerum*; see pp. 4-5. For references to Alhacen ("auctor perspective"), see *De proprietatibus rerum*, III.17 ("De virtute visibili"), pp. 39-45.

³³Robert Grosseteste, whom Roger Bacon extols for his mastery of optics, evidently had no access to the *De aspectibus* when he composed his optical treatises sometime during the first half of the 1230s; see Richard C. Dales, "Robert Grosseteste's Scientific Works," *Isis*, 52 (1961): 394-402. Given his intense interest in optics, Grosseteste would surely have taken full advantage of the *De*

aspectibus had a copy been available to him at that time.

³⁴For a discussion of this Italian translation, see "Manuscripts and Editing," p. clx below.

³⁵For this list, which includes eighty-seven works, see George Sarton, *An Introduction to the History of Science*, vol. 2 (Baltimore: Williams & Wilkins, 1927), pp. 339-344,

³⁶This work does figure in the list of Gerard's works; see *ibid.*, p. 342.

³⁷The title of Nuñez' work is *De crepusculis liber unus, . . . Item Allacen . . . De causis crepusculorum liber unis, a Gerardo Cremonensi iam olim latinitate donatus*. . . (Lisbon, 1542). Friedrich Risner's title for the *De crepusculis* is "Alhazen filii Alhayzen de crepusculis et nubium ascensionibus liber unus, Gerardo Cremonensi interprete"; see *Opticae thesaurus*, p. 283.

³⁸See Sarton, *Introduction*, p. 342; note that Sarton, following Nuñez and Risner, misattributes this work to Ibn al-Haytham.

³⁹See A. I. Sabra, "The Authorship of the *Liber de crepusculis*, an 11th-Century Work on Atmospheric Refraction," *Isis* 58 (1967): 77-85. For a recent edition of the Latin version of this treatise, see A. Mark Smith, "The Latin Version of Ibn Mu'adh's Treatise 'On Twilight and the Rising of Clouds,'" *Arabic Sciences and Philosophy* 2 (1992): 83-132. For editions of the medieval Hebrew and Italian versions, see A. M. Smith and Bernard R. Goldstein, "The Medieval Hebrew and Italian Versions of Ibn Mu'adh's 'On Twilight and the Rising of Clouds,'" *Nuncius* 8 (1993): 613-643.

⁴⁰See "Manuscripts and Editing," pp. clxviii-clxix below for further discussion.

⁴¹For a detailed analysis of these changes and their ramifications, see "Manuscripts and Editing," pp. clxviii-clxx below.

⁴²See Sabra, *Optics*, vol. 2. p. lxxiii

⁴³*De aspectibus* should be translated as "On appearances" if *manazir* is taken as the plural of *manzar* = "appearance." However, Sabra notes that in this case *manazir* is intended as the plural not of *manzar*, but of *manazara* = "that by means of which vision is effected." Hence, according to Sabra's account, *manazir* is best translated as "optics" (*optika* = "having to do with the eye") rather than as "appearances," a point that apparently went unnoticed by the Latin translator(s); see Sabra, "Ibn al-Haytham," p. 203, n. 9.

⁴⁴The opening title, ALHACEN PERSPECTIVA, that occurs at the very beginning of ms *P1* (see entry 5 in "Manuscripts and Editing," p. clvi below) is clearly added by a later hand. Reference to "perspectiva Alhacen" in the colophon to ms *E* (see entry 1 in "Manuscripts and Editing," p. clv below), is in the hand of the corrector, Guido de Grana, not the original scribe. Finally, ms *L1* and the fourteenth-century Italian version of the text (see entries 13 and 18 in "Manuscripts and Editing," pp. clx and clx below) end with the following explicit: "Explicit liber Alacen in scientia perspectiva," but in both cases "perspectiva" is obviously intended not as a title but as a descriptive term. There is, of course, no denying that the *De aspectibus* was commonly cited as *Perspectiva* by medieval and Renaissance commentators, but this title was prob-

ably conferred upon it generically, according to subject-matter and approach (mathematical optics = *perspectiva*).

⁴⁵Alhacen's full name is Abu Ali al-Hasan ibn al-Hasan ibn al-Haytham, "al-Hasan" being his given name. Assuming that the "c" is soft, the "h" is aspirated, and the stress is on the second syllable, then "Alhacen" constitutes an accurate Latin transliteration of "al-Hasan."

⁴⁶I know of only one place--in the sixteenth-century Paris manuscript described under entry 16, p. clx below--where "Alhazen" is used, but not to designate Ibn al-Haytham's given name. It appears in the following incipit: *Incipit primus tractatus Alhacen filii Alhazen de aspectibus et 7 sunt differentie*. Might this be one of the two manuscripts Risner claims to have drawn upon for his edition? Perhaps so, given that the manuscript in question falls squarely within the family-tradition from which Risner drew. It bears noting that, unlike any of the manuscript-sources, Risner further Latinizes "Alhazen" by adding "us" as a suffix in order to make it declinable (i.e., Alhazenus, Alhazeni, etc.).

⁴⁷If we add the Italian translation to the account, then the total of manuscripts dating to the fourteenth century rises to ten.

⁴⁸For details on the composition and dissemination of these derivative works, see pp. lxxii-lxxxiii above.

⁴⁹Friedrich Risner was taken under Petrus Ramus' wing at Paris as a young man. It was, as he tells us in the preface to the *Opticae thesaurus*, at Ramus' behest that he decided to edit Alhacen's work; see David Lindberg's preface to the Johnson Reprint edition of the *Opticae thesaurus* (New York, 1972), p. xxvii.

⁵⁰For a discussion of this tripartition into subfamilies, see "Manuscripts and Editing," pp. clxi-clxvii below.

⁵¹The six manuscripts in question are listed as entries 1, 2, 4, 12, 13, 16, and 17 in "Manuscripts and Editing," pp. clv-clvi and clx-clx below.

⁵²The omission of these three chapters reduces the size of the first book by nearly half. Furthermore, it is in these three chapters that Ibn al-Haytham establishes certain methodological norms while laying the foundations for his later analysis of light- and color-radiation; see Sabra, *Optics*, vol. 2, pp. 3-41.

⁵³See table 1 of appendix 2, pp. 653-654 below, for a breakdown of chapters by manuscript-groups.

⁵⁴There is absolutely no indication in any of the manuscripts that the translator thought he was taking up his task *in medias res*. Furthermore, there are very few explicit cross-references within the extant text to indicate any missing portion even though the work, as a whole, abounds with cross-references. Most of these, however, are allusive rather than explicit, the common form being "It has already been demonstrated that. . ." Although in hindsight we can see that several of these cross-references do refer to passages located in the missing portion, we can still key them in one way or another to places in the five chapters that have actually come down to us.

⁵⁵As can be seen from table 1 of Appendix 2, pp. 653-654 below, the number of chapters ranges fairly widely: of the sixteen texts (including Risner's) that

have book 1 in its entirety, five contain seven chapters, six contain eight, four contain nine, and one contains ten. That book 1 of the Latin version was originally divided into nine chapters follows from my analysis of the manuscripts and subsequent conclusions about which manuscripts are most representative of the *Urtext*; see “Manuscripts and Editing,” p. clxix below for details.

⁵⁶From table 1 of Appendix 2, pp. 653-654 below, it can also be seen that, even when there is agreement among manuscripts about the number of chapters, there is not always agreement about their placement. Thus, for example, among the six manuscripts containing eight chapters, there are three different patterns of subdivision.

⁵⁷For details on these discrepancies in number and placement, see tables 2 A, 2B, 3A, and 3B of Appendix 2, pp. 654-657 below.

⁵⁸For a complete breakdown of the divisions and subdivisions within book 3, see tables 4 and 5 of Appendix 2, pp. 658-659 below.

⁵⁹Book 4 is divided into six chapters in seven of the manuscripts; in all the remaining manuscripts it is divided into five chapters. In book 5, the number and placement of chapters is quite variable, even though the prologue specifies quite clearly that the book consists of two chapters. In book 6, the number and placement of chapters is also variable, but not to the same extent as book 5. Book 7, on the other hand, is divided fairly consistently into seven chapters, there being only one exception, which has it divided into six. See tables 6-7 of Appendix 2, pp. 660-661 below, for details.

⁶⁰In Sabra’s English translation of the Arabic text, the first three chapters of book 3 occupy 31 pages, the remainder of the book 108. In the Latin text, on the other hand, the first three chapters of book three occupy 33 pages whereas the remainder of the book occupies only 30 pages. Thus, *mutatis mutandis*, the second portion of the book in the Latin version is roughly one-quarter the size of the same portion in the Arabic version.

⁶¹See, e.g., I, 5.39, p. 22, line 34; I, 6.6, p. 23, line 45; I, 6.14, p. 27, line 141; I, 6.43, p. 42, line 26; I, 6.76, p. 55, line 91; and II, 3.71, p. 126, line 256.

⁶²See Nebbia, “Ibn al-Haytham,” pp. 179 -180, for a full listing of the commentaries upon various Galenic works attributed to Ibn al-Haytham.

⁶³See Nebbia, “Ibn al-Haytham,” entry 1.b.4, p. 176.

⁶⁴For example, after an extensive critique of the visual-ray theory (as exemplified in the Euclidean analysis), Alhacen concludes in I, 6.61, p. 374 below, that “what we have shown—namely, how vision takes place—conforms to the opinion of those who have verified it on mathematical grounds as well as [those who have verified it] on physical grounds. It has been shown therefore that both parties have something true to say and that both opinions are correct and compatible, but neither is wholly satisfactory without the other [to complement it], nor can vision be properly accounted for without drawing upon what both have to say.”

⁶⁵This reconciliation-process was already well underway in late Antiquity, for instance, with the efforts of various Neoplatonist commentators to interpret

the works of Aristotle critically in the light of their Platonist leanings.

⁶⁶For color as the proper object of sight, see *De anima*, 2, 6.418a11-14; for Aristotle color is an inherent quality of physical objects, not a mere visual affect, or psychological effect, created by the interaction of matter in various forms and sizes; see *De anima*, 2, 7.418a29-419a20. In taking this position, Aristotle is arguing against not only the atomists, but also Plato; see, e.g., *Timaeus* 67d-e.

⁶⁷As Aristotle puts it in *De anima*, 2, 7.418b11-12, "light is as it were the proper colour of what is transparent and exists whenever the potentially transparent is excited to actuality by the influence of fire," trans. J. A. Smith, in Jonathan Barnes, ed., *The Complete Works of Aristotle: The Revised Oxford Translation* (Princeton: Princeton University Press, 1984), p. 666.

⁶⁸The transmission of color through transparent media is a matter of a formal transformation of that medium, one that occurs instantaneously in much the same way that water is transformed all at once into ice; see *De sensu et sensato*, 6, 447a2-3.

⁶⁹For Aristotle's use of the seal-and-wax analogy to explain visual impression, see *De anima*, 3, 12.434b29-435a10.

⁷⁰For Aristotle's discussion of the common sensibility and the common sensibles, see *De anima*, 3.1.

⁷¹*De anima*, II, 6, 418b 20-23.

⁷²For an extensive discussion of the psychological/perceptual basis of Aristotle's epistemology, see Michael V. Wedin, *Mind and Imagination in Aristotle* (New Haven: Yale University Press, 1988).

⁷³For example, despite his championing of intromissionism in the *De anima* and *De sensu et sensato*, Aristotle's analysis of the rainbow and other "meteorological" phenomena in *Meteorology*, 3.2-5 is based on rays sent out by the eye.

⁷⁴Euclid's *Optics* opens as follows: "Let it be supposed: (1) that straight lines diverge outward from the eyes to comprehend vast spaces, (2) that these visual rays form a cone whose vertex is located in the eye and whose base is formed at the boundaries of visible objects, (3) that objects with which the visual flux makes contact are seen, whereas those objects not contacted by the visual flux are not seen" (from A. Mark Smith, *Ptolemy and the Foundations of Ancient Mathematical Optics*, Transactions of the American Philosophical Society, 89.3 (Philadelphia: American Philosophical Society, 1999), p. 51).

⁷⁵As Euclid puts it in the fifth and sixth postulates of the *Optics*, "Objects seen with higher rays appear higher, whereas those seen with lower rays appear lower; and objects seen with right-hand rays appear to the right, whereas those seen with left-hand rays appear to the left" (from Smith, *Ptolemy and the Foundations*, p. 55). The perception of shape is implicit rather than explicit in Euclid's model—e.g., in the notion expressed in the second postulate that the base of the visual cone is delineated by the boundaries of objects.

⁷⁶Euclid's fourth postulate asserts that "objects viewed under a larger angle appear larger, whereas those viewed under a smaller angle appear smaller, and those viewed under equal angles appear equal" (from Smith, *Ptolemy and the*

Foundations, p. 56).

⁷⁷This notion of the tactile sensing of motion by ray-ends is implicit in props. 49-51 and 53-55 of the *Optics*.

⁷⁸Euclid deals with such variation in visual acuity in the second and third propositions of the *Optics*.

⁷⁹In the first proposition of the *Optics*, however, Euclid asserts that, in order for any object to be seen in its entirety, it must be scanned by the visual flux, which implies that clear vision occurs only within a narrow region of the visual cone's base, presumably toward its core, which is centered on the visual axis.

⁸⁰*Optics*, II, 20, in Smith, *Ptolemy's Theory*, p. 78.

⁸¹*Optics*, II, 20, in *ibid.*, p. 78.

⁸²*Optics*, II, 19, in *ibid.*, pp. 76-77.

⁸³*Optics*, II, 20, in *ibid.*, pp. 77-78. Presumably, the increasing "absence" of rays is due to the spreading out of the impinging flux over the frontal plane of the visual field.

⁸⁴*Optics*, II, 50, in *ibid.*, pp. 91-92.

⁸⁵"Indeed, colors are never seen in darkness, except for [the color of] an object that shines from inherent whiteness or that is exceedingly polished, for each of these is a case of brightness, and brightness is a kind of luminosity," *Optics*, II, 5, in *ibid.*, pp. 71-72.

⁸⁶See *ibid.*, pp. 29-30.

⁸⁷"Colors are primarily visible, because nothing, besides light, that does not have color is seen. Still, colors are not intrinsically visible, since colors are somehow contingent on the compactness of bodies and are not visible *per se* without light. All the rest of the . . . visible properties are secondarily visible, because the visual faculty apprehends things as bodies by means of their [inherent] colors and characteristics, whereas objects that have no compactness, but are exceedingly tenuous and have no color, are neither sensed nor perceived as bodies by the visual faculty. Furthermore, size, place, and shape are perceived only through the mediation of bodies' surfaces, which coincide with the colors upon which external light falls. Activity and rest, as well, are apprehended by means of an alteration, or lack thereof, in any of the aforementioned visible properties;" *Optics*, II, 5, in *ibid.*, pp. 71-72. Note that Ptolemy's secondary visibles are, in essence, Aristotle's common sensibles.

⁸⁸Ptolemy is thus arguing against both the atomists and Plato; see *ibid.*, p. 27.

⁸⁹" . . . since light and visual flux strike the surfaces of bodies together, it is quite appropriate that the first thing to be sensed in all visible objects is a characteristic of their surfaces. And color is more properly attributed to the surface than to the interior of things. For this reason, the ancients used to equate surface and color, because color is a certain property affixed to the substance of an illuminated thing, and the genus "surface" is like that; and so it is an apt designation for it. As far as the remaining visible properties are concerned, corporeity is not surface, because surface is its boundary, yet all the remaining visible prop-

erties depend upon something in bodies having to do with surface. For instance, size is the boundary of a surface's quantity, whereas shape is a qualitative arrangement of surface, and place is the boundary of the location of a surface. Activity, though, depends upon surface insofar as it is attributed to any of those properties [i.e., size, shape, and place]—for instance, the activity of alteration, or of growth, or of diminution, or of locomotion;" *Optics*, II, 13, in Smith, *Ptolemy's Theory*, p. 74.

⁹⁰*Optics*, II, 25 and 47 in *ibid.*, pp. 81-82 and 90.

⁹¹*Optics*, II, 57, in *ibid.*, p. 95.

⁹²This is the underlying point of Euclid's analysis in propositions 34-36 of his *Optics*.

⁹³*Optics*, II, 124, in Smith, *Ptolemy's Theory*, p. 120; see also *Optics*, II, 126, in *ibid.*, p. 121.

⁹⁴*Optics*, II, 67, in *ibid.*, p. 99.

⁹⁵*Optics*, II, 129, in *ibid.*, p. 122.

⁹⁶"We are naturally disposed to turn our raised eyes unconsciously in various directions with a remarkable and accurate motion, until both eyes converge on the middle of a visible object, and both cones form a single base upon the visible object they touch," *Optics*, II, 28, in *ibid.*, p. 83.

⁹⁷For Ptolemy's analysis of image-doubling in diplopia, see *Optics*, II, 27-46, in *ibid.*, pp. 82-90.

⁹⁸Elsewhere, I have contrasted Ptolemy and Euclid according to methodological commitment, seeing in Euclid an example of instrumentalism or positivism (i.e., having no concern for whether his analytic model reflects physical reality) and in Ptolemy an example of realism (i.e., believing his visual model to reflect physical reality); see A. Mark Smith, "The Physiological and Psychological Grounds of Ptolemy's Visual Theory: Some Methodological Consideration," *Journal of the History of the Behavioral Sciences* 34 (1998): 231-46.

⁹⁹Ptolemy describes the apparatus for analyzing diplopia in *Optics*, II, 30, and III, 43, in Smith, *Ptolemy's Theory*, pp. 83 and 147. The apparatus for analyzing reflection is described in *Optics*, III, 8-10, in *ibid.*, pp. 135-135. The apparatus for analyzing refraction is described in *Optics*, V, 8-9, 14, and 29, in *ibid.*, pp. 232, 234, and 236-237.

¹⁰⁰The two primary extant sources for Galen's thought on the anatomy and physiology of sight, as well as on the visual act itself, are books 8-10 of the *De usu partium*, translated by Margaret Talmadge May, *Galen on the Usefulness of the Body* (Ithaca, NY: Cornell University Press, 1968), pp. 384-503, and book 7 of the *De placitis Hippocratis et Platonis*, trans. Phillip De Lacy, *Galen on the Doctrines of Hippocrates and Plato*, *Corpus Medicorum Graecorum* 4, 4, 1, 2 (Berlin: Akademie Verlag, 1980-84), pp. 428-479.

¹⁰¹*De usu partium*, X, ii, 94, in May, p. 491

¹⁰²*De usu partium*, X, ii, 55, in *ibid.*, p. 463.

¹⁰³"The vitreous humor," Galen asserts, "is moist like fused glass and [only] as clear as you would expect a substance to be if a little black were mixed with

a large clear body and the perfection of its clearness were impaired throughout," *De usu partium*, X, ii, 56, in *ibid.*, p. 464.

¹⁰⁴*De usu partium*, X, ii, 55-61, in *ibid.*, pp. 463-468.

¹⁰⁵*De usu partium*, X, ii, 61-62, in *ibid.*, pp. 468-469.

¹⁰⁶*De usu partium*, X, ii, 62-66, in *ibid.*, pp. 469-472.

¹⁰⁷The term *ooeides*, meaning "egg-like," is presumably meant to indicate that this humor is like albumen in its transparency—a comparison reflected in the Latin term *albugineus* that is applied to this humor.

¹⁰⁸*De usu partium*, VII, i, 465, in May, p. 402. "Accordingly," Galen concludes, "the encephalon extends a part of itself [via the optic nerves] to the crystalline humor in order to know how it is being affected, and this outgrowth is properly the only one to have a perceptible channel, because it alone contains a very large amount of the psychic pneuma."

¹⁰⁹*De placitis*, 7, 3.23-26, in De Lacy, pp. 445-447.

¹¹⁰*De usu partium*, X, ii, 56-59, in May, pp. 465-467.

¹¹¹*De placitis*, 7, 3.4-22, in De Lacy, pp. 441-445.

¹¹²See the quotation on the following page.

¹¹³*De placitis*, 7, 7.19, in De Lacy, p. 475

¹¹⁴"Here," Galen asserts, "Aristotle was quite correct when he said about the sudden change of bodies thus altered that it is very nearly instantaneous, and also, with regard to this alteration, that it is in the nature of bright air, when altered by colors, to transmit the alteration all the way to the organ of sight," *De placitis*, 7, 7.4, in De Lacy, p. 471.

¹¹⁵Galen cites Plato's claim in *Timaeus* 45b-d that what is emitted by the eye into the air is a sort of fire, but one that is so gentle as not to burn; see *De placitis*, 7, 6.3-4, in *ibid.*, p. 463.

¹¹⁶*De placitis*, 7, 5.33-37, in *ibid.*, p. 461.

¹¹⁷*De placitis*, 7, 7.24, in *ibid.*, p. 467.

¹¹⁸See esp. *De usu partium* X, ii, 95 in May, p. 492.

¹¹⁹"Now if you care to stand [facing] a pillar," Galen suggests, "and open and close each eye in turn while gazing steadily at it, it will seem to jump from one place to another; if it is the right eye you close, the pillar jumps to that side, and if it is the left, it jumps to the other side. Moreover, if you open the right eye, the pillar will seem to jump to the left, and if you open the left one, it will seem to jump to the right; [but] if you look with both eyes at once, it seems to occupy a place midway between the places it appears to occupy to each eye separately," *De usu partium* X, ii, 100, in May, p. 496.

¹²⁰*De usu partium*, X, ii, 110 in *ibid.*, p. 502.

¹²¹For Galen's discussion of diplopia, see *De usu partium* X, ii, 99-104 in *ibid.*, pp. 495-498.

¹²²See, e.g., *De usu partium*, VII, i, 448-451 in May, pp. 388-391.

¹²³See *De placitis* 7, 7.20, in De Lacy, p. 475.

¹²⁴*De placitis* 7, 7.20, in *ibid.*, p. 475.

¹²⁵For a brief discussion of Ptolemy's putative sources and the historiography of their analysis, see Smith, "The Physiological and Psychological Grounds of Ptolemy's Visual Theory," pp. 241-242. See also Smith, *Ptolemy's Theory*, pp. 14-18.

¹²⁶See *Ibid.*, pp. 28-29.

¹²⁷Diophantus' dates are problematic, but Heath's dating to the mid-third century is currently accepted; see T. L. Heath, *Diophantus of Alexandria*, 2nd ed. (1910; reprint, New York: Dover, 1964), pp. 1-2. Among the most important of the late-Antique commentators on Aristotle are Alexander of Aphrodisias (fl. early third century), Porphyry (fl. late third century), Themistius (fl. late fourth century), Simplicius (fl. early sixth century), and John Philoponus (fl. mid-fifth century).

¹²⁸See Smith, *Ptolemy's Theory*, pp. 49-55.

¹²⁹*Oeuvres philosophiques et scientifiques d'al-Kindi*, vol. 2, ed. Roshdi Rashed and Jean Jolivet (Leiden: Brill, 1998), p. vii.

¹³⁰Among the key figures in this process of specification and elaboration are al-Kindi, al-Farabi (c. 870-950), and Avicenna. Two later figures, al-Ghazali (1058-1111) and Ibn Rushd, or Averroes (1126-1198), were instrumental in systematizing the model of faculties, or "internal senses," that developed from the mid-ninth century. In many ways, the wellspring of this development was the larger issue of how the soul manages to grasp the Universal—the datum of true knowledge that is absolutely unchanging and immaterial—from sense-induction, which is based on an objective world that is both material and changeable. In response to this issue, al-Kindi and his successors (probably following Alexander of Aphrodisias) articulated a distinction (actually, a set of distinctions) between the higher, active intellect (or "intellect in act")—which grasps the true Universal—and the lower potential intellect—which is the intellect in search of that Universal. The material soul, with its constituent faculties or internal senses, is the arena within which the potential intellect conducts this search. There is an immense literature dealing with this highly vexed, and equally important, subject; for a good overview of the problem and efforts at its resolution among the figures cited above, see the relevant sections on al-Kindi, al-Farabi, and Ibn Sina in 'Abdurrahman Badawi, *Histoire de la Philosophie en Islam*, vol. 2 (Paris: Vrin, 1972), pp. 385-695. See also Jean Jolivet, "L'Intellect selon al-Farabi: quelques remarques," in *Philosophie médiévale arabe et latine* (Paris: Vrin, 1995), pp. 211-219.

¹³¹Aside from the *Shifa*, Avicenna wrote a variety of other works within which he dealt with perception, epistemology, and vision; foremost among these are the *Kitab al-Najat* ("Book of Deliverance"), *Maqala f 'l-Nafs* ("Compendium on the Soul"), and the *Kitab al-Qanun f 'l-Tibb* ("Canon of Medicine").

¹³²For an overview of this epistemological model, its evolution, and its implications, see H. A. Wolfson's classic study, "The Internal Senses in Latin, Arabic, and Hebrew Philosophical Texts," *Harvard Theological Review* 25 (1935): 69-133. See also E. Ruth Harvey, *The Inward Wits: Psychological Theory in the Middle Ages and the Renaissance*, Warburg Institute Surveys, 6 (London: University of Lon-

don Press, 1975), A. Mark Smith, "Getting the Big Picture in Perspectivist Optics," *Isis* 72 (1981): 568-589), and A. Mark Smith, "Picturing the Mind: The Representation of Thought in the Middle Ages and Renaissance," *Philosophical Topics* 20 (1992): 149-170. For an informative terminological analysis of this model and its relationship to Alhacen, see the section entitled "The Psychological Apparatus" in Sabra, *Optics*, vol. 2, pp. 62-67.

¹³³*De placitis*, 7, 3.21, in De Lacy, p. 445; I have changed the punctuation slightly in order to make the passage syntactically clearer.

¹³⁴See, esp. Wolfson, "The Internal Senses," for a discussion of such differences.

¹³⁵For a useful account of Hunayn's life and works, see G. C. Anawiti's and A. Z. Iskandar's article, "Hunayn ibn Ishaq" in *Dictionary of Scientific Biography*, ed. C. C. Gillispie, vol. 15, supplement 1 (New York: Charles Scribner's Sons, 1978), pp. 230-249. Along with his son, Ishaq, his nephew, Hubaysh, and a third, nonrelated collaborator, Isa ibn Yahya, Hunayn in fact founded a veritable school of translators at Baghdad.

¹³⁶Edited and translated into English by Max Meyerhof, *The Book of the Ten Treatises on the Eye Ascribed to Hunain ibn Is-haq* (Cairo: 1928).

¹³⁷It bears noting that Hunayn specifies the perceptual and epistemological functions of the pneuma within these ventricles in much the same way as those who articulated the model of faculties discussed above. Thus, as Hunayn puts it, "Through the pneuma which is in the posterior cavity movement and the act of recollection are accomplished, through the pneuma which is in the anterior part of the brain observation and imagination, and through the pneuma which is in the middle part of the brain reflection;" trans. Meyerhof, *The Book of the Ten Treatises*, p. 18.

¹³⁸As is clear from Bruce Eastwood's analysis of the first three treatises, Hunayn departs from Galen in variety of minor ways; for more detail, see Bruce S. Eastwood, *The Elements of Vision: The Micro-Cosmology of Galenic Visual Theory according to Hunayn Ibn Ishaq*, Transactions of the American Philosophical Society, 72.5 (Philadelphia: American Philosophical Society, 1982).

¹³⁹Meyerhof, *The Book of the Ten Treatises*, p. 4. These protective and useful functions are much the same as those described by Galen. For instance, the vitreous humor nourishes the lens while the albuminoid humor protects it from damage by the cornea. The cornea, in turn, serves two purposes: to protect the lens by its hardness and to allow light to reach the lens through its transparency.

¹⁴⁰Meyerhof, *The Book of the Ten Treatises*, p. 4.

¹⁴¹In May, p. 503.

¹⁴²Eastwood, *The Elements of Vision*, pp. 4-5.

¹⁴³See Sabra, *Optics*, vol 2, pp. liv-lx.

¹⁴⁴Hence, when applying ray-geometry to the analysis of vision and visual appearances, Arab thinkers tended to take an extramissionist stance, and this includes such natural philosophers as al-Farabi, who were deeply Aristotelian

in their philosophical sympathies. Avicenna, on the other hand, remained unequivocal in his commitment to intromissionism, as did later key Aristotelians, such as Averroes; see esp. David C. Lindberg, *Theories of Vision from Al-Kindi to Kepler* (Chicago: University of Chicago Press, 1976), pp. 42-57. For a recent study of the early textual transmission of Euclidean Optics in Arabic, see Elaheh Kheirandish, *The Arabic Version of Euclid's Optics* (New York: Springer Verlag, 1999).

¹⁴⁵Roshdi Rashed, "A Pioneer in Anaclastics: Ibn Sahl on Burning Mirrors and Lenses," *Isis* 81 (1990): 464-491; see also Rashed, *Géométrie et dioptrique au X^e siècle: Ibn Sahl, Al-Quhi et Ibn al-Haytham* (Paris: Les Belles Lettres, 1993).

¹⁴⁶Roshdi Rashed, "Futhitos et al-Kindi sur 'l'illusion lunaire,'" in *ΣΟΦΙΗΣ ΜΑΙΗΤΟΡΕΣ* "Chercheurs de sagesse": *Hommage à Jean Pépin* (Paris: Institut d'Études Augustiniennes, 1972).

¹⁴⁷For a Greek text and English translation of Anthemius' work, see G. L. Huxley, *Anthemius of Tralles: A Study in Later Greek Geometry* (Cambridge, MA: Harvard University Press, 1959). In the *Fihrist*, Ibn al-Nadim tells us of a certain Utarid ibn Muhammad, who claims to have used Anthemius' work as the basis for his own; see Sabra, *Optics*, vol. 2, p. xlv. For "Dtrums," see Rashed, "A Pioneer in Anaclastics," p. 468.

¹⁴⁸See Sabra, *Optics*, vol. 2, p. xlv.

¹⁴⁹These two treatises were translated into Latin by Gerard of Cremona. For critical Latin texts, with German translations and commentary, see Axel Björmbom and Sebastian Vogel, ed. and trans., *Alkindi, Tideus und Pseudo-Euklid: Drei optische Werke* (Leipzig: Teubner, 1912).

¹⁵⁰For a recent study of al-Kindi's optical thought and its philosophical foundations, see Pinella Travaglia, *Magic, Causality and Intentionality. The Doctrine of Rays in Al-Kindi*, Micrologus Library, vol. 3. (Florence: Edizioni del Galluzzo, 1999).

¹⁵¹As we have seen on pp. xxix-xxx above, Ptolemy also insisted that visual radiation is absolutely continuous and, on that basis, reduced the ray to a virtual entity. However, since it seems unlikely that al-Kindi availed himself of Ptolemy's *Optics*, the two thinkers must have arrived at this conclusion independently.

¹⁵²According to Sabra, *Optics*, vol. 2, pp. 25-26, Ahmad ibn Isa, who preceded al-Kindi, took essentially the same approach to the problem, accepting "the hypothesis of continuous visual radiation (against Euclid) and [having] the idea that perception of a given point in the visual field was in general effected through all points on an area of the surface of the eye which we may designate as the visually effective area."

¹⁵³That Ibn al-Haytham was familiar with at least some of these sources—e.g., Ahmad ibn Isa and Ibn Sahl—is likely, but whether or how such sources might have had a formative influence on his work is by no means certain.

¹⁵⁴In the dedicatory preface to his *Perspectiva*, Witelo refers to the "tedium of Arabic verbosity" (*tedium verborum arabice*), which is presumably directed at

Alhacen; see Risner, *Opticae thesaurus*, p. 1.

¹⁵⁵For this list, see III, 3.1-3, p. 588 below. Ibn al-Haytham discusses these preconditions much earlier, in book 1, chapter 2 of the Arabic text, but this is one of the three chapters missing in the Latin version (see p. xxiii above).

¹⁵⁶On the distinction between *lux* (essential light) and *lumen* (accidental light), see I, 4.1, note 2 to book 1, p. 395 below. Alhacen's most extensive discussion of light and transparency occurs in book 1, chapter 3 of the Arabic version (see Sabra, *Optics*, vol. 1, pp. 13-51). Although this chapter is missing from the Latin version, there are clues scattered throughout it (see esp. I, 6.1-4, p. 356 below) that make it easy to reconstruct his theory of light-radiation and transparency.

¹⁵⁷Note the similarity between Alhacen's model of indifferent radiation from every point on a luminous surface and al-Kindi's model of indifferent radiation from every point on the corneal surface; see pp. l-lii above.

¹⁵⁸On the punctiform radiation of light from luminous surfaces, see I, 6.1, p. 355 below; on the sphere of propagation, see I, 3.9-19, in Sabra, *Optics*, vol. 1, pp. 15-20; on the virtual status of the mathematical ray, see IV, 3, prop. 16, in Risner, *Opticae thesaurus*, p. 112 (*Omnia linea per quam movetur lux a corpore luminoso ad coprus opposito est linea sensualis, non sine latitudine Observatur ergo in omni luce ratio linearum et punctorum intellectorum, licet ab eis aut per ipsas non procedat lux*).

¹⁵⁹On opacity *per se*, see I, 6.50, p. 371 below; on the distinction between reflective and nonreflective opaque bodies, see IV, 3, prop. 6, in Risner, *Opticae thesaurus*, p. 104; on the relative nature of opacity, see I, 8.10, p. 394 below; on illuminated bodies as light-sources in their own right, see I, 3.88, in Sabra, *Optics*, vol. 1, p. 38; see *ibid.* on secondary (or accidental) vs primary light (see also I, 6.99-104, pp. 382-384 below).

¹⁶⁰Actually, Alhacen never makes it clear whether, on its own, color even has the power to replicate itself through transparent media.

¹⁶¹On the natural concurrence of opacity and color, see I, 8.9-10, pp. 393-394 below; on the nonilluminative nature of color *per se* and the need for light to render it visible, see I, 8.6, p. 392 below; on the natural commingling of color and light, see I, 6.2-3, p. 356 below.

¹⁶²On transparency as the natural capacity to transmit light, see I, 6.4 and 6.50, pp. 356 and 371 below; on the inherent opacity or *spissitudo* of such exquisitely transparent bodies as air, see I, 3.44, in Sabra, *Optics*, p. 29; on the tinging of light by air, see I, 3.45-46, in Sabra, *Optics*, p. 29.

¹⁶³On refractivity in general, see I, 6.18, p. 360 below; for an extensive discussion of the physical cause of refractivity, see also A. Mark Smith, "Extremal Principles in Ancient and Medieval Optics," *Physis* 31 (1994): 113-140, and *Descartes's Theory of Light and Refraction: A Discourse on Method*, Transactions of the American Philosophical Society 77, 3 (Philadelphia: American Philosophical Society, 1987), pp. 32-56.

¹⁶⁴For the dynamic properties of rays and the likening to trajectories, see I, 6.24 and 6.43, pp. 363 and 369 below; see also Smith, "Extremal Principles" and

Descartes's Theory.

¹⁶⁵On the basic function of the eye to be affected by light and color, see I, 6.1, pp. 355-356 below; on afterimage, see I, 4.3-4.7, p. 343 below; on the difficulty in seeing strong colors in weak light, see I, 4.20, p. 346 below; on the failure to see strongly colored transparency in weak light, see I, 4.22, p. 347 below; on the firefly, see I, 4.16, p. 346 below.

¹⁶⁶See pp. lxxxiv-xc above.

¹⁶⁷For the relevant discussions of Aristotle, Ptolemy, Galen, and al-Kindi, see pp. xxvi-xxvii, xxix-xliv, and l-lii above.

¹⁶⁸For Alhacen's actual argument, see I, 6.58-59, pp. 373-374 below.

¹⁶⁹On the hollow optic nerves, see I, 5.2, p. 348 below; on the scleral and uveal tunics, see I, 5.5-6, p. 348 below; on the corneal continuation of the sclera, see I, 5.8 and 5.18, pp. 348 and 350 below; on the pupil, see I, 5.7, p. 348 below.

¹⁷⁰On the glacial sphere and its two humors, glacial and vitreous, see I, 5.9-10, p. 349 below; on the albugineus humor, see I, 5.12, p. 349 below; on the aranea, see I, 5.10 and 7.5, pp. 349 and 388 below.

¹⁷¹On the passage of visual spirit from the brain through the hollow optic nerves, see I, 5.14, pp. 349-350 below; on the role of visual spirit in sensitizing the lens, see I, 7.7, p. 388 below; for Galen's and Hunayn's discussions of *pneuma psychikon* and the essential sensitivity of the lens see pp. xxxix-xl and xlviii above; note also al-Kindi's model of visual radiation from the corneal surface, see pp. l-li above.

¹⁷²On the muscular attachments of the eyeball, see I, 5.38, p. 355 below; on the flexing of the optic nerve at the back of the eyeball, see I, 5.17, p. 350 below.

¹⁷³On the sphericity of the eyeball, see I, 7.15, pp. 389-390 below; on the placement of the glacial sphere and its centerpoint toward the front of the eyeball, see I, 5.9 and 5.10, p. 349 below; on the flattening of the anterior surface of the *glacialis*, see I, 5.10, p. 349 below; on the concentricity of that surface with the corneal surface, see I, 5.29, p. 353 below.

¹⁷⁴On the axial line, see I, 5.23-28, pp. 351-353 below; on the meeting of all orthogonals at the eye's centerpoint, see I, 6.25-26, p. 363 below.

¹⁷⁵Since Hunayn has the lens at the very center of the eye, he does not need to have the cornea bulge outward in order to leave some space between its inner surface and the anterior surface of the lens. On the other hand, Hunayn does not explicitly rule out the possibility of that bulge as Alhacen does; for Hunayn's description of the cornea and its relation to the scleral tunic, see *The Book of the Ten Treatises*, pp. 4 and 9.

¹⁷⁶Cf. pp. xlviii-xlix above.

¹⁷⁷Alhacen sets up this problem in I, 6.12-13, p. 358 below.

¹⁷⁸On the sensitive and refractive selection of orthogonal impressions, see I, 6.14-24, pp. 358-363 below; on the resulting cone of radiation with vertex at the centerpoint of eye, see I, 6.25-28, pp. 363-364 below; on the resulting point-by-point representation on the lens' surface, see I, 6.29-30, pp. 364-365 below; on reasons why no other model will work, see I, 6.31-42, pp. 365-369 below.

¹⁷⁹On the problem of image-reversal, see II, 2.6, p. 419 below.

¹⁸⁰On the necessity that the interface between glacial and vitreous humors lie ahead of the eye's centerpoint, see II, 2.9, p. 420 below; see *ibid.* on the necessity that this interface be less sharply curved than the anterior surface of the lens; on the differing refractivity of glacial and vitreous humors, see II, 2.14, pp. 421-422 below; on visual spirit as the transmittive medium in the optic nerves, see II, 2.17-18, p. 423 below; on the passage of forms to the optic chiasma and their presentation to the final sensor there, see II, 2.23-24, pp. 426-427 below; on the fusion of binocularly perceived forms at the optic chiasma, see III, 2.17, pp. 569-570 below. For Galen's earlier claim that image-fusion occurs at the optic chiasma, see pp. xlii-xliii above.

¹⁸¹On the pain of the initial visual impression at the lens and its normal imperceptibility, see I, 6.67, p. 376 below; on the neurological transmission of this pain to the final sensor, see II, 2.14, pp. 421-422 below; on the double receptivity (refractive and sensitive) of the optic complex, see II, 2.11-16, pp. 421-423 below.

¹⁸²On the nonjudgmental nature of brute sensation, see II, 3.54-56, pp. 443-444 below; for the list of twenty-two visible intentions, see II, 3.44, pp. 438-439 below.

¹⁸³On the faculty of discrimination and its function of differentiating among visible intentions, see II, 3.17, p. 431 below.

¹⁸⁴On the syllogistic nature of discrimination, see II, 3.26-31, pp. 433-434 below; on the process of comparison, or correlation, see II, 4.17, pp. 518-519 below; on the deduction of transparency, see II, 3.13 and 3.195, pp. 430-431 and 502-503 below; on the deduction of corporeity, see II, 3.122, p. 470 below.

¹⁸⁵On the innate capacity to discriminate and deduce, see II, 3.38-39, pp. 436-437 below; on learning through repetition, see II, 3.42, pp. 437-438 below; on the imagination as storehouse of learned and remembered forms, see II, 4.12, pp. 516-517 below.

¹⁸⁶On the distinction between remoteness *per se* and remoteness as distance, see II, 3.68, p. 448 below.

¹⁸⁷II, 3.73, p. 450 below.

¹⁸⁸See II, 3.71, p. 449 below.

¹⁸⁹On determining distance according to bodily measure, see II, 3.151-156, pp. 481-485 below; on the recognition of distances through repetition and recognition, see II, 3.154, pp. 483-484 below; on our tendency to reach such perceptual determinations unconsciously, without being aware of the process through which we reach them, see II, 3.36-41, pp. 435-437 below; on the need for a continuous ordered range of bodies for determining long distance, see II, 3.78-80, pp. 452-453 below; on successive portions of ground serving as such a range, see II, 3.150, p. 481 below; on the fundamental accuracy of resulting determinations, see II, 3.87-89, pp. 455-456 below; on the inaccuracy of mere estimation for vast distances over which there are no definite landmarks, see II, 3.91, p. 456 below.

¹⁹⁰For Alhacen's overall account of size-perception, see II, 3.134-146, pp. 474-479 below; on imagining the visual angle, see II, 3.144, p. 478 below; on the threefold correlation among the relative extent of the portion of the visual field occupied by the object, the size of the imagined visual angle subtended by that portion, and distance, see II, 3.146, p. 479 below.

¹⁹¹On size-perception through repetition and recognition, see II, 3.149, pp. 480-481 below; for the example of viewing our hand against a wall, see II, 3.147, p. 479 below; see also II, 3.136-137, p. 475 below for a clear articulation of the size-distance invariance principle.

¹⁹²Cf. Ptolemy's account of distance- and size-perception on pp. xxxii-xxxiii above; note his inclusion of the object's slant in the determination of size; Alhacen, too, refers to slant, e.g., in II, 3.138-139, pp. 475-476 below.

¹⁹³In "The History of the Theory of Human Proportions as a Reflection of the History of Styles," in *Meaning in the Visual Arts* (Garden City, N.Y.: Doubleday, 1955), Erwin Panofsky claims, to the contrary, that "Alhacen's aesthetics is remarkable, . . . above all, for its pervasive relativism" (p. 90n). Suffice to say, I find this assessment at best misleading, at worst misconceived.

¹⁹⁴On the inherent beauty of lunar light, rose-red, and smoothness, see II, 3.202, 3.203, and 3.215, pp. 504-506 below; on the relational nature of characteristics that confer beauty, see II, 3.222-223, pp. 507-508 below; on the moon's being more beautiful than a star by virtue of size, see II, 3.208, p. 505 below; on the proportionate nature of eye-shape and size, see II, 3.224, p. 508 below; on the ugliness of blue eyes and blond hair, see III, 7.124 in Sabra, *Optics*, vol. 1, pp. 322-323.

¹⁹⁵II, 3.230, p. 509 below.

¹⁹⁶II, 3.227, *idem.*.

¹⁹⁷*Idem.*

¹⁹⁸Despite his emphasis on relation and proportionality as the overarching principle in beauty, Alhacen reveals certain "absolutist" tendencies in his assessment of beauty. Two instances are his claims in I, 7.9 and 7.14, pp. 388-389 below, that the whiteness of the sclera and the doubling of the eyes were specifically designed by the Creator (*operator*) to make the face comely.

¹⁹⁹For some elaboration on this point, see Sabra, *Optics*, vol. 2, pp. 99-100.

²⁰⁰My mistress' eyes are nothing like the sun;/ Coral is far more red than her lips' red;/ If snow be white, why then her breasts are dun;/ If hairs be wires, black wires grow on her head. / I have seen roses damask'd, red and white, / But no such roses see I in her cheeks; / And in some perfumes is there more delight / Than in the breath that from my mistress reeks. / I love to hear her speak, yet well I know / That music hath a far more pleasing sound; / I grant I never saw a goddess go; / My mistress, when she walks, treads on the ground: / And yet, by heaven, I think my love as rare / As any she belied with false compare.

²⁰¹Thus, as Alhacen puts it in II, 3.197, p. 503 below, "Opacity is perceived by sight through the absence of transparency. So when sight perceives a body but senses no transparency in it, it will deduce its opacity."

²⁰²See II, 3.178-186, pp. 496-499 below.

²⁰³See II, 4.1, p. 512 below, on the impossibility of any visible intention's existing alone and on the consequent fact that objects are perceived as a totality of their visible attributes, each of which is perceived in isolation only through analysis; see II, 4.2-4, pp. 512-513 below on the need of close visual scrutiny (*intuitio*) for certification.

²⁰⁴On the increasing weakness of lateral vision within the visual cone, see II, 2.24-25, pp. 427-428 below; on the concerted effort of both eyes to focus the visual axes on a single point, see III, 2.3, p. 563 below. Alhacen explains the weakness of lateral vision on the basis of the refraction of visible spot-forms at the interface between glacial into the vitreous humors: the farther removed those spot-forms are from the axis, the more they are refracted and, consequently, the more they are weakened; see II, 2.25, pp. 427-428 below.

²⁰⁵In the case of monocular vision, according to Alhacen's account in II, 3.102, p. 461 below, "a surface [is said] to face the eye directly when it is perceived by sight straight ahead and when the visual axis touches some point on it so as to form equal [i.e., right] angles with it": moreover, he goes on to say in II, 3.106, pp. 462-463 below, "when the point on the surface or line to which the [visual] axis will be perpendicular is the midpoint of that surface or line, the surface or line will be [in a] perfectly facing [disposition] vis-à-vis the eye (*in fine directe oppositionis visui*)."

In binocular vision, then, an object will have a perfectly facing disposition when the two axes come to focus on the midpoint of the object's surface and, in so doing, form equal angles with that surface; see III, 2.2, p. 563 below.

²⁰⁶See III, 2.12, p. 567 below.

²⁰⁷Note the virtual equivalence between Alhacen's and Ptolemy's conception of the common axis; see pp. xxxiii-xxxiv above.

²⁰⁸On the increasing indefiniteness of vision as the object viewed gets farther from the common axis, see III, 19-20, pp. 570-572 below.

²⁰⁹On the visual scan of cross-sections, see II, 4.8, p. 514 below; on the double impression of part and whole, see II, 4.10, pp. 515-516 below; on committing the resulting form to memory, see II, 4.12, pp. 516-517 below; on making that form more definite and planting it more firmly in memory through rehearsal, see II, 4.13-14, p. 517 below; on memorizing a speech as an analogue, see II, 4.15, pp. 517-518 below.

²¹⁰On assimilation as finding identical notional form, see II, 3.21, p. 432 below.

²¹¹On memorizing unfamiliar attributes or objects, see II, 4.18, pp. 519-520 below; on trying to fit an unfamiliar form into a given niche by assimilating it to notional entities already ensconced in the imagination, see 4.19, pp. 520-521 below.

²¹²On the relative generality and simplicity of the universal form according to the limited set of its defining characteristics, see II, 4.16, p. 518 below; on the individual form as a complex of many specific defining characteristics, see II,

4.23, p. 523 below; on remembering individuals according to ambient circumstances, see II, 4.12, pp. 516-517 below.

²¹³On recognition by “signs” or defining features as a shorthand way of perceiving things, see II, 4.20-22, pp. 521-523 below.

²¹⁴On vision at first glance, with or without recognition, see II, 4.33, p. 528 below; on the indeterminacy or inaccuracy of such vision, even with recognition, see II, 4.32, pp. 527-528 below; on close visual scrutiny with or without recognition, see II, 4.34, pp. 528-529 below.

²¹⁵On the fact that all perception takes time, see II, 3.57, p. 444 below; on the fact that perception with recognition takes less time than perception without recognition, see II, 4.20 and 4.34, pp. 521 and 528-529 below; on the fact that the universal form is perceived before the individual form, see II, 4.23, p. 523 below; on the difficulty of distinguishing between almost identical objects, see II, 4.25, pp. 524-525 below.

²¹⁶There is, however, a fundamental difference between Alhacen’s universal form and Aristotle’s universal in that the former is a compendium of physical attributes alone, whereas the latter somehow indicates essence. Accordingly, the universal form of “human” for Alhacen might simply represent “featherless biped,” while Aristotle’s universal would somehow represent “mortal, rational animal.”

²¹⁷See pp. xlv-xlvii above.

²¹⁸Throughout book 2 of the *De aspectibus*, Alhacen refers various perceptual functions—particularly mnemonic functions—to the soul. Since these functions follow the process of discrimination carried out by the final sensor, and since Alhacen explicitly locates the final sensor in the brain (see note below), it follows that the soul resides in the brain. That being the case, Alhacen seems to conceive of the soul according to its embodiment in the brain, much as al-Kindi, al-Farabi, and their like conceived of it; see p. xlvii above.

²¹⁹On the location of the final sensor at the front of the brain, see I, 6.68, p. 376 below; on the visible form’s presentation to the final sensor at the optic chiasma, see II, 2.4, p. 418 below.

²²⁰Alhacen’s notion of the “impression” or “etching” (*figere*) of forms in the imagination is reminiscent of Aristotle’s seal-and-wax analogy; see p. xxvii above..

²²¹See, e.g., II. 3.25-40, pp. 433-437 below. That Aristotle conceived of seeing as a sort of knowing, and vice-versa, is clear from his insistence that we think through images; for an account of Aristotle’s sense-based epistemology that is slanted toward vision, see Smith, “Picturing the Mind.”

²²²See IV, 1, prop. 1 in Risner, *Opticae thesaurus*, p. 102.

²²³For Alhacen’s discussion of the normative range of these preconditions, see III, 3.6, p. 589 below.

²²⁴For Alhacen’s full supporting discussion of this account of locational correspondence and formal overlap at the optic chiasma, see III, 2.7-8 and III, 2.13-18, pp. 565-566 and 567-568 below.

²²⁵On the relative indeterminacy of vision at a slant, see III, 2.66 and 2.80-85, pp. 583 and 586-588 below; for Alhacen's explanation of that indeterminacy, see III, 2.80, p. 586 below.

²²⁶On the various ways in which the overall continuity of the visual impression is emphasized over its specific discontinuities, see III, 2.7 and 2.19-21, pp. 565-566 and 570-572 below.

²²⁷On image-doubling when the object is placed in front of or behind the intersection of the visual axes, see III, 2.22, pp. 572-573 below; on image-doubling when the object is placed on only one visual axis, see III, 2.23, p. 573 below; although Alhacen does not explicitly state that image-doubling becomes more pronounced with the acuteness of displacement, it is implicit in the experiment he describes in III, 2.34-43, pp. 575-576 below; cf. Ptolemy's analysis of the relationship between displacement and image-doubling on pp. xxxiv-xxxv above

²²⁸For Alhacen's description of the plaque, see III, 2.26-27, p. 573 below; the series of experiments, along with summaries of their results, is described over the remainder of chapter 2 of the third book.

²²⁹On the proportionate nature of the normative range according to all eight preconditions, see III, 3.15-33, pp. 592-593 below.

²³⁰On illusions arising from brute sensation, see III, 5.1-15, pp. 595-596 below. These misperceptions are limited to light and color alone, since they constitute the sole proper object of brute sensation

²³¹On illusions arising from misrecognition, see III, 6.1-31, pp. 597-600 below. These misperceptions are specific to universal or individual forms, since those are recognized according to notional representations in the imagination.

²³²On illusions arising from improper deduction, see III, 7.1-60, pp. 600-609 below. This is by far the longest section of his overall analysis of illusions because deduction is specific to individual visible intentions. Accordingly, for each of the eight skewed preconditions, the effect of that skew must be illustrated for each of the twenty-two visible intentions.

²³³Note, however, that Alhacen's categorization of illusions is based on the relative "immediacy" or simplicity of the perception, brute sensation being simplest and most immediate, recognition being less immediate but still relatively simple because of its basis in signs and comprehensive notional forms, and deduction or discrimination being least immediate because of its basis in close visual scrutiny.

²³⁴See, e.g., Sabra's discussion in *Optics*, vol. 2, pp. 106-111.

²³⁵All of the remarks in this concluding section apply to the original Arabic version, not just its Latin counterpart—hence the continuing reference to "Ibn al-Haytham" rather than "Alhacen."

²³⁶Hunayn, of course, is of the Arabic intermediaries upon whom Alhacen may have drawn. What others, if any, Alhacen consulted is an open question. Hunayn himself mentions several factions in his own day who were split over the number of tunics composing the eye (from seven down to two), but he gives no names; see *The Book of the Ten Treatises*, pp. 10-11. It does seem likely

that Alhacen was arguing from authority rather than from direct experience in his account of the eye; see I, 5.2, 5.14, 5.39, and 6.14, pp. 348, 349-350, 355, and 358-359 below.

²³⁷See A. Mark Smith, "Alhazen's Debt to Ptolemy's *Optics*," in T. H. Levere and W. R. Shea, eds., *Nature, Experiment, and the Sciences* (Dordrecht: Kluwer, 1990), pp. 147-164.

²³⁸That the vertex of the cone still serves as the ultimate reference-point for distance-perception in Alhacen's theory is evident in his explanation for why objects seen from too close appear larger than they should; see III, 7.25, pp. 605-606 below.

²³⁹For a broad survey of this translation-movement and a representative sample of the texts involved, see David C. Lindberg, "The Transmission of Greek and Arabic Learning," in David C. Lindberg, ed., *Science in the Middle Ages* (Chicago: Chicago University Press, 1978), pp. 52-90.

²⁴⁰Aristotle's *De sensu* was first translated from Greek into Latin by an as-yet-unknown translator. Euclid's *Optics* appeared in three different versions during the twelfth century, one of them from the Greek (version 1), the other two from Arabic. Gerard of Cremona is probably responsible for one of the versions (version 2) drawn from the Arabic. Euclid's *Catoptrics* was probably translated from the Arabic by the same person who produced version 3 of the *Optics*. Ptolemy's *Optics* was rendered into Latin by the Emir Eugene of Sicily. The earlier translation of Aristotle's *De anima* (from the Arabic) was translated by James of Venice. For details on these translations, see Sarton, *Introduction*, vol. 2.1, p. 340; Wilfred Theisen, "The Mediaeval Tradition of Euclid's *Optics* (PhD dissertation, Madison: University of Wisconsin, 1974); Ken'ichi Takahashi, *The Medieval Latin Traditions of Euclid's Catoptrica* (Fukuoku: Kyushu University Press, 1992); and Smith, *Ptolemy's Theory*.

²⁴¹Al-Kindi's *De intellectu* was translated into Latin by John of Seville (or perhaps Gerard of Cremona), his *De aspectibus* by Gerard of Cremona, and his *De radiis* by an as-yet-unknown translator. Al-Farabi's *De ortu scientiarum* first appeared in Latin at the hand of John of Seville, although it was later rendered into Latin by Gerard of Cremona. Hunayn ibn Ishaq's *De intellectu et intellecto* was translated by Gerard of Cremona, his *Ten Treatises* about a century earlier by Constantine the African. Gerard of Cremona was also responsible for Latin versions of Razes' *Liber ad Almansorem* and Avicenna's *Canon*. The portion of Avicenna's *Al-Shifa* on the soul was perhaps translated by Domenicus Gundissalinus, although it cannot be definitively ascribed to him. Al-Ghazali's *De ortu scientiarum* was translated by both John of Seville and Gerard of Cremona. The earlier translation of Aristotle's *De anima* (from the Greek) was made by James of Venice (fl. c. 1145). For discussions of these translations, see Sarton, *Introduction*, vol. 2.1, pp. 171-172, 325, 340, and 342, and vol. 2.2, pp. 579-580; Simone Van Riet, *Avicenna Latinus: Liber de anima seu sextus de naturalibus*, I-II-III (Leiden: E. J. Brill, 1972), pp. 91*-105*; M-Th. d'Alverny and F. Hudry, "Al-Kindi, De radiis," *Archives d'histoire doctrinale et littéraire du moyen âge* 41 (1974): 139-260.

²⁴²Grosseteste wrote several works dealing with light and its various manifestations, but the *De luce* ("On Light") stands as the best example of his commitment to light-metaphysics; for an English translation of this work, see Clare C. Riedl, *Robert Grosseteste on Light* (Milwaukee, 1942). As "Christianized" by Augustine, the tradition of light metaphysics is based upon the idea that we cannot achieve true knowledge without the aid of Christ's divine light. The sources for the development of this tradition to the time of Grosseteste are manifold, including not only pagan Greek and Christian sources, but also such Arabic sources as al-Kindi's *De radiis* and the *Fons vitae* of Avicenna (Ibn Gabirol). For a brief account of the development of this tradition and its implications for optics, see Lindberg, *Roger Bacon's Philosophy*, pp. xxxv-liii. See also Lindberg, "The Genesis of Kepler's Theory of Light: Light Metaphysics from Plotinus to Kepler," *Osiris* 2 (1986): 5-42.

²⁴³See Lindberg, *Roger Bacon's Philosophy*, pp. xxxiii-xxxv. Aside from Alhacen's *De aspectibus*, a sampling of Lindberg's sampling includes Seneca, Cicero, Pliny, Boethius, Aristotle (nine treatises), Avicenna (six treatises), Averroes (six treatises), Ptolemy's *Optics*, the Pseudo-Aristotelian *Liber de causis*, Thabit ibn Qurra, al-Battani, al-Kindi, and al-Farabi.

²⁴⁴For what has become the canonical account of this development, see Lindberg, *Theories of Vision*. Since Lindberg has provided most of the important narrative details there, I will not repeat them at length in the discussion that follows.

²⁴⁵For details, see Lindberg, *Roger Bacon and the Origins*, pp. cii-cv.

²⁴⁶For details, see Lindberg, *Roger Bacon's Philosophy of Nature*, pp. lxxv-lxxviii.

²⁴⁷For details, see Unguru, *Witelonis Perspectivae Liber Secundus et Liber Tertius*, pp. 32-36, and Smith, *Witelonis Perspectivae Liber Quintus*, pp. 72-76.

²⁴⁸For details, see David C. Lindberg, *A Catalogue of Medieval and Renaissance Optical Manuscripts* (Toronto: Pontifical Institute of Mediaeval Studies, 1975), pp. 68-71. See also Lindberg, *Roger Bacon and the Origins*, p. xcvi.

²⁴⁹See Lindberg, *Catalogue*, p. 71. For a more detailed description, see Lindberg, *John Pecham and the Science of Optics*, pp. 52-57.

²⁵⁰See Smith, *Witelonis*, p. 76.

²⁵¹See Lindberg, *Roger Bacon and the Origins*, p. cv, and *Roger Bacon's Philosophy of Nature*, p. lxxviii.

²⁵²See Lindberg, *Roger Bacon and the Origins*, p. xcvi. That Perspectivist optics was commonly studied in late-fourteenth-century England is suggested by Chaucer's mention of Alhacen and Witelo in a brief passage on "perspective" in the *Canterbury Tales* (lines 225-234 of the "Squire's Tale"): And somme of hem wondred on the mirour, / That born was up into the maister-tour, / Hou men myghte in it swiche thynges se. / Another answerde, and seyde it myghte wel be / Naturelly, by composiciouns / Of anglis and of slye reflexiouns, / And seyde that in rome was swich oon. / They speken of alocen and vitulon, / And aristotle, that writen in hir lyves / Of queynte mirours and of perspectives.

²⁵³See Lindberg, *Catalogue*, pp. 22-36.

²⁵⁴See pp. cvi and cxi above for further discussion on these two figures.

²⁵⁵For a brief discussion of Maurolyco, see pp. xci-xcii above. For a more extensive discussion of both Maurolyco and Porta as optical thinkers, see David C. Lindberg, "Optics in Sixteenth-Century Italy," in *Novità celesti e crisi del sapere*, supplement to *Annali dell'Istituto e Museo di Storia della Scienza* fasc. 2 (1983): 131-148.

²⁵⁶For Lindberg's account of Kepler, see *Theories of Vision*, pp. 185-208.

²⁵⁷*Theories of Vision*, p. 208. See also Lindberg "Continuity and discontinuity in the history of optics: Kepler and the medieval tradition," *History and Technology* 4 (1987): 431-448.

²⁵⁸Cf., however, my discussion on pp. c-ci above.

²⁵⁹Perhaps the most obvious problem with Descartes's demonstration is that it depends upon the supposition that light travels faster in optically denser media than it does in optically rarer one. This assumption flies in the face of Descartes's earlier assertion that light is transmitted instantaneously.

²⁶⁰For this argument and its justification, see Smith, *Descartes's Theory of Refraction*. For the primary counter-argument, which has been repeated at several reprises—most recently in Stephen Gaukroger, *Descartes: an intellectual biography* (Oxford: Clarendon Press, 1995)—see Gaston Milhaud, *Descartes savant* (Paris: Librairie Félix Alcan, 1921).

²⁶¹See, e.g., *Perspectiva* III.3,1-4, in Lindberg, *Roger Bacon and the Origins*, pp. 321-335. Bacon also stresses the practical utility of optics, a proper knowledge of which will allow us to extend and improve physical vision through reflection and refraction. In fact, eyeglasses first appeared within some thirty years of the writing of the *Perspectiva*, and they were in common use by the later Renaissance. During the Renaissance, as well, concave spherical mirrors were used as reading glasses for close work in reading, writing, and illumination.

²⁶²As Lindberg points out in *Roger Bacon's Philosophy*, p. liv, al-Kindi's *De radiis stellarum*, a treatise on the radiation of astrological influences, was instrumental to Bacon's conception of power and its radiation.

²⁶³On the relationship between passive and active power, see *De multiplicatione specierum*, I, 3, in Lindberg, *Roger Bacon's Philosophy*, pp. 44-49. See d'Alverny and Hudry, "Al-Kindi, De radiis" for a detailed discussion of the *De radiis* and its dissemination in the Latin West.

²⁶⁴For the distinction between *lux* and *lumen*, see *De multiplicatione specierum*, I, 1, in Lindberg, *Roger Bacon's Philosophy*, pp. 2-5. For Bacon's description of species-multiplication, see *De multiplicatione specierum*, II, 1, in Lindberg, *Roger Bacon's Philosophy*, pp. 90-95. For a good analysis of Bacon's doctrine of species-multiplications, see Lindberg, *Roger Bacon's Philosophy*, pp. liv-lxiii; see also Smith, "Getting the Big Picture," pp. 578-580. Bacon's conception of multiplication as a spot-by-spot passage through the medium led him to propose that light-radiation takes time rather than occurring instantaneously—a proposal that set him apart from all of his later Perspectivist confreres; see David C. Lindberg, "Medieval Latin Theories of the Speed of Light," in René Taton, ed.,

Roemer et la vitesse de la lumière (Paris: Vrin, 1978).

²⁶⁵See *Perspectiva*, I, 2.2-I, 6.1, in Lindberg, *Roger Bacon and the Origins*, pp. 2-74. Bacon disagrees with Alhacen over the location of the final sensor, placing it at the optic chiasma itself rather than in the forepart of the brain.

²⁶⁶For Bacon's discussion of the three levels of visual perception, see *Perspectiva*, I, 10.3 and II, 3.1-9, in Lindberg, *Roger Bacon and the Origins*, pp. 154-159 and 194-251. In *Perspectiva*, I, 10.3, Bacon describes the universal form as a sort of "diffuse particular" (*particulare vagum*), which "is as common as its universal and is convertible with it" (p. 157).

²⁶⁷Bacon's almost-boundless admiration for Avicenna is summed up in his remark in *Perspectiva*, I, 1.3 that "Avicenna was the perfect imitator and expositor of Aristotle and the commander and prince of philosophy after him" (Lindberg, *Roger Bacon and the Origins*, p. 17).

²⁶⁸For Bacon's discussion of the perceptual faculties and their locations in the brain, see *Perspectiva*, I, 1.2-5, in Lindberg, *Roger Bacon and the Origins*, pp. 4-21.

²⁶⁹*Ibid.*, p. 9.

²⁷⁰See *Perspectiva*, I, 1.4, in Lindberg, *Roger Bacon's Philosophy*, pp. 12-17. The example of a sheep perceiving the wolf's malignant intentions is drawn from Avicenna, who uses it to show how we can perceive things that are *per se* imperceptible; see *Liber de anima*, I, 5, in Van Riet, *Avicenna Latinus, I-II-III*, p. 86.

²⁷¹See pp. lxi-lxiv and lxviii-lxxii above.

²⁷²For an account of how Ibn al-Haytham (but not necessarily Alhacen) might have understood "form" (= *sura* in Arabic), see A. I. Sabra, "Form in Ibn al-Haytham's Theory of Vision"; see also Sabra's account in *Optics*, vol. 2, pp. 68-70.

²⁷³See *De multiplicatione specierum* I, 1, in Lindberg, *Roger Bacon's Philosophy*, p. 5.

²⁷⁴*Ibid.*, p. 43.

²⁷⁵To underline this point, Bacon insists that, contrary to the claims of some philosophers, species are not spiritual; they must have material or corporeal existence; see, e.g., *Perspectiva*, I, 6.4, in Lindberg, *Roger Bacon and the Origins*, pp. 86-89.

²⁷⁶See *De multiplicatione specierum*, I, 3, in Lindberg, *Roger Bacon's Philosophy*, pp. 47-49.

²⁷⁷For a useful discussion of the meaning of "intention" (= *ma'na* in Arabic) as used by various Arabic thinkers, including Avicenna, see Sabra, *Optics*, vol. 2, pp. 70-73.

²⁷⁸It should be pointed out that, in its intentional state, the species is not an object of perception. Only when it is realized in the appropriate faculty does it manifest its intentions in such a way that what is actually perceived is the object that it intends. In a sense, then, the faculty actually "becomes" the object intended by the species. Hence, when I perceive Martin, I perceive Martin himself, not his depiction in the species, so the species *per se* does not intervene

between me, as perceiver, and the object as perceived.

²⁷⁹On the problem of correspondence, see Smith, "Getting the Big Picture" and "Picturing the Mind."

²⁸⁰The sophistication of Alhacen's treatment of reflection is evident in his solution of what came to be called "Alhazen's Problem," which was posed thus by Christiaan Huygens in 1669: "Given a spherical convex or concave mirror, and given a centerpoint of sight and a point on a visible object, to find the point of reflection on the mirror's surface." Isaac Barrow, an exceptional mathematician for his day, also dealt with this problem in his *Lectiones opticae* of 1669. Both Huygens and Barrow solved the problem algebraically, whereas Alhacen's solution is strictly geometrical and depends in part upon the properties of hyperbolic sections—a fact that led Barrow to complain about its untoward length and tediousness. For an analysis of Alhacen's approach to the problem, see A. I. Sabra, "Ibn al-Haytham's Lemmas for Solving 'Alhazen's Problem,'" *Archives for History of Exact Sciences* 26 (1982): 299-324.

²⁸¹For a brief discussion of Grosseteste, see Lindberg, *Roger Bacon and the Origins*, pp. xxxvii-xl. Albertus Magnus (c. 1200-1280) also drew upon Euclid's *Optics* and al-Kindi's *De aspectibus* for his knowledge of mathematical optics, although, unlike Grosseteste, he also drew upon Alhacen's *De aspectibus*. However, while Grosseteste was led by his sources to favor the extramissionist theory of sight, Albertus opposed that theory because of his deep Aristotelian sympathies; see Cemil Akdogan, *Albert's Refutation of the Extramission Theory of Vision and His Defence of the Intramission Theory* (Kuala Lumpur: International Institute of Islamic Thought and Civilization, 1998).

²⁸²Just how unsophisticated Grosseteste's ray-analysis was is evident from his half-angle rule of refraction. According to that rule, the angle of refraction is half the angle of incidence; for details, see Bruce S. Eastwood, "Grosseteste's 'Quantitative' Law of Refraction: A Chapter in the History of Non-Experimental Science," *Journal of the History of Ideas* 28 (1967): 403-414. That Grosseteste probably never read Ptolemy's *Optics* goes a long way toward explaining his relative ineptitude at ray-analysis. For a list of Grosseteste's optical works and their manuscript-traditions, see Lindberg, *Catalogue*, pp. 57-62.

²⁸³See *Perspectiva*, I, 7.2, in Lindberg, *Roger Bacon and the Origins*, p. 101: "... Ptolemy, in his *Book of Optics*, ... presented this science [i.e., *perspectiva*] before Alhacen—a science that Alhacen took from Ptolemy and expounded."

²⁸⁴According to Lindberg's count, Euclid's *Optics*, which was transmitted in several different versions, including a fifteenth-century Italian translation, is represented by 44 manuscripts; Euclid's *Catoptrics* exists in 52 manuscripts; Ptolemy's *Optics* survives in 15 manuscripts; Pseudo-Euclid's *De speculis* exists in 18 manuscripts; Tideus' *De speculis* survives in 15 manuscripts; and al-Kindi's *De aspectibus* is represented by 14 manuscripts. For details, see Lindberg, *Catalogue*, pp. 21-22, 46-56, and 76-77.

²⁸⁵Euclid's *Catoptrica* was published in 1504 on the basis of a Renaissance translation drawn from the Greek text; see Lindberg, *Catalogue*, p. 55. For details on the contemplated publication of Ptolemy's *Optics*, see Smith, *Ptolemy's Theory*,

p. 9.

²⁸⁶Cf., however, Gérard Simon, *Le regard, l'être et l'apparence dans l'Optique de l'Antiquité* (Paris: Seuil, 1988). Simon points out quite rightly that the direction of radiation can make some subtle, but fundamental difference, in how optical phenomena are construed.

²⁸⁷Only the first third or so of the work published in 1611 under the title *Photismi de lumine* comprises the *Photismi* itself; the remainder of the book comprises three short treatises on refraction, the last of these dealing with the eye. This latter treatise was completed in 1554, some 33 years after the *Photismi* itself. Maurolyco himself claims solid grounding in Perspectivist optics on the basis of reading the treatises of Bacon and Pecham: *Quod et in expositionem perspectivae tam Rogerij Bacchonis, quam Io. Petsan feceramus* (*Photismi*, p. 73).

²⁸⁸For Maurolyco's full analysis of the problem, see *ibid.*, pp. 73-80.

²⁸⁹*Ibid.*, pp. 76-77.

²⁹⁰The Latin texts upon which these three English passages are based read as follows: [1] *Radii visuales ad coincidentiam properantes, minime proveniunt ad remotiora dispicienda* (*Photismi*, p. 77); [2] *Expansiores radii ad longius spectandum feruntur, concursu iam protelato* (*Photismi*, p. 77); [3] *Item concauis conspiciliis breuem obtutum extendi, atque conuexis longum breuiari; quoniam scilicet illis collecti dilatantur, his vero dilatati colliguntur radii* (*Photismi*, p. 79)

²⁹¹For further discussion of this point within the broader context of medieval lens-theory, see Smith, "Ptolemy, Alhazen, and Kepler and the Problem of Optical Images," *Arabic Sciences and Philosophy* 8 (1998): 9-44.

²⁹²"The Sidereal Messenger," trans. Albert Van Helden, *Sidereus Nuncius or The Sidereal Messenger* (Chicago: University of Chicago Press, 1989), pp. 38-39 see also p. 50. At the end of this brief explanation, Galileo promises to "publish a complete theory" at some later occasion, a promise he never fulfills.

²⁹³Galileo's competence in optics is evident from his brief *Theorica speculi concaui sphaerici* in Antonio Favaro, ed., *Le opere di Galileo Galilei*, vol 3.2 (Florence: Barbèra, 1907), p. 869. This treatise is in fact copied from an original by Ausonius; for details see Sven Dupré, "Mathematical Instruments and the 'Theory of the Concave Spherical Mirror': Galileo's Optics beyond Art and Science," *Nuncius: Annali di storia della scienza* 15 (2000): 551-588.

²⁹⁴See Mario Biagioli, *Galileo Courtier* (Chicago: University of Chicago Press, 1993) for a lengthy discussion of the critical importance of reputation to Galileo in his lifelong search for preferment and patronage. For further discussion of the implications of Galileo's discussion of the telescope, see A. Mark Smith, "Practice vs theory: the background to Galileo's telescopic work," *Atti della Fondazione Giorgio Ronchi* 56 (2001): 149-162.

²⁹⁵See p. lvii above.

²⁹⁶Another example of this tendency to compartmentalize is the continuing, albeit uneasy, coexistence of the Aristotelian model of cosmology, which is based on homocentric spheres, and the Ptolemaic model of astronomy, which is based on eccentrics, equants, and epicycles. For a brief discussion of the acceptance

of Hunayn's model of the eye among medical thinkers of the Middle Ages and Renaissance—including Andreas Vesalius—see Smith, "Problem of Optical Images."

²⁹⁷For a discussion of Renaissance instrumentalism and some possible causes for it, see Smith, "Knowing Things Inside Out: The Scientific Revolution from a Medieval Perspective," *The American Historical Review* 95 (1990): 726-744; see also pp. xcvi-xcix above for some amplification of this point. There is good reason to believe that, at least as far as cosmology is concerned, Galileo was anything but an instrumentalist, and that, to the contrary, he was convinced of the absolute truth of the Copernican model and the absolute falsity of the Aristotelian/Ptolemaic alternative. Hence, if Galileo's explanation of the telescope was truly instrumentalist, then either he was disingenuous in offering it, or he had yet to be convinced that human reason is capable of true understanding.

²⁹⁸For a detailed explanation and justification of this schema, see Lindberg, *Theories of Vision*, pp. 143-146.

²⁹⁹*Ibid.*, pp. 122-132.

³⁰⁰*Ibid.*, pp. 132-139.

³⁰¹*Ibid.*, pp. 139-142.

³⁰²See Richard Newhauser, "Der 'Tractatus moralis de oculo' des Petrus von Limoges und seine *exempla*," in Walter Haug und Burghard Wachinger, eds., *Exempel und Exempel-sammlungen* (Tübingen: Max Niemeyer Verlag, 1991), pp. 95-136.

³⁰³For a more detailed discussion of these and other visual analogies used by Peter, see Dallas Denery, "Seeing and Being Seen: Vision, Visual Analogy and Visual Error in Late Medieval Optics, Theology and Religious Life" (PhD dissertation, Berkeley: University of California, 1999).

³⁰⁴See Heather Phillips, "John Wyclif and the Optics of the Eucharist," in Anne Hudson and Michael Wilks, eds., *From Ockham to Wyclif* (Basil Blackwell, 1987), pp. 245-258. The account that follows is based upon her discussion.

³⁰⁵See Phillips, "John Wyclif," p. 249. Alhacen's analysis of the distortions these seven types of mirror can create is to be found in book 6 of the *De aspectibus*.

³⁰⁶See pp. lxxxviii-lxxxix above.

³⁰⁷See note 266, p. cxliv above.

³⁰⁸For an excellent summary account, see Richard C. Dales, *The Problem of the Rational Soul in the Thirteenth Century* (Leiden: E. J. Brill, 1995).

³⁰⁹According to the Augustinian tradition, the Christian believer can "see" the universal Truth of the particular data of sense-induction by means of Christ's divine light. Christ therefore teaches us the Truth by showing it to us. Within the Aristotelian tradition as mediated by the likes of Avicenna and Averroes, our ability to realize the truth of what we abstract from sensible particulars depends upon a generalized Agent Intellect that gives us the true Universal. Thus, it is only through access to this grand repository of forms that we are able to achieve actual knowledge. Moreover, in this case, belief is irrelevant, since we all have the potential to know and can have this potential fulfilled by cooperat-

ing with the Agent Intellect. The conflation of these two positions during the first half of the thirteenth century resulted in what Etienne Gilson called "Avicennizing Augustinianism" in his classic study, "Les sources Gréco-Arabes de l'Augustinisme Avicennisant," *Archives d'histoire doctrinale et littéraire du moyen âge* 4 (1929): 5-149.

³¹⁰If the Agent or Active Intellect is common to, yet transcends the individual, potential intellect, then the personal soul, insofar as it is immortal, cannot carry with it the knowledge gained in life, since that knowledge can only be actualized in and by the Agent Intellect. Or, to put it another way, the immortality of our intellective souls is common rather than personal and individual. Along with several other problematic positions (e.g., the eternity of the world), the doctrine of a higher, common intellect was ultimately anathematized in the Condemnations of 1277, after which both the doctrine of divine illumination and that of the Agent Intellect fell out of favor; for a thumbnail sketch, see John F. Wippel, "The condemnations of 1270 and 1277 at Paris," *The Journal of Medieval and Renaissance Studies* 7 (1977): 169-201.

³¹¹For an admirably comprehensive, nuanced, and lucid account of this undertaking during roughly the first half of the fourteenth century—i.e., from the time of Duns Scotus (d. 1309) and Peter Aureol (d. 1322) to the final condemnation of Nicholas of Autrecourt in 1347—see Katherine Tachau, *Vision and Certitude in the Age of Ockham: Optics, Epistemology and the Foundations of Semantics, 1250-1345* (Leiden: E. J. Brill, 1988). Among several important points Tachau makes in this study is that Ockham was far less influential as a source for the epistemological critique of the fourteenth century than has generally been supposed. For a more recent study that covers much the same ground in a more cursory way, but with a sharper theological focus, see Denery, "Seeing and Being Seen," esp. pp. 133-219.

³¹²See pp. lxiv-lxvi above.

³¹³Nicholas of Autrecourt, for example, suggests a particle-theory of light-transmission based on atomism, but he does not attempt to develop a detailed account on the basis of that suggestion; see Tachau, *Vision and Certitude*, pp. 349-350.

³¹⁴See, for example, Denery, "Seeing and Being Seen," pp. 196-200; see also pp. 21-220.

³¹⁵See Tachau, *Vision and Certitude*, pp. 353-383.

³¹⁶This instrumentalist view of hypothesis is clearly grounded in the notion of probability discussed just above. Accordingly, a given hypothesis is deemed probable not because it is assumed to reflect how things actually are but because it effectively describes how things appear to be.

³¹⁷See, e.g., Étienne Gilson, *Reason and Revelation in the Middle Ages* (New York: Scribner's, 1938); Armand Maurer, *Medieval Philosophy* (New York: Random House, 1962); and Gordon Leff, *The Dissolution of the Medieval Outlook: An Essay on Intellectual and Spiritual Change in the Fourteenth Century* (New York: New York University Press, 1976).

³¹⁸See, e.g., E. A. Moody, "Empiricism and Metaphysics in Medieval Philosophy," *Philosophical Review* 67 (1958: 145-163); William A. Wallace, *Causality and Scientific Explanation*, vol. 1 (Ann Arbor: University of Michigan Press, 1972); and Edward Grant, *Much Ado about Nothing: Theories of Space and Vacuum from the Middle Ages to the Scientific Revolution* (Cambridge/New York: Cambridge University Press, 1981) and *The Foundations of Modern Science in the Middle Ages* (Cambridge: Cambridge University Press, 1996).

³¹⁹See, e.g., Anneliese Maier, *Die Vorläufer Galileis im 14. Jahrhundert: Studien zur Naturphilosophie der Spätscholastik*, 2nd ed. (Rome: Edizioni di storia e letteratura, 1966); for a useful overview of Maier's work, see Steven D. Sarjent, ed. and trans., *On the Threshold of Exact Science* (Philadelphia: University of Pennsylvania Press, 1982). See also Marshall Clagett, *The Science of Mechanics in the Middle Ages* (Madison: University of Wisconsin Press, 1959), and Edward Grant, *In Defense of the Earth's Centrality and Immobility: Scholastic Reaction to Copernicanism in the Seventeenth Century* (Philadelphia: American Philosophical Society, 1984).

³²⁰Particularly telling in this regard is Maurolyco's agreement that the anterior surface of the crystalline lens "accepts species and, having received them, passes them through the optic nerve to the common sense for its judgment" *Photismi*, p. 70.

³²¹See p. lxxxiv above.

³²²Idem.

³²³It is worth noting that the image formed on the retina is a real, physical image and that, in recognition of this fact, Kepler calls it a "depiction" (*pictura*). On the other hand, the image formed at the anterior surface of the lens is virtual, not real, and therefore a quasi-psychological rather than a physical construct. Hence, Kepler's account of image-formation allows no room for the succession of abstractions from visible, through sensible, to intelligible species that provides the basis for the Perspectivist account of sense-cognition.

³²⁴For the actual loci of these quotations, see Smith, *Descartes's Theory of Light and Refraction*, pp. 14 and 45.

³²⁵Descartes analyzed the physical universe according to three kinds of elemental particles that were distinguished from one another by size and shape. The smallest particles, infinitesimal in size, composed what he called Fire. Air consisted of larger, but still quite small, particles that were perfectly spherical. Earth, finally, consisted of even larger, crasser particles of various shapes. As a whole, these particles formed a plenum through perfect contiguity.

³²⁶For a more complete and detailed description of Descartes's theory of light, see Smith, *Descartes's Theory of Light and Refraction*, pp. 13-19.

³²⁷Over the course of several years after publication of the *Dioptrique*, Descartes attempted in various ways to explain how, according to his mechanistic model of sight, we are able to gain a proper impression of the spatial properties of things. Surely the most notorious of these attempts was his effort to explain the problem away on the basis of the pineal gland and its mediating role be-

tween pure physical sensation and cognition. For a useful account of these attempts (and their ultimate failure), see Celia Wolf-Devine, *Descartes on Seeing: Epistemology and Visual Perception* (Carbondale and Edwardsville, Ill.: Southern Illinois University Press, 1993).

³²⁸Giotto and Michelangelo provide only the roughest limits to this development. The tendency toward naturalism in Renaissance art, at least in Italy, is discernible in the thirteenth century, and artists continued to paint naturalistically well after the death of Michelangelo.

³²⁹Another striking example of such image-distortion is Parmigianino's self-portrait of 1524, which reflects quite self-consciously the distorted view he had of himself in a convex mirror.

³³⁰For an especially clear photographic resolution of this anamorphic distortion, see Susan Foister, Ashok Roy, and Martin Wyld, *Holbein's Ambassadors: Making and Meaning* (London: National Gallery Publications, 1997), pp. 90-96.

³³¹See Robert Gibbs, *Tomaso da Modena: Painting in Emilia and the March of Treviso, 1340-80* (Cambridge: Cambridge University Press, 1989), p. 85. That such reading mirrors were in common use well into the sixteenth century is evident from Giovanbattista Palatino's description of 1540: "The [concave] mirror is used to save the sight and to assist it in continuous steady writing. It is much better of glass than of steel," trans. Henry K. Pierce, *The Instruments of Writing* (Newport, RI: Berry Hill Press, 1953).

³³²For elaboration, see Vincent Ilardi, "Renaissance Florence: The Optical Capital of the World," *The Journal of European Economic History* 22 (1993): 507-541.

³³³"I remember" Maurolyco mentions in an aside to his discussion of lenses, "that in times past the makers of glasses were so diligent that they advertised with small marks inscribed [somewhere on the glasses] the age, according to the number of years, to which the glasses were properly suited," *Photismi*, p. 79.

³³⁴*The Heritage of Giotto's Geometry: Art and Science on the Eve of the Scientific Revolution* (Ithaca: Cornell University Press, 1991), pp. 47-87.

³³⁵See, e.g., Leon Battista Alberti's account of chiaroscuro in the second book of the *Della pittura*, trans. John R. Spencer, *Leon Battista Alberti On Painting* (1956; rev. ed. New Haven: Yale University Press, 1966), pp. 81-83.

³³⁶As Alberti puts it in the prologue to *Della pittura*, "I used to marvel and at the same time grieve that so many excellent and superior arts and sciences from our most vigorous antique past could now seem lacking and almost wholly lost. We know from [remaining] works and through references to them that they were once widespread. Painters, sculptors, architects, musicians, geometricians, rhetoricians, seers and similar noble and amazing intellects are rarely found today and there are few to praise them. Thus I believed, as many said, that Nature . . . no longer produced either geniuses or giants which in her more youthful and more glorious days she had produced so marvellously and abundantly," Spencer, *On Painting*, p. 39; see also pp. 63-67.

³³⁷That classical painters and architects were convinced, at least to some

extent, that a knowledge of optics is useful for their craft is evident from Vitruvius' claim, in the first chapter of book I of *De architectura*, that the architect should be well versed in all the liberal arts, including optics; see esp. I, 1.4 and 16 in Frank Granger, trans., *Vitruvius: De architectura, Books I-V* (Cambridge, Mass.: Harvard University Press, 1931), pp. 9 and 21.

³³⁸See, e.g., J. Playfair McMurrich, *Leonardo da Vinci, the Anatomist (1452-1519)* (Baltimore: Williams & Wilkins, 1930). The same desire to understand the workings of nature that inspired Leonardo's anatomical research is evident in Alberti's observation that "before dressing a man we first draw him nude, then we enfold him in draperies. So in painting the nude we place first his bones and muscles which we then cover with flesh so that it is not difficult to understand where each muscle is beneath," Spencer, *On painting*, p. 73.

³³⁹For full documentation, see Graziella Vescovini, "Alhazen Vulgarisé: Le *De li aspecti* d'un manuscrit du Vatican (moitié du XIVe siècle) et le troisième commentaire sur l'optique de Lorenzo Ghiberti," *Arabic Sciences and Philosophy* 8 (1998): 67-96.

³⁴⁰Leonardo's Italian version of the prologue to Pecham's *Perspectiva communis* can be found in Jean Paul Richter, ed., *The Literary Works of Leonardo da Vinci* (London/New York: Oxford University Press, 1939), p. 117. Among the three citations of Witelo ("Vitulone") in the above collection, one includes Leonardo's observation that "In Vitulone sono 805 conclusioni in prospettiva" (ibid., vol. 2, p. 377; see also pp. 348 and 361). For Leonardo's ruminations on optics and its relationship to linear perspective, see ibid., vol. 1, pp. 127-161. Unlike Alberti (see pp. cvii-cviii above), Leonardo explicitly rejects the visual-ray model in favor of the visible radiation model, so his analysis of sight is based throughout on the cone of radiation described by Alhacen and his Perspectivist followers.

³⁴¹Bruce S. Eastwood, "Alhazen, Leonardo, and Late-Medieval Speculation on the Inversion of Images in the Eye," *Annals of Science* 43 (1986): 413-446.

³⁴²For a good thumbnail sketch of Leonardo's optical ideas, see Lindberg, *Theories of Vision*, pp. 154-168.

³⁴³Manetti, *Vita di Brunelleschi*, ed. and trans., Howard Saalman and Catherine Enggass, *The Life of Brunelleschi by Antonio di Tuccio Manetti* (University Park: Pennsylvania State Press, 1970), p. 42. Saalman and Enggass offer a tentative date of around 1482 for the composition of Manetti's *Vita*.

³⁴⁴For the relevant passages in Manetti upon which these reconstructions are based, see ibid., pp. 42-46.

³⁴⁵See Spencer, *On Painting*, pp. 39-40. The Latin version of this treatise, *De pictura*, was probably composed in 1435.

³⁴⁶Ibid., p. 56

³⁴⁷Ibid., p. 58.

³⁴⁸For the full narrative from which this description of Alberti's projection-technique is derived, see ibid., pp. 56-58. For a diagrammatic exposition, see pp. 110-112.

³⁴⁹See *ibid.*, pp. 45-48.

³⁵⁰*Ibid.*, p. 46.

³⁵¹*Ibid.*, p. 47.

³⁵²See, e.g., Graziella Vescovini, *Studi sulla prospettiva medievale* (Torino: Università di Torino, 1965) and Samuel Edgerton, *The Renaissance Rediscovery of Linear Perspective* (New York: Basic Books, 1975).

³⁵³C. D. Brownson, "Euclid's Optics and its Compatibility with Linear Perspective," *Archive for History of Exact Sciences* 24 (1981): 165-194.

³⁵⁴See Martin Kemp, *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat* (New Haven: Yale University Press, 1990). Brunelleschi, of course, was responsible for the design and construction of the dome to Florence's cathedral. That he was not alone among Renaissance artists in combining the skills of painting and engineering is clear. Leonardo, for instance, is notorious for his machine-designs, and Albrecht Dürer (d. 1528) was deeply interested in what constituted higher mathematics (i.e., the study of conic sections) in his day. For a good, standard survey of the relationship between art and engineering in the Renaissance, see Bertrand Gille, *Engineers of the Renaissance* (Cambridge, Mass.: M.I.T. Press, 1966).

³⁵⁵To understand the play and light of shadow properly requires an understanding of how light is projected from its source. If we take that source to be a point, then the projected light forms a "cone" of radiation whose vertex lies at the source and whose base is formed on whatever surface the light shines upon. Thus, the cone of light-projection can be analyzed according to the same mathematical rules as the cone of vision in linear perspective.

³⁵⁶The Latin text of this quotation, which is reproduced in facsimile in William M. Ivins, *On the Rationalization of Sight* (New York: Da Capo, 1973), reads as follows: *Etenim (quod philosophicis speculationibus perspectum est) omnes res videntur tanquam per lineas ab oculo egredientes: scilicet per triangulum. Cuius basis est res visa: eiusque diameter super partes ipsius rei vise discurrit. Sed lux ab oculo non egreditur: verum ex lucis exterioris splendore in oculum cadente, fit reflexio quasi a speculo ignito: per quam forme rerum concipiuntur.* Viator's reference to a "triangle," rather than to a cone, formed by the visual rays echoes Alberti's description in the first book of *Della pittura*: "It is said that vision makes a triangle. The base of [this triangle] is the quantity seen and the sides are those rays which are extended from the quantity to the eye," Spencer, *On Painting*, p. 47.

³⁵⁷Edgerton, *Heritage*, p. 93.

³⁵⁸For the full argument, see *ibid.*, pp. 91-107.

³⁵⁹Summers, *The Judgment of Sense: Renaissance Naturalism and the Rise of Aesthetics* (Cambridge: Cambridge University Press, 1987).

³⁶⁰The source of this interpretation is Panofsky's seminal *Idea* of 1924.

³⁶¹*Judgment of Sense*, p. 2.

³⁶²*Idem.*

³⁶³See esp. chaps. 1, 2, 5, and 8.

³⁶⁴*Judgment of Sense*, p. 316.

³⁶⁵Quoted in *ibid.*, p. 319.

³⁶⁶See *ibid.*, pp. 170-177.

³⁶⁷*Ibid.*, p. 176.

³⁶⁸See, e.g., Steven Straker, "The Eye Made 'Other': Dürer, Kepler, and the Mechanisation of Light and Vision," *The University of Calgary Studies in History* 1 (1976): 7-25; Edgerton, *Heritage*, esp. pp. 108-289; and Mary G. Winkler and Albert Van Helden, "Representing the Heavens: Galileo and Visual Astronomy," *Isis* 83 (1992): 195-217.

³⁶⁹*The New York Times Magazine*, Sunday, April 18, 1999, pp. 80-83

³⁷⁰*De aspectibus*, I, 6.61, p. 374 below.

³⁷¹For a description and explanation of this instrument, see Saleh Omar, *Ibn al-Haytham's Optics: A Study of the Origins of Experimental Science* (Minneapolis: Bibliotheca Islamica, 1977).

³⁷²To be original is not necessarily to be "revolutionary." Conversely, to be "revolutionary" is not necessarily to be original. Copernicus' heliocentric hypothesis is a good case in point; many thinkers before him had entertained the possibility—purely hypothetical in most cases—that the earth moves. In the case of Ibn al-Haytham, however, there is a tendency among some scholars to conflate "original" and "revolutionary," and my response to that conflation is in no way based upon an acceptance of its validity.

³⁷³The notion of scientific "revolution" has its origins in political thought, where revolution is understood in terms of overturning—a particular governmental system being entirely overthrown in favor of another. The classic account is to be found in Crane Brinton's *The Anatomy of Revolution* (1938; rev. ed. New York: Random House, 1965), where Brinton provides a morphology of political revolution according to preconditions, triggers, revolution, and aftermath. In the context of this model, a scientific revolution would follow the same morphology, the result being the overthrow and replacement of an old theoretical system (e.g., Ptolemaic cosmology) by an entirely new one (i.e., Copernican cosmology). The alternative model provided by T. S. Kuhn in *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962) characterizes scientific revolution in terms not of overturning but of a gestalt-shift that results in an entirely different way of looking at the same phenomena. Such a gestalt-shift is the result of "crisis" arising from the inability of current theory to resolve various anomalies. According to Kuhn, then, the process of revolution is less psychologically or socially disruptive than it is according to Brinton. Neither model seems applicable to Ibn al-Haytham. On the one hand, he did not so much overturn as perfect earlier theory. On the other, his account of vision does not entail a gestalt-shift insofar as the terms of his analysis are essentially the same as those of his classical forebears.

³⁷⁴Smith, "Getting the Big Picture."

³⁷⁵For instance, Descartes's and Hooke's erroneous supposition that color is a modification of white light was instrumental in the development of Newton's

counter-theory that white light is a composite of all colors. Likewise, Dufay's two-fluid theory of electricity (vitreous and resinous) was instrumental as the foil against which Franklin responded in developing his one-fluid counter-theory.

MANUSCRIPTS AND EDITING

The manuscripts: At present twenty-two manuscripts containing all or part of Alhacen's *De aspectibus* are known to exist. Of these twenty-two, seventeen are either complete or almost so. In addition, there exist two other versions of the treatise: a fourteenth-century Italian translation represented in one manuscript and Friedrich Risner's printed edition of 1572. Altogether, then, at least twenty-four versions of the *De aspectibus* are extant in one form or another. They are given in the following list,¹ along with relevant sigla and descriptions. I have subdivided the list into four categories for the sake of later discussion and analysis.

PRIMARY MANUSCRIPTS

1. *E* Edinburgh, Royal Observatory, Crawford Library: MS Cr3.3, ff 2r-186r—thirteenth century.

Written on parchment, this manuscript contains copious inter-linear and marginal corrections in a second hand that belongs to a certain Guido de Grana, author of the colophon rendered below. It also includes copious summary glosses in a third hand, as well as a variety of diagrams that themselves represent glosses of a sort. The incipit / title attributes the treatise to "Alacen filii alhaycen." Ibn Mu'adh's *De crepusculis* is appended at the end without attribution in the original text, although a marginal attribution to Ibn Mu'adh is provided by the aforementioned Guido de Grana: *Liber de nubium ascensione cuius verus titulus est iste: Incipit liber abomadhi malfagar, id est de crepusculo matutino et vespertino et ssafac; verba eius: Ostendere quid sit crepusculum.* Dated 1269, the colophon reads as follows: *Ego magister Guido dictus de Grana correxi diligenter istos duos libros, scilicet perspectivam alhacen et librum de ascensionibus nubium, iuxta exemplar magistri Iohannis Lundoniensis quod ipsemet diligenter correxit ut dicitur. Completa fuit correctio horum librorum anno domini m.cc.lx. nono. quinto ydus maii, scilicet in vigilia penthecostes.* This manuscript is very closely related to the manuscript listed in entry 6 below. Catalogue reference: N. R. Ker, *Medieval Manuscripts in British Libraries*, vol. 2

(Oxford: Clarendon Press, 1977), pp. 559-60.

2. **C1** Cambridge, Trinity College: MS 0.5.30, ff. 1r-165r—thirteenth century.

Written on parchment in double-column format, this manuscript has suffered considerable water-damage. Indeed, the first fifteen folios are so permeated by rot as to be mostly unreadable, and subsequent portions are extremely difficult to decipher because of the ink's being partially washed off. The explicit reads: *Explicit liber hacen filii hucaym filii haycen de aspectibus*. Catalogue reference: M. R. James, *The Western Manuscripts in the Library of Trinity College Cambridge: A Descriptive Catalogue*, vol. 3 (Cambridge: Cambridge University Press, 1902), pp. 330-331.

3. **Er** Erfurt, Wissenschaftliche Bibliothek: MS Ampl F.392, ff. 1r-143v—late thirteenth century.

Written on parchment in double-column format, this manuscript contains a fair number of interlinear and marginal corrections in the original hand as well as in a second hand. Catalogue reference: *Beschreibendes Verzeichniss der Amplonianischen Handschriften-Sammlung zu Erfurt* (Berlin: Weidemannsche Buchhandlung, 1887), p. 275.

4. **L3** London, Royal College of Physicians: MS 383, ff. 1r-132r—thirteenth century.

Written on parchment in double-column format, this manuscript lacks all of the first book to paragraph 107 of the sixth chapter (see p. 384 of the critical Latin text below), that portion probably corresponding to the first 12-folio signature. The incipit to book 4 attributes the treatise to *Hacen filii Hucam filli Haicen*. Catalogue reference: N. R. Ker, *Medieval Manuscripts in British Libraries*, vol. 1 (Oxford: Clarendon Press, 1969), pp. 211-212.

5. **P1** Paris, Bibliothèque Nationale: MS Lat 7247, ff. 1r-107v—fourteenth century.

Written on parchment, this manuscript contains version 1 of chapter 3 of book 3 (see below, pp. clxi and clxviii-clxix). At the top of the first folio the title "ALHACEN PERSPECTIVA" has

been added in a much later hand. The explicit reads: *Explicit liber septimus Alhacen*. Catalogue reference: *Catalogus codicum manuscriptorum bibliothecae regiae*, vol. 4 (Paris: 1744), p. 331.

6. **P3** Paris, Bibliothèque Nationale: MS Lat 7319, ff 1r-340v—late thirteenth / fourteenth century.

Written on parchment, this manuscript is either a direct copy, or a copy from a close intermediate version, of the Edinburgh manuscript in entry 1, p. clv above. Not only does it contain the same glosses, but it has at least one marginal notation in a hand that is much like that of Guido de Grana, the primary corrector of *E* (see entry 1 above). It also contains most of the diagrams in *E*. Like *E*, this manuscript has an incipit ascribing the treatise to *Alhacen filii Alhaycen*, and it includes Ibn Mu'adh's *De crepusculis* at the end, without attribution in the original but with a marginal ascription that reads as follows: *Incipit liber de ascensionibus nubium. Verus titulus est iste: incipit liber abomadhi malfagar, id est de crepusculo matutino et vespertino et ssaphac; verba eius: Ostendere etc.* Catalogue reference: *Catalogus codicum manuscriptorum bibliothecae regiae*, vol. 4 (Paris: 1744), p. 386.

7. **S** Saint-Omer, Bibliothèque Municipale: MS 605, ff 1r-153v—fourteenth century.

Written on parchment in double-column format, this manuscript probably originates from the famous local abbey of St. Bertin. It contains a fair number of interlinear and marginal corrections, most of them in a second hand. Along with version 1 of the third chapter of book 3 (see below, pp. clxi and clxviii-clxix), this manuscript also includes Ibn Mu'adh's *De crepusculis* at the end without attribution but with the following introductory explicit / incipit: *Explicit liber hacen filii hucayn filii haycen De aspectibus. Incipit liber de ascensionibus nubium ? hoc modo.* Catalogue reference: *Catalogue générale des manuscrits des bibliothèques publiques des départements*, old series, vol. 3 (Paris: 1861), p. 265.

SECONDARY MANUSCRIPTS

8. **F** Florence, Biblioteca Nazionale Centrale: MS II.III.324, ff 1r-136v—fifteenth century.

Written on parchment in double-column format, this manuscript includes version 1 of the third chapter of book 3 (see below, pp. clxi and clxviii-clxix). However, it lacks all of book 1 up to the first paragraph of chapter 7 (see p. 355 of the critical Latin text below). It also lacks most of book 2, the missing portion extending from paragraph 25 of chapter 2 to paragraph 205 of chapter 3 (see pp. 427-505 of the critical Latin text below). In addition, it lacks the final part of chapter 7 of the seventh book. Catalogue reference: G. Mazzatinti, *Inventari dei manoscritti delle biblioteche d'Italia*, vol. 10 (Florence: Forli, 1900), p. 38.

9. **O** Oxford, Corpus Christi College: MS 150, ff. 1r-112r—thirteenth century.

Written on parchment, this manuscript contains version 1 of the third chapter of book 3 (see below, pp. clxi and clxviii-clxix). Aside from numerous corrections, it contains a series of interpolations and misplaced sections between ff 42r and 47v. Catalogue reference: Henry O. Coxe, *Catalogus codicum manuscriptorum qui in collegiis aulisque Oxoniensibus hodie adservantur*, part 2 (Oxford, 1852), p. 59.

10. **Va** Vatican, Biblioteca Apostolica: MS Palat Lat 1355, ff 1r-147r—thirteenth century?

Written on parchment in double-column format and containing numerous interlinear and marginal corrections in a later hand, this manuscript contains version 1 of chapter 3 of book 3 (see below, pp. clxi and clxviii-clxix). It also contains Ibn Mu'adh's *De crepusculis*, which is appended to Alhacen's treatise without any explicit attribution. The explicit reads: *Explicit liber achen filii hucaym filii aycen de aspectibus*.

11. **V2** Brugge, Stedelijke Openbare Biblioteek: MS 512, ff 1r-113v—thirteenth century.

Written on parchment, this manuscript contains version 1 of the third chapter of book 3 (see below, pp. clxi and clxviii-clxix). It opens with the following inscription in a hand other than that of the primary scribe: *sermo libri achen filii hucayn filli alhacen de aspectibus, et est tractatus primus, et sunt in toto libro septem tractatus*. Written in the original hand, its explicit reads: *Explicit liber achen*

filiu hucaym filii aycen de aspectibus. Catalogue reference: L'Abbé A. de Poorter, ed., *Catalogue des manuscrits de la bibliothèque de la ville de Bruges*, vol. 2 (Paris: Société d'Édition Les Belles Lettres, 1934), p. 512.

TERTIARY MANUSCRIPTS

12. **C2** Cambridge, University Library: MS Peterhouse 209, ff 1r-111v—fourteenth century.

Written on parchment, this manuscript contains Ibn Mu'adh's *De crepusculis*, which is appended to Alhacen's treatise without any explicit attribution. It attributes the treatise to *Alhacen filii Alhachen* at the beginning of book 6, chapter 7. Catalogue reference: M. R. James, *A Descriptive Catalogue of the Manuscripts in the Library of Peterhouse* (Cambridge: Cambridge University Press, 1899), p. 251.

13. **L1** London, British Library: MS Royal 12.G.7, ff 1r-102v—fourteenth century.

Written on parchment in double-column format, this manuscript contains Ibn Mu'adh's *De crepusculis*, which is appended to Alhacen's treatise without any attribution. The explicit at the end of the seventh book reads: *Explicit liber de aspectibus*. The explicit at the end of Ibn Mu'adh's treatise reads: *Explicit Alacen in scientia perspectiva*. This manuscript is undoubtedly the source of the Italian translation described below in entry 18. Catalogue reference: George F. Werner and Julius P. Gilson, eds., *Catalogue of Western Manuscripts in the Old Royal and King's Collection*, vol. 2 (1921), p. 72.

14. **L2** London, British Library: MS Sloane 306, ff. 14-177v—fourteenth century.

Written on parchment. Catalogue reference: *Catalogus librorum manuscriptorum Bibliothecae Sloanianae* (unpublished), p. 48.

15. **M** Munich, Bayerische Staatsbibliothek: MS CLM 10269, ff. 1r-160r—fourteenth century.

Written on parchment. The explicit reads: *Explicit liber hacen filii*

huchaym filii haicen de aspectibus. Catalogue reference: Karl Halm and Wilhelm Meyer, *Catalogus codicum latinorum bibliothecae regiae Monacensis*, vol. 1, fasc. 2 (Munich: 1874).

16. **P2** Paris, Bibliothèque Nationale: MS Lat. 16199, ff 1r-277v--sixteenth century.

Written on paper in a cursive hand, this manuscript contains Ibn Mu'adh's *De crepusculis*, which is appended to Alhacen's treatise as book eight but without any explicit attribution. The incipit reads: *Incipit primus tractatus alhacen filli alhazen de aspectibus, et 7 sunt differentie*. Catalogue reference: Léopold Delisle, *Inventaire des manuscrits de la Sorbonne conservés à la bibliothèque impériale sous les numéros 15176-16718 du fonds latins* (Paris: 1870), p. 46.

17. **V1** Vienna, Österreichische Nationalbibliothek: MS 5322, ff 1r-270r—fifteenth century.

Written on paper in a cursive hand, this manuscript contains Ibn Mu'adh's *De crepusculis*, which is appended to Alhacen's treatise without any explicit attribution. The incipit of the treatise reads as follows: *Perspectiva Alacen liber primus*. The explicit to book 1 reads: *Explicit primus liber Alacen de aspectibus*. Catalogue reference: *Tabulae codicum manu scriptorum praeter graecis et orientales in Bibliotheca Palatine Vindobonensis asservatorum*, vol. 4 (Vienna: 1870), p. 102.

OTHER VERSIONS

18. **I** Vatican, Biblioteca Apostolica: MS Lat. 4595, 1r-177v—fourteenth century.

Written on parchment, this Italian translation of the *De aspectibus* contains Ibn Mu'adh's *De crepusculis*, which is appended to Alhacen's treatise without any explicit attribution. Its Latin source is the manuscript listed under entry 13 above.² This translation was used by Lorenzo Ghiberti in the framing of his three commentaries on art and vision, particularly the *commentario terzo*.³

19. **R** Friedrich Risner, *Opticae thesaurus: Alhazeni arabis libri septem, . . . eiusdem liber de crepusculis et nubium ascensionibus. Item Vitellonis*

Thuringopoloni libri X (Basel, 1572).

The first printed edition of the *De aspectibus*, this book includes an edition of Witelo's *Perspectiva*, which was heavily dependent upon Alhacen's treatise. This constitutes a genuine edition, not simply another version, insofar as Risner took pains to "modernize" the Latin in terms of grammatical structure, vocabulary, and spelling. In addition, he imported his own structure into the text, breaking it up into theorems and adding his own enunciations. As the title indicates, Risner's edition includes Ibn Mu'ahd's *De crepusculis*, ascribing it to Alhacen, or "Alhazen" in his rendering.⁴

FRAGMENTARY TEXTS

20. Cracow, Bibl. Jagiellonska: MS 569, pp. 247-50.
21. Erfurt, Wissenschaftliche Bibl.: MS Amp. Q.23, ff. 72r-74v
22. Milan, Bibl. Ambrosiana: MS S.100 sup., ff. 4(1)r-8(5)v.
23. Rome, Bibl. Angelica: MS 76, ff. 25r-25v.
24. Vienna, Österreichische Nationalbibl.: MS 2438, ff 144r-147r.

Selection-Procedures: In an effort to pare the list of twenty-two Latin manuscripts down to manageable proportions, I started by excluding the five fragmentary versions, none of which extends beyond a few folios in length. I then fell back upon two basic strategies to cull the remaining seventeen manuscripts. The first strategy involved a comparison of those manuscripts on the basis of gross structural features. A variety of connections came to light through this analysis, but four in particular stand out.

(1) Seven of the manuscripts—*E*, *P3*, *S*, *C2*, *L1*, *P2*, and *V1* (entries 1, 6, 7, 12, 13, 16, and 17)—have Ibn Mu'adh's brief *De crepusculis et nubium ascensionibus* appended to book 7 of the *De aspectibus*.⁵ With only two exceptions (*E* and *P3* [entries 1 and 6]), this work is treated as an integral part of the *De aspectibus*. Indeed, one manuscript (entry 16) includes it explicitly as book eight.

(2) Six of the manuscripts—*P1*, *S*, *F*, *O*, *Va*, and *V2* (entries 5, 7, 8, 9, 10, and 11)—contain two versions of the third chapter of book 3, both versions of this chapter clearly related yet quite distinct.

(3) Four of the manuscripts—*E*, *P3*, *P2*, and *V1* (entries 1, 6, 16, and 17) share numerous glosses and diagrams that are found in none of the remaining versions. *E* and *P3* are especially close in this regard, so close that *P3* must have been copied directly from *E* or from a very near intermediate version.

(4) A comparative examination of the internal structure (i.e., chapters and subsections) for all seventeen manuscripts, as well as for the Risner edition (*R* in entry 19), indicates clear and close links among *E*, *P3*, *P2*, and *R* (entries 1, 6, 16, and 19). Likewise, this comparison suggests a fairly close relationship among *Va*, *P1*, *F*, *V2*, and *S* (entries 10, 5, 8, 11, and 7), as well as among *C1*, *L3*, *Er*, and *M* (entries 2, 4, 3, and 15)⁶ As we will see later on, these groupings are corroborated by detailed textual similarities.

As far as overlap among these three groupings is concerned, entries 1, 6, and 7 are particularly salient, the first two because they contain Ibn Mu'adh's treatise and are closely related through glosses and marginal diagrams, the third because it contains Ibn Mu'adh's treatise as well as version 1 of the third chapter of book 3. Less salient, but nonetheless discernible, is the overlap among the three manuscript-groups (1, 6, 16, 19), (5, 7, 8, 10, 11), and (2, 3, 4, and 15) on the basis of internal structure.

My second strategy entailed a close comparison of textual similarities among manuscripts—sixteen in this case, because *P3* (entry 6) was unknown to me at the time.⁷ The methodological path I followed was essentially the one blazed by Joseph Mogenet nearly five decades ago in his critical edition of Autolycus of Pithane's two treatises on spherical geometry.⁸ At the heart of this methodology is a comparative analysis of shared variants among manuscripts according to nine variant-types. Each of these variant-types is weighted according to the probability of its occurring by chance in more than one manuscript.⁹ For instance, the likelihood that two or more independent scribes would omit the very same phrase by accident or whim is extremely low, as is the likelihood that the two would add the very same phrase by accident or whim. On the other hand, the probability of accidental transpositions (e.g., from "corpus album" to "album corpus") or transformations (e.g., from "punctus" [masc.] to "punctum" [neut.]) is relatively high, no matter how punctilious the scribe. Hence, the omission or addition of a phrase is far more significant than the transposition of a word-couple or the transformation of a single word. The following list gives the nine variant-types ranged in order of relative significance from top to bottom:

1. Omission of a phrase (two or more words)
2. Insertion of a phrase (two or more words)
3. Repetition of a phrase (two or more words)
4. Omission of a single word
5. Insertion of a single word
6. Repetition of a single word
7. Substitution of obviously dissimilar words
8. Transposition
9. Transformation

In order to refine these categories even further, I included corrections, such as the retransposition of an inverted word-couple or the erasure of an added phrase, as partial variants within each type.

For the purposes of overall comparison, I chose *O* (entry 9) as my base-text. In order to make the comparison as broad as possible, I took fifteen textual slices, ranging in size from one to five folios, at relatively equal intervals throughout the 112-folio extent of *O*.¹⁰ Altogether, I selected nearly forty percent of the entire text in order to establish a representatively broad basis for comparison. Then, with the relevant portions of *O* transcribed, I made parallel transcriptions from the fifteen remaining manuscripts so as to establish a complete line-by-line, word-by-word compilation of the full set of fifteen textual slices for all sixteen manuscripts.

On the basis of these parallel transcriptions, I was then able to tabulate variants. By "variant" I meant any reading, repetition, or omission shared by fewer than half the texts. I made no judgment about the correctness or incorrectness of the given reading; I simply treated each variant as a shared trait. The greater the number of these shared traits, the more closely related the manuscripts sharing them should be.

Precisely how this analysis works is illustrated in Table 1 on the following page. It provides a tabulation of shared variants for the fourth textual slice (34r-37r), with *F* as the standard against which the remaining fifteen manuscripts are compared.

TABLE 1

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|---|------|------|-----|------|-----|--------------|
| F | | 1.0 | | | 2.0 | 1.0 | | 1.0 | 23.0 |
| O | 1.0 | | | 4.0 | | | 1.0 | 1.0 | 50.0 |
| E | | 1.0 | | 1.0 | 1.5 | | 3.0 | 1.0 | 36.5 |
| L1 | | | | 1.0 | 0.5 | | 2.0 | | 17.5 |
| L2 | 1.0 | 1.0 | | 2.0 | 6.5 | | 3.5 | 4.0 | <u>95.5</u> |
| L3 | | 1.0 | | | | | | 2.0 | 10.0 |
| C1 | | 1.0 | | | | | | 1.0 | 16.0 |
| C2 | | | | | 2.0 | | 1.0 | 3.5 | 16.5 |
| P1 | 3.0 | 4.0 | | 10.0 | 13.5 | | 10.0 | 7.0 | <u>267.0</u> |
| P2 | | | | | 1.0 | | 2.0 | 8.0 | 19.0 |
| M | | | | | 2.0 | | 1.0 | 8.5 | 21.5 |
| V1 | | 1.0 | | | | | | 4.0 | 12.0 |
| V2 | 3.0 | 2.0 | | 10.5 | 1.5 | | 7.0 | 7.0 | <u>246.0</u> |
| Er | | | | | 1.0 | | | 5.0 | 10.0 |
| Va | 3.0 | 2.0 | | 7.5 | 14.5 | | 11.0 | 9.0 | <u>249.5</u> |
| S | 2.0 | 1.0 | | 4.0 | 8.5 | | 7.5 | 2.0 | <u>146.0</u> |

The top row in the table lists the variant-types by number, from 1 (most significant) to 9 (least significant). The leftmost column lists the manuscripts by sigla, from *F* to *S*. For every manuscript, the number of times each variant-type occurs is tabulated in the appropriate column. The variants listed for *F* are unshared and therefore idiosyncratic. For the remaining manuscripts, however, the listed variants are all shared with *F*.

To illustrate, let us start with *F* itself. According to the tabulations listed from left to right, *F* has added 1 phrase (col. 2), inserted 2 single words (col. 5), repeated 1 single word (col. 6), and transformed 1 word (col. 9)—all of these occurrences being unique to *F*. As we have already established, omitting a phrase is far more significant than transforming a word. How much more? For the sake of convenience, I chose to rank significance in simple arithmetical order. Accordingly, I adjudged omission of a phrase to be nine times as significant as a mere word-transformation; addition of a phrase eight times as significant; repetition of a phrase seven times as significant; and so on down the line. So weighted, a phrase-omission counts for nine points, a phrase-addition for 8, a phrase-repetition for 7, and so forth. Meantime, any correction counts for half a full variant, so that, for example, an inserted phrase that is then erased counts for four points. Accordingly, the overall score for *F* in terms of idiosyncratic variants is as follows: $1 \times 8 + 5 \times 2 + 4 \times 1 + 1 \times 1 = 23$. Using the same algorithm, we can compute the score for the remaining fifteen manuscripts from *O* to *S*, each score indicating that

manuscript's relative affinity with *F*. In other words, the higher the score, the more (or more important) variants shared overall and therefore the greater the presumed affinity.

The main pitfall of this method is its apparent (and specious) precision. There is, in fact, no demonstrable reason to suppose that a phrase-omission is exactly, or even approximately, nine times as significant as a word-transformation. Such multipliers indicate nothing more than *relative* significance among variant-types. The final score should therefore be interpreted as a rough gauge, not a precise measure, of how closely related each manuscript is to *F*. Furthermore, if, as is probable, any of the sixteen manuscripts involved was produced according to *pecia*, whatever conclusions we may draw on the basis of such a statistical analysis will be tentative at best.¹¹

Bearing these points in mind, what are we to make of Table 1? First and most obvious is that *P1*, *V2*, and *Va* outstrip all the other manuscripts by a wide margin. Presumably, then, they have a significantly greater affinity with *F* than any of the other manuscripts. On that basis, they, along with *F*, can be taken to form a distinct family, which we will call Family I. Second, although they lag behind *P1*, *V2*, and *Va* in their overall scores, *L2* and *S* nonetheless show a markedly greater affinity for *F* than do the ten remaining manuscripts. We should therefore include *L2* and *S* within the *P1-V2-Va-F* family group, but not as core members.

TABLE 2

| | | | | | | | |
|-----------|--------------------|-----------|--------------------|-----------|--------------------|-----------|--------------------|
| F | 154 | P1 | 1689 | Va | 1261 | V2 | 2038 |
| O | 581 | O | 582 | O | 441 | O | 464 |
| E | 185 | E | 374 | E | 274 | E | 593 |
| L1 | 207 | L1 | 335 | L1 | 401 | L1 | 687 |
| L2 | <u>967</u> | L2 | <u>1095</u> | L2 | <u>1049</u> | L2 | <u>851</u> |
| L3 | 130 | L3 | 169 | L3 | 191 | L3 | 319 |
| C1 | 202 | C1 | 179 | C1 | 226 | C1 | 276 |
| C2 | 163 | C2 | 265 | C2 | 281 | C2 | 394 |
| P1 | <u>2263</u> | P2 | 330 | P1 | <u>2440</u> | P1 | <u>1809</u> |
| P2 | 222 | M | 376 | P2 | 386 | P2 | 558 |
| M | 350 | F | <u>2263</u> | M | 338 | M | 425 |
| V1 | 233 | V1 | 384 | F | <u>2159</u> | F | <u>1476</u> |
| V2 | <u>1476</u> | V2 | <u>1809</u> | V1 | 394 | V1 | 527 |
| Er | 256 | Er | 261 | V2 | <u>2467</u> | Er | 284 |
| Va | <u>2159</u> | Va | <u>2440</u> | Er | 332 | Va | <u>2467</u> |
| S | <u>753</u> | S | <u>879</u> | S | <u>1028</u> | S | <u>946</u> |

Following the same procedure for each manuscript in turn, then for each textual slice in turn, we add the totals from all fifteen slices to arrive at a grand total for each manuscript.¹² Comparing the same four manuscripts—i.e., *P1*, *V2*, *Va*, and *F*—on the basis of this comprehensive tabulation, we get the following results as listed in Table 2 on the previous page.

Not surprisingly, this final tabulation bears out the two main conclusions drawn from Table 1: namely, that *P1*, *V2*, *Va* and *F* form a core family-group and that *L2* and *S* belong to that group as somewhat distant members. However, within the core family-group, *P1* and *Va* show a greater affinity for *F* than does *V2*. *F*, *P1*, and *Va*, in short, form the inner core of that core family-group. Being most closely related among each other, then, these three manuscripts should be most closely related to the family-progenitor, *V2* being somewhat more distant, *L2* and *S* being most distant.

So far, then, we have isolated the three manuscripts that lie closest, as a group, to Family I's progenitor. To determine which particular manuscript within that group lies closest, however, we need to look at idiosyncratic variants. Briefly put, idiosyncratic variants provide some indication of the relative distance of a given manuscript from a common source. All things being equal, the more idiosyncratic variants a manuscript has, the farther it should lie from the common source.¹³ Applying this general rule to the case in point, we see from table 2 that *F* has a far lower score for idiosyncratic variants (154) than *P1* and *Va*. In fact, this extraordinary dearth of idiosyncratic variants suggests not only that *F* lies closest to Family I's progenitor, but that it lies very close indeed.¹⁴ By the same token, *Va* would seem to lie somewhat closer than *P1*, although in terms of shared variants, *P1* would seem to lie marginally closer to *F* (and thus to Family I's progenitor) than *Va*. *Va* also shows a greater affinity for *F*'s more distant relative, *V2*, than does *P1*. Overall, then, *P1* would seem to be slightly closer to the family progenitor than *Va*..

Using the same technique, I was able to break the ten remaining manuscripts into two groups: Family II, consisting of *C1*, *Er*, *O*, and *M* (entries 2, 3, 9, and 15), and Family III, consisting of *E*, *L3*, *C2*, *L1*, *P2*, and *V1* (entries 1, 4, 12, 13, 16, and 17). Family II is fairly cohesive, *Er* being perhaps somewhat closer to the family-progenitor than *O*, *M* lying farther from it but not by much, and *C1* lying farthest. Family III, on the other hand, is as diffuse as Family II is tightly knit. Its core comprises *E*, *P2*, and *L1*, with *E* lying closest to the family-progenitor. Considerably more distant from that progenitor than the three core-manu-

scripts are *V1* and *C2*, and more distant yet is *L3*. Meantime, although I have put it in Family II, *C1* shows an almost equivalent affinity with Family III so that it stands virtually equipoised between the two. *C1* therefore forms a bridge, albeit a relatively narrow one, between the Families II and III. Likewise, *S* forms a bridge of sorts between Family I and Family II.¹⁵

Having isolated these three families as well as having evaluated the relationships not only among their individual members, but also among the family-groups themselves, I was in a position to choose the appropriate manuscripts for collation in the critical text. Obviously, all three families had to be represented by appropriate exemplars. Logic dictates that these be the manuscripts most closely related to their respective family-progenitors. On that basis, *F*, *Er*, and *E* emerged as clear choices. But in this case *F* had to be rejected because it lacks so much of the relevant text: i.e., virtually all of book 1 and most of book 2. I therefore substituted *P1* for it.¹⁶ Along with these three core manuscripts, I included *S*, *L3*, and *C1* because of their status as bridges, *S* linking Families I and II, *C1* and *L3* linking Families II and III. Finally, having discovered *P3* too late to include it in my comparative analysis, I added it to the list in order to be on the safe side. Altogether, then, I selected seven manuscripts for collation: *P1*, *S*, *E*, *Er*, *C1*, *L3*, and *P3*. They are listed as "primary manuscripts" on pp. clv-clvii above.

This choice of manuscripts makes sense according to a comparison not only of detailed textual features but also of gross structural features. For one thing, *E*, *C1*, and *S* belong to the group of seven manuscripts that have integrated Ibn Mu'adh's *De crepusculis* into the *De aspectibus*. For another, *P1* and *S* belong to the group of six manuscripts that contain both versions of the third chapter of book 3. As it turns out, this is a critical point, but more on that later. Finally, as is manifest from its description in entry 6 above, *P3* is clearly derivative from *E*. In short, all seven of the manuscripts chosen for collation are representative of the text at more than one level.

Afterthoughts on Manuscript-Selection: Having chosen these seven manuscripts for collation, I had certain expectations about how they would dovetail in the critical text. For the most part, these expectations were met. For example, *P1* and *S* not only bore out their family affiliation, but they proved to be even closer to one another than anticipated. Likewise, *E* and *P3* displayed the exceptionally close affinity expected of them. Somewhat less clear, but still discernible, was the expected affinity between *L3* and *C1*, both of them turning out (as anticipated) to be

more closely allied to each other than to their family representative *E*. As anticipated, both showed a relatively weak yet marked affinity for *Er*. Thus far there were no surprises.

Wholly unexpected, on the other hand, were the interpretive issues raised by the two versions of book 3, chapter 3, alluded to on p. clxi above. The first and more easily resolved of these issues is whether both versions are somehow integral to the text. Even the most superficial comparison makes it evident that they are not. On the contrary, they seem to parallel one another fairly closely—at least up to a point—so they are in essence redundant. The second issue is how to decide which of the two is extraneous. At first glance the answer seems straightforward enough. Both versions start out with a discussion of the threshold conditions of sight, and both continue in good order until paragraph 13. At that point, version 1 suddenly shifts to another subject.¹⁷ As it turns out, this shift involves a leap backward to the second half of chapter 2, which has been interpolated into paragraph 13 in abrupt and somewhat disordered fashion.¹⁸ Being thus incoherent, version 1 of the third chapter would seem to be a later addition, and a maladroitness at that. Presumably, then, we can dismiss it from consideration in establishing the critical text.

Were it not for A. I. Sabra's edition and English translation of the Arabic version of books 1-3, we might feel safe in leaping to this conclusion. But a comparison of his edition (in English translation) against the Latin text reveals several things that should restrain us. For one thing, such a comparison makes it clear that, from the beginning of book 1 to the very point where the textual shift occurs in version 1 of chapter 3, the Latin translation is remarkably faithful to its Arabic source. This changes dramatically with the textual shift. From that point on, the translation becomes so loose as to be little more than a paraphrase. Moreover, while fairly fluid to that point, the Latin style becomes somewhat awkward and confused thereafter. This change in style is accompanied by some significant changes in vocabulary as well.¹⁹

Taken as a whole, these changes suggest very strongly that at the point of the textual shift there was a sudden switch of translators, from an accomplished master to a relative tyro. If so, then the initial portion of version 1 up to the textual shift has to be the work of the master, whereas from that point on, to the very end of the third book in fact, the translation bears all the earmarks of his less polished successor. In all likelihood, then, version 1 of chapter 3 represents a pastiche, the first half being integral to the translation as originally conceived by translator 1, the second half representing an interpolation by his successor.

Also, while this addition constitutes a non sequitur vis-à-vis what precedes it, it dovetails perfectly with what follows it: namely, version 2 of chapter three, which is also the work of translator 2. Thus, the textual shift within version 1 of chapter 3 marks a clear divide between two coherent segments of the treatise: segment 1, which extends from the beginning of book 1 to the middle of chapter 3 in book 3 (translator 1); and segment 2, which extends from around the middle of chapter 2, book 3, to the end of that book (translator 2).

Why was version 1 created? When? Why was it created as it was; that is, why was translator 2's rendition of the second half of chapter 2 appended out of order to translator 1's rendition of the first half of chapter 3? How did it end up being included in the final text? These are all matters for speculation.²⁰ One thing seems incontestable, though: the first part of version 1 is an authentic continuation of, not a later addition to, the original text. This point is crucial, for if version 1 truly belongs to the original Latin text as it was disseminated for copying, it follows that any manuscript containing it falls within a textual tradition that harks directly back to that original. Accordingly, the six manuscripts comprising this tradition—i.e., *F*, *P1*, *Va*, *V2*, *S*, and *O*—should be more “authentic,” and thus more authoritative, than the other eleven. Furthermore, being closest to the family progenitor within this tradition, *F* should be the most authoritative of all.

The acid test of this conjecture is in the critical text itself. If the manuscripts within the *F-P1-Va-V2-S-O* tradition are indeed more authoritative than those outside it, then, as representatives of that tradition, *P1* and *S* should be more authoritative than the other five manuscripts chosen for collation. In practical terms, this means that, at those points in the text where the seven manuscripts disagree, *P1* and *S* should be more reliable than the rest in determining the correct reading. This in fact turned out to be the case. *P1* and *S* did prove to be more reliable, although not by the margin I anticipated.²¹ Nor did I anticipate that, given its relatively large distance from *F*, *S* would prove to be somewhat more reliable than *P1*. Still, I am confident enough in my overall reconstruction that, were I able to modify my selection of manuscripts in retrospect, the most I would do is substitute *O* for *Er* and drop *P3* as redundant.

The Critical Text: Even before I began editing the Latin text I was faced with two editorial decisions. The first was what to do about book 1. The problem is that, lacking all or most of this book, *C1* and *L3* could not be used in establishing its critical text. Since these two manuscripts

were selected as bridges rather than as core representatives, however, I felt relatively safe in leaving them unreplaced. Accordingly, the critical text of book 1 is based on the remaining five manuscripts alone: i.e., *P1*, *S*, *E*, *Er*, and *P3*.

The second and more difficult decision had to do with version 1 of chapter 3 in the third book. The problem here was twofold. On the one hand, I could simply include it in the critical text, but that would clearly disrupt the narrative flow. Furthermore, by my account it was never meant for inclusion in the final text anyway. On the other hand, I could discard it entirely, but that would be to ignore its crucial transitional status. In view of these problems, I took a middling course. I incorporated virtually all of the first portion of version 1 (consisting of translator 1's version of paragraphs 1-12 of chapter 3) into the critical text and remanded the second portion (consisting of translator 2's version of the second half of chapter 2) to Appendix 1 on pp. 642-647 below. To this latter textual segment I added the initial portion of version 2, consisting of translator 2's rendition of paragraphs 1-12 of chapter 3 (see pp. 646-651 below). Hence, as it is represented in my critical text, chapter 3 of the third book consists of two parts: paragraphs 1-12 from version 1, paragraphs 13-34 from version 2. Appendix 1, for its part, contains translator 2's version of the second half of chapter 2 as well as his version of paragraphs 1-12 of chapter 3.

The resulting critical text has two virtues. First, it reflects the full measure of translator 1's contribution, right up to paragraph 13 of chapter 3. In so doing, it also reflects the Arabic source as fully as possible. Second, since translator 2's contribution takes up seamlessly at that point, the narrative flow of the treatise is uninterrupted. The drawback is that, arranged in this way, the critical text does not, in all likelihood, reflect the Latin treatise as it was finally—and erroneously—compiled for fair copy and dissemination. Suffice to say, I think the virtues outweigh the drawback.

Since only two of the seven manuscripts chosen for collation contains version 1 of chapter 3 (i.e., translator 1's version of paragraphs 1-12 of chapter 3 coupled with translator 2's version of the second half of chapter 2), I decided for the sake of thoroughness to base version 1's critical text on the full complement of manuscripts containing it. Thus, the critical apparatus for the first twelve paragraphs of chapter 3 in the main text includes variants not only from *P1* and *S*, but also from *F*, *O*, *Va*, and *V2*, these latter four being listed under "secondary manuscripts" on pp. clvii-clix above. The same holds for the critical apparatus of the first section of the appendix. With the exception of book 1 and the first

twelve paragraphs of book 3, chapter 3, then, the main critical text is based upon the seven primary manuscripts chosen for collation.

Although I did not use it in establishing the critical text itself, I transcribed *R*, the 1572 edition by Friedrich Risner (entry 19, pp. clx-clxi above), in order to include its variants in the critical apparatus. In terms of textual details, *R* shows a marked affinity for the *E-P3* manuscript-group, an affinity that extends to its inclusion of Ibn Mu'adh's *De crepusculis* and its concomitant exclusion of version 1 of chapter 3. *R*'s text therefore falls within the less definitive of the two basic manuscript-traditions discussed above. It also falls within the least definitive of the three family-traditions discussed above. In addition, *R* has emended the text so extensively that it should be regarded as a separate edition, not a mere version, of the *De aspectibus*.

Finally, as far as the Latin text is concerned, I have tried to keep it as true as possible to its medieval form. In accordance with that aim, I have followed the basic orthographic conventions of medieval Latin: the short *e* for the *ae* diphthong, the occasional substitution of *y* for *i* (e.g., *ymago* and *dyiameter*), the use of *m* rather than *n* in such agglomerates as *quodcumque*, and so forth. In the critical apparatus, on the other hand, if the variant is unique, I have followed the usage of the given manuscript, even if it departs from these conventions. This is particularly evident for *R*, whose orthography harks back to classical rather than medieval norms.

Summary of Results: At this point it might be useful to recapitulate the key points of the preceding textual analysis:

(1) Altogether, I had seventeen manuscripts available for collation. After an extensive comparative study of all seventeen, I was able to subdivide them into three basic groups: Family I consisting of *F*, *P1*, *Va*, *V2*, *L2*, and *S*; Family II consisting of *Er*, *C1*, *O*, and *M*; and Family III consisting of *E*, *P3*, *P2*, *L3*, *C2*, *L1*, and *V1*. On the basis of these groupings, I chose seven manuscripts as adequately representative for collation: *P1*, *S*, *E*, *Er*, *C1*, *L3*, and *P3*.

(2) After analyzing version 1 of chapter 3, book 3, I concluded that it reflects the work of two distinct translators. The initial portion, which consists of roughly the first thirteen paragraphs of chapter 3, is the work of translator 1, who was responsible for the Latin text of books 1 and 2 as currently extant. The second portion, which consists of roughly the second half of chapter 2, is the work of translator 2, who succeeded

translator 1 after his sudden abandonment of the project in the middle of chapter 3.

(3) Having concluded that the initial portion of version 1 is a genuine continuation of the original text, I also concluded that the six manuscripts containing it belong to a tradition that harks directly back to that original. These six consist of *P1* and *S*, which are listed above as primary manuscripts, and *F*, *O*, *Vat*, and *V2*, which are listed as secondary manuscripts. Being thus related to the original, these six manuscripts can be regarded as more authoritative than the remaining eleven. Accordingly, among the seven manuscripts chosen for collation in the critical text, *P1* and *S* should be the most reliable witnesses to the original text.

(4) In deciding how to incorporate version 1 into the critical text, I finally chose to include the first portion, to the end of paragraph 12 of chapter 3, in the main text of book 3 and to place the rest of version 1 in an appendix. In that same appendix I placed the equivalent portion of chapter 3 from version 2, which is translator 2's rendition of that chapter. Accordingly, the first 12 paragraphs of chapter 3 in the main text of book 3 hark back to the original translator (translator 1). The remainder of book 3 is the work of his successor (translator 2).

(5) Although the critical text is based, overall, on the seven primary manuscripts discussed above (*P1*, *S*, *E*, *Er*, *C1*, *L3*, and *P3*), there are two exceptions: book 1, whose critical text is based on five of those seven (*P1*, *S*, *E*, *Er*, and *P3*), and version 1 of chapter 3, whose text is based on the two primary manuscripts *P1* and *S* along with the four secondary manuscripts *F*, *O*, *Vat*, and *V2*.

The Critical Apparatus: My choice of manuscripts for collation was dictated by the desire not only to make the critical text as accurate as possible, but also to make the critical apparatus as representative as possible. To that end I cast a fairly broad net but one that was finely woven enough to trap virtually everything but orthographic variants. Even the relatively minor distinction between *igitur* and *ergo* is signaled in the critical apparatus. Such distinctions may seem overly nice, but what appear at first sight to be insignificant variants can turn out to be hallmarks within a particular manuscript tradition. With that in mind, I have chosen caution over convenience.

The conventions I have used in my critical apparatus are fairly standard. A given variant is referred first to a line-number within the text

and then to a particular keyword in that line. When the variant involves a phrase that extends beyond the initial line, it will be listed according to its first and last words with appropriate line-numbers given. For instance, "13 oculus . . . centrum (15)" designates the entire text running from "oculus" in line 13 to "centrum" in line 15. Substitutions are signaled by a colon between the keyword and its replacement, after which is written the siglum/sigla of the manuscript(s) containing that substitution. Thus, "3 quando: si EP3" means that, instead of "quando" in line 3, *E* and *P3* have "si." If the keyword is one of several identical words in the same line, its relative position is signaled by a superscript number. For example, "68 et³" designates the third "et" in line 68. When several variants in a given line are referenced to the same keyword, they are separated by semicolons. Hence, "54 inveniet: invenit *Er*; inveniret EP3" means that "inveniet" in line 54 has been changed to "invenit" in *Er* and to "inveniret" in *E* and *P3*. Variants within a given line that are not referenced to the same keyword are separated by a slash mark (/). Thus, "12 ipsius: illius *E* / auferat: convertat *R*" means that in line 12 *E* has substituted "illius" for "ipsius," and *R* has substituted "convertat" for "auferat." Doubtful or undecipherable readings are signaled by a question mark (?). Following is a list of abbreviations used in the critical apparatus:

- a. m.* *alia manu* ("in another hand"; i.e., by a scribe other than the original one): see example for *add.* below.

- add.* *addidit* ("has added"): **example** = "243 post et *add.* tamen *a. m.* EP3" means that after "et" in line 243, *E* and *P3* have added "tamen" in another hand.

- alter.* *alteravit* ("has changed"): **example 1** = "34 corporis *alter. in* corporialis *Er*" means that "corporis" in line 34 has been changed to "corporialis" in *Er*; **example 2** = "34 corporis *alter. ex* corporalis *in* corporeitatis *S*" means that instead of "corporis" in line 34, *S* had "corporalis," which was then changed to "corporeitatis."

- corr.* *correxuit* ("has corrected"): **example 1** = "34 corporis *corr. ex* corporialis *C1*" means that "corporis" in line 34 has been corrected from "corporialis" in *C1*; **example 2** = "34 corporis *alter. in* corporialis *deinde corr. ex* corporalis *a. m.* L3" means that "corporis" in line 34 was changed to "corporialis" by the original scribe and then corrected back to "corporis" by another scribe in *L3*.

- inter.* *interposuit* ("has made an interlinear insertion"): **example** = "26 *post et inter. iam L3*" means that after "et" in line 26 "iam" was inserted above, between lines 25 and 26, in *L3*.
- mg.* *in margine* ("in the margin"): **example** = "56 *post tamen add. quod mg. a. m. E*" means that after "tamen" in line 56 "quod" was added as a marginal insertion by another hand in *E*.
- om.* *omisit* ("has omitted"): **example** = "23 *tamen om. EP3*" means that "tamen" in line 23 is missing in *E* and *P3*.
- rep.* *repetevit* ("has repeated"): **example** = "74 *paulatim rep. Er*" means that "paulatim" in line 74 has been repeated in *Er*.
- scr. et del.* *scripsit et deleuit* ("has written and deleted"): **example** = "44 *post quod scr. et del. plurimum C1*" means that after "quod" in line 44 "plurimum" was deleted in *C1*.
- transp.* *transposuit* ("has transposed"): **example** = "97 *ille color transp. R*" means that, instead of "ille color" in line 97, *R* has "color ille."

Finally, there are cases in which variants shared by several manuscripts have subvariants. In these cases, the subvariants are listed at the end of the main variant within parentheses. Thus, for example, "57 *post et add. si revertatur ad umbram apparebit color ille super ipsum et EErP3* (color ille *transp. Er*)" means that after "et" in line 57 *E*, *Er*, and *P3* have added the phrase "si . . . ipsum et" but that, within this added phrase, *Er* has transposed "color ille" to "ille color."

The Translation: As a translator, I am mindful of St. Paul's admonition that the letter kills. An overly literal translation can indeed kill a text. Worse, it can bludgeon it senseless in the process. On the other hand, while it may be more graceful, an overly liberal translation can be just as invidious. Bearing that in mind, I have tried to navigate between these extremes, getting the intent of the text across as clearly as possible without straying too far from the actual Latin. Suffice to say, this is often simpler in theory than it is in fact.

For one thing, there are cases, particularly in the second half of book 3, where the critical Latin text makes little or no sense as it stands. The temptation in such cases is to bend the English—if not the Latin—to the apparent (i.e., "correct") rather than the literal (i.e., "incorrect") intent

of the Latin. I have tried to avoid that temptation. After all, the critical text is supposed to be a faithful replica of the original, warts and all. To excise those warts from the English translation would thus be, in a sense, to Bowdlerize the text.

For another thing, certain key terms lose intended connotations while others gain unintended ones when they are translated literally. Take, for example, *comprehensio*. Rendered as “comprehension” or “understanding,” this term would convey a sense of profound intellectual awareness that is quite clearly unmeant in the Latin text. “Perception” conveys the intent far better. Likewise, as used in the Latin text, the term *sillogismus* would be improperly rendered as “syllogism,” because that denotes a particular, structured form of logical argument. In the text itself *sillogismus* denotes the act of drawing perceptual, and thus subrational, conclusions: e.g., “there is a window between me and what I see through it.” To convey this looser sense, I have translated the term throughout as “deduction.”

As far as format is concerned, I have tried to key my Latin and English texts to Sabra’s Arabic original insofar as possible. To that end, I have broken my text into paragraphs according to his version and have numbered each paragraph according to their appropriate placement in his text. Thus, the very first paragraph of chapter 1 in the Latin version is numbered 4.1 to reflect that it is the first paragraph of chapter 4 in the Arabic version; in fact, the numbering of paragraphs on this basis extends through chapter 5 of the Latin version, the last paragraph in that chapter being 4.28. In some cases, particularly in the second half of book 3, the two texts are so divergent that such pinpointing is extremely difficult. I have nonetheless done my best to keep the texts as parallel as possible within reasonable limits.

There are, in addition, some clear topical subdivisions in the text of the *De aspectibus*. In the third chapter of book 2, for instance, Alhacen deals in order with the twenty-two “visible intentions” that are perceived in the process of sight: i.e., light, color, distance, spatial disposition, corporeity, shape, size, discontinuity or separation, continuity, number, motion, rest, roughness, smoothness, transparency, opacity, shadow, darkness, beauty, ugliness, similarity, and difference. Although two of the manuscripts (*E* and *P3*) subdivide all of these topics physically, three (*Er*, *O*, and *M*) provide no physical subdivision at all. The rest of the manuscripts subdivide some of the topics, but in an apparently haphazard way (see Tables 2B and 8.3 in Appendix 2, pp. 655 and 663 below). As a result, I have decided to signal none of these subdivisions in the Latin text. In the English translation, on the other hand, I have sig-

naled all of them for the sake of easy reference. Likewise, in the seventh chapter of book 3, Alhacen deals in order with the eight conditions that can cause misperception. As with his discussion of the visible intention, so with his discussion of these conditions, the topical transitions are clear. Nonetheless, those transitions are not always demarcated by physical subdivisions in the manuscripts (see Tables 3B and 8.5 in Appendix 2, pp. 657 and 664 below). In this case, however, since the transitions are marked by an introductory summary, I have subdivided both the Latin text and English translation and rendered those introductory summaries in italics. In both cases, then, I have tried, insofar as possible, to honor the intended structure of the Latin original.

Then there is the matter of diagrams. While it is clear from the text that only one diagram was actually intended as an integral part of the treatise,²² many of the manuscripts provide supplementary diagrams that are intended to explain or illustrate points made in the text. The most copious supply of such diagrams is to be found in *E* and *P3*, the latter having clearly been copied from the former. I have included these diagrams at appropriate spots in my running commentary, keying them to where they actually fit in the text. I have used the figures from *P3*, the copy, rather than *E*, the original, because the former are more clearly rendered than the latter. A cross-listing of these diagrams for all the relevant manuscripts is provided in Appendix 4, p. 677 below.

My rationale for including these diagrams is twofold. First, I view them as variants; their inclusion or rejection in given manuscripts serves as another means, along with textual variants and intratextual organization, of segregating manuscripts into groups. Second, as glosses of a sort, they provide an interpretive guide to the text, serving either to mark points of particular interest or concern (“nota bene”) or to elucidate what the scribe or commentator took to be knotty issues. I did not, on the other hand, include all the glosses because, given their number and variety, I felt that incorporating them would have been too time-consuming, and the results too unwieldy, to warrant the effort.

A few words, finally, about reference-aids. First, in order to make it easier for the interested reader to locate particular subjects in the text, I have provided a fairly detailed topical synopsis at the beginning of each book in the English translation. Each chapter of the relevant book is defined in terms of its general subject-matter (e.g., in the synopsis for book 1, the general subject-matter of chapter 6 is “The Physical Structure of the Eye”). Underneath each chapter-description is a listing of specific topics according to the paragraphs within which they are treated (e.g., under chapter 6 of book 1, the first listing reads “[5.1-5.3] Origin of

optic system in the brain; connection through hollow optic nerves.”).

Second, in an effort to make this edition as user-friendly as possible, I have included a Latin-English index, which provides a relatively complete concordance of Latin and English terms keyed to the critical text and the parallel translation. This index is complemented by an English-Latin glossary, which is meant to serve as a convenient cross-reference. These two indexes are followed by a general index, which is keyed primarily toward the introduction and commentary.

NOTES

¹Of the twenty-four items listed below, twenty-two are given by David Lindberg in his *Catalogue*, pp. 17-19. The two that have since been uncovered are listed as entries number 6 and 23, pp. clvii and clxi above. My thanks to Dr. Richard Lorch for alerting me to the existence of the first of these manuscripts.

²For further discussion, see A. Mark Smith, "The Latin Source of the Fourteenth Century Italian Translation of Alhacen's *De aspectibus* (Vat. Lat. 4595)," *Arabic Sciences and Philosophy* 11 (2001): 27-43. See also A. Mark Smith and Bernard R. Goldstein, "The Medieval Hebrew and Italian Versions of Ibn Mu'adh's 'On Twilight and the Rising of Clouds,'" *Nuncius: Annali di storia della scienza*, 8 (1993): 613-643, esp. 628-629.

³See Vescovini, "Alhazen Vulgarisé."

⁴See "Introduction," p. xxi above, for a discussion of the proper rendering of Alhacen's name.

⁵For a detailed account of this treatise and its manuscript tradition, see A. M. Smith, "The Latin Version of Ibn Mu'adh's Treatise 'On Twilight and the Rising of Clouds,'" *Arabic Sciences and Philosophy* 2 (1992): 83-132.

⁶See Appendix 2, pp. 653-665 below for details, esp. Tables 8.1-8.9 on pp. 662-665 below.

⁷In fact, by the time I became aware of *P3*'s existence I was virtually ready to begin editing; see p. clxii above.

⁸*Autolycus de Pithane: Histoire du texte suivie de l'édition critique des Traités de la sphère en mouvement et des levers et couchers*. Recueil de travaux d'histoire et de philologie de l'Université de Louvain 3, 37 (Louvain, 1950).

⁹The overarching assumption here is that medieval scribes felt no license whatever to depart from the text they were copying.

¹⁰The actual slices are as follows: 1r-4v, 11r-14r, 2v-25r, 34r-37r, 40v-42v, 44r-49v, 52r-53r, 55v-58r, 63r-64r, 69r-70r, 74r-76r, 81v-82v, 87r-90r, 96r-97v, 104v-105v.

¹¹For a discussion of the problems posed by manuscript-production according to *pecia*, see Smith, *Witelonis Perspectivae liber quintus*, p. 77n; see also Unguru, *Witelonis Perspectiva liber secundus et liber tertius*, p. 34. For a more recent discussion of this subject, see Mary A. Rouse and Richard H. Rouse, *Authentic Witness: Approaches to Medieval Texts and Manuscripts* (Notre Dame, Ind.: University of Notre Dame Press, 1991), esp. pp. 259-338; see also pp. 339-408 for a discussion of how manuscript-collections developed into "libraries" during the later Middle Ages.

¹²The final tabulations for all sixteen manuscripts are given in Tables 2-17 of Appendix 3, pp. 669-676 below.

¹³If we assume a relatively consistent level of accuracy among medieval scribes, then the number of idiosyncratic variants can be telling. Assume, for instance, that scribe A copies a treatise from manuscript *V*. In the process of creating his own manuscript-version, *W*, scribe A will make errors, mistranscribing words, adding or omitting phrases, and so forth. If *W* subsequently becomes the basis for scribe B's copy, *X*, of the treatise, then scribe B will reproduce most of the errors imported by scribe A while adding some of his own. But some of his errors will involve mistranscriptions of errors imported into *W* by scribe A. Improperly reproduced, the original errors will thus be left untouched in *W*. They will therefore constitute idiosyncratic variants. The same holds for copy *Y* made by scribe C from *W*, as well as for copy *Z* made by scribe D from *Y*. Now, if all four versions happen to survive so that we can submit them to the comparative analysis described above, we should get the following results. *Z*, the last manuscript in line, will have the greatest number of idiosyncratic variants, because none of the errors imported by scribe D will have had a chance to get copied and thus become shared. The progenitor, *V*, on the other hand, will have the fewest, because the lion's share of its idiosyncratic variants will have become shared variants in the process of transmission through *W*, *X*, *Y*, and *Z*. Throughout this process of transmission, then, there will be a continual accretion of idiosyncratic variants through the steady and inexorable compounding of scribal errors. Furthermore, even if the intermediate versions between *V* and *Z* were missing, their presence would be indicated by the relatively high number of idiosyncratic variants contained by *Z*. All of this is of course contingent on a relatively consistent level of accuracy among the scribes. An inordinately sloppy scribe can skew the results badly, particularly if his version is the last in the series.

¹⁴Just to put things into perspective, *C2* (which is not a member of *F*'s family) has a score of just under 6,100 for idiosyncratic variants. This number is so high that it most likely indicates not the relative distance of *C2* from its family progenitor but the ineptitude of its scribe.

¹⁵See Appendix 3, pp. 667-676 below, for the composite numerical data upon which these conclusions are based.

¹⁶In essence, I chose *P1* over *Va* because of *Va*'s greater affinity for *V2*.

¹⁷This textual shift occurs as follows, starting with paragraph 13:

Et etiam visus, cum fuerit lesus, aut accidet ei aliquod accidens transmutans . . . / / . . et ex hoc quodcumque sumatur viso punctum K. Non per axem comprehendatur, sed per radium videtur axi communi fixo propinquius loco vero . . . (Moreover, when the eye is injured, or something happens to it that changes. . . / / . . and on this visible object let some point *K* be taken. It should not be perceived along the axis, but it is seen by a ray nearer to the actual location [of the object] than the fixed common axis. . .).

¹⁸See Appendix 1, p. 642-651 below, for the full interpolation.

¹⁹For instance, whereas translator 1 uses the term *remotio* to denote "distance" in a generic sense, translator 2 uses *longitudo*.

²⁰I offer the following tentative reconstruction: having reached the middle

of paragraph 13 in chapter 3, translator 1 abruptly abandoned the project (sudden death?), leaving it to his apprentice, translator 2, to finish the job. Unused to working independently, translator 2 decided to practice by translating the second half of chapter 2 and checking the results against the text already established by his master. Finally satisfied that he was as prepared as he could hope to be, translator 2 began his own work in earnest somewhere in the course of chapter 3. For the sake of textual continuity, he decided at that point to ignore translator 1's partial text of chapter 3 and place his own version of chapter 3 (i.e., version 2) at the end of chapter 2 in the original text. This decision made, translator 2 gathered up translator 1's incomplete text of chapter 3, added his own practice-translation from chapter 2, and set the resulting sheaf of folios (i.e., version 1) aside to be recycled or discarded later. However, when the Latin text of the *De aspectibus* was finally compiled for fair copy, that sheaf of folios was inadvertently inserted into book 3, right at the end of chapter 2 where it seemed to belong.

²¹There is an obvious potential circularity in the claim that *P1* and *S* confirmed my expectations in the first place. The actual confirmation, however, was based on the fact that more often than not where the texts diverged—particularly in those cases where meaning changed—*P1*'s and *S*'s readings were most consistent in making sense.

²²This is clear from the text itself, where there is reference to only one figure by letter-designations (i.e., by lettered points, lines, and angles); see III, 2.27-44, pp. 573-577 below. According to Sabra's edition, moreover, there is only the one figure.

ALHACEN'S
DE ASPECTIBUS
LATIN TEXT

[PRIMUS TRACTATUS]

[CAPITULUM 1]

[4.1] Invenimus visum quando inspexerit luces valde fortes fortiter dolebit ex eis et habebit nocumentum, aspiciens enim quando aspexerit corpus solis non poterit bene aspicere ipsum, quoniam visus eius dolebit propter eius lucem. Et similiter quando inspexerit speculum tersum super quod ascendebat splendor solis et fuerit visus eius in loco ad quem reflectitur lux ab illo speculo, dolebit etiam propter lumen reflexum perveniens ad suum visum a speculo, et non poterit aperire oculum ad inspiciendum illud lumen.

[4.2] Et invenimus etiam quando aspiciens intuetur corpus mundum album super quod ascendebat lux solis et moretur in aspectu ipsius, deinde auferat visum suum ab eo ad locum obscurum debilis lucis, quod fere non poterit comprehendere res visibiles illius loci comprehensione vera, et inveniet coopertorium quasi inter ipsum et ipsas. Deinde paulatim discooperietur, et revertetur visus in suam dispositionem. Et iterum quando inspiciens inspexerit fortem ignem et fuerit intuens ipsum et moretur in aspiciendo longo tempore, deinde declinet visum suum ad locum obscurum debilis lucis, et inveniet etiam idem in visu suo.

[4.3] Et iterum invenimus quando inspiciens inspexerit corpus mundum album super quod oriebatur lux diei et fuerit illa

1 visum: quod visus R 3 quando: si EP3 4 eius²: ipsius R 5 tersum: rursum Er
6 splendor: lux EP3R; speculum P1 7 etiam: iterum R
8 perveniens corr. ex proveniens a. m. E; corr. ex peveniens a. m. S/suum visum transp. P1 / non inter. a. m. E/poterit corr. ex potuit a. m. P3 9 illud lumen transp. R
10 etiam: iterum R 11 moretur corr. ex moritur S 12 ipsius: illius E/ auferat: convertat R/suum om. P3 13 poterit: potuit E; alter. ex potui in potuit a. m. P3
14 coopertorium (15) corr. ex cooperitorium P3 15 ipsum: visum P1/post paulatim add. et paulatim EP3 (mg. a. m. E) 16 quando (17): quoniam Er 17 post inspexerit scr. et del. quoniam Er/fortem ignem transp. EEP3R/intuens: intuitus R/ ipsum om. Er 19 et: etiam Er; om. R/etiam: iterum R 21 iterum invenimus transp. P3

lux fortis, quamvis non sit lux solis, et moretur in aspectu diu,
 deinde auferat visum suum ad locum obscurum, inveniet for-
 25 mam illius lucis in loco obscuro illo, et inveniet cum hoc figur-
 am eius. Deinde si clauserit visum et fuerit intuens secundum
 horam, inveniet in oculo suo formam illius lucis. Deinde aufer-
 etur hoc, et revertetur visus in suam dispositionem. Et simili-
 ter erit dispositio visus quando inspexerit corpus super quod
 30 oriebatur lux solis.

[4.4] Et similiter si inspexerit corpus clare album super
 quod oriebatur lux ignis, quando lux ignis fuerit fortis, et more-
 tur in aspiciendo ipsum, deinde recesserit ad locum obscurum,
 inveniet in eo etiam idem hoc in suo visu. Et similiter quando
 35 aspiciens fuerit in domo in qua fuerit foramen amplum disco-
 opertum ad celum et aspexerit ex illo loco celum in luce diei et
 moretur in aspiciendo ipsum, deinde revertatur visus eius ad
 locum obscurum in domo, inveniet formam lucis quam compre-
 hendebat ex foramine cum figura foraminis in loco obscuro. Et
 40 si clauserit oculum suum, inveniet etiam in eo formam illam.

[4.5] Omnia ergo ista significant quod lux operetur in vi-
 sum aliquam operationem.

[4.6] Et invenimus etiam inspicientem quando inspexerit
 viridarium multe spissitudinis herbarum super quod oriebatur
 45 lux solis et moretur in aspiciendo ipsum, deinde auferat visum
 suum ad locum obscurum, inveniet in illo loco obscuro formam
 illius lucis coloratam a virore illarum herbarum. Deinde si as-
 pexerit in ista dispositione visibilia alba et fuerint illa visibilia
 in umbra et loco debilis lucis, inveniet colores illos admixtos
 50 cum virore. Et si clauserit oculum suum etiam et fuerit intuens
 in eo, inveniet in suo oculo formam lucis et formam viroris.
 Deinde discooperietur illud et auferetur. Et similiter si aspe-
 xerit corpus coloratum colore lazuleo vel rubeo vel alio colore

23 quamvis: quam *Er*/lux² *alter. in lumen a. m. EP3* 24 auferat: convertat *R*/
 inveniet: invenit *Er* 25 illius lucis *transp. EEP3/obscurum om. EP3R* 26 post
 visum *add. et fuerit visum EP3/et . . . horam (27) om. R* 27 inveniet *corr. ex in-*
 venient *P3/oculo: ipso R/suo om. R* 28 post revertetur *add. oculus vel E; add.*
oculus et P3/visus: oculus R 29 ante corpus *scr. et. del. visus P3* 31 si: quan-
 do *R* 32 quando lux ignis *om. P1* 34 in eo etiam: etiam in eo *EP3R/etiam: iter-*
um R/hoc in suo rep. P1/quando rep. Er 35 fuerit²: fuit *P1* 36 et¹ *corr. ex ex a.*
m. E/ex: in Er 37 visus *om. P1* 40 etiam: iterum *R* 43 etiam . . . quan-
 do: iterum quod quando aspiciens *R* 45 auferat: convertat *R/visum su-*
um (46) transp. EP3R 47 illius lucis *om. EP3R/lucis om. P1; inter. S/herbar-*
um: herbas Er 48 ista: illa *Er* 50 etiam: iterum *R/et² . . . eo (51) om. R*
 51 suo oculo: ipso *R* 52 discooperietur *corr. ex discooperiatur a. m. E* 53 co-
 lore¹ *corr. ex colorem P3/ lazuleo: caeruleo R; corr. ex laleo E*

55 forti scintillante super quod oriebatur lux solis et moretur in
aspiciendo ipsum, deinde auferat visum suum ad visibilia alba
in loco debilis lucis, inveniet colores eorum admixtos cum illo
colore.

[4.7] Ista ergo significant quod colores illuminati operentur
in visum.

[CAPITULUM 2]

[4.8] Et etiam videmus stellas in nocte, et non videmus ip-
sas in luce diei; et nulla differentia est inter duo tempora nisi
quod aer medians inter visum nostrum et celum est in die illu-
minatus et in nocte obscurus. Dum ergo aer fuerit obscurus,
5 nos videmus stellas; cum autem illuminatus fuerit aer medius
inter visum nostrum et stellas, latebunt nos stelle.

[4.9] Et similiter si aspiciens fuerit de nocte aspiciens in
loco luminoso lumine ignis, et fuerit lumen ignis extensum su-
per terram, et fuerint in illo loco visibilia subtilia aut visibilia in
10 quibus sunt res subtiles, et fuerint in aliqua umbra sed non for-
ti, et non fuerit ignis medius inter visum et illa visibilia, et fue-
rit tunc inspiciens comprehendens illa visibilia et res subtiles
que sunt in eis, deinde moveatur a suo loco donec sit ignis me-
dius inter visum suum et illa visibilia. Tunc illa visibilia late-
15 bunt ipsum, si fuerint subtilia, vel subtilia que in eis sunt, et
fere non comprehendet ipsa cum ignis fuerit medius inter vi-
sum suum et ipsa visibilia. Et si cooperiatur ignis a visu suo,
comprehendet statim illa visibilia que latebant ipsum; et si
20 auferatur coopertorium inter visum suum et ignem, latebunt
ipsum iterum illa visibilia.

[4.10] Iste ergo dispositiones significant quod luces fortes

54 scintillante *corr. ex* sintillante *E* 56 in loco *rep. P1* / eorum: illos *ER*; *om. P3* /
illo *corr. ex* illos *P3* 58 ergo: igitur *Er* / illuminati: luminati *P1S*; *corr. ex* illumi-
na *a. m. P3* 1 etiam: iterum *R* / *post* etiam *add. quod EP3* 2 differentia est *transp.*
R / duo *om. R* 4 obscurus¹ *corr. ex* obscuris *S* / *ante* dum *scr. et del.* nos videmus stellas
P3 / dum: cum *R* / *post* obscurus² *add. et S* 5 aer *inter. a. m. E* 6 *post* stellas
scr. et del. p P1 7 fuerit *de om. R* / aspiciens²: aspexerit *R* 9 subtilia aut visibilia
om. P1 10 subtiles: similes *P3* 11 visum . . . visibilia: illa visibilia et visum
EP3R / fuerit (12): comprehenderit *R*; *corr. ex* fuerint *P3* 12 inspiciens: aspiciens
EP3R / comprehendens *om. R* / *post* visibilia *rep. et*³ (11) . . . visibilia (12) *Er* (*om. compre-*
hendens) 13 deinde: demum *ErP1S* 14 visum . . . visibilia¹: illa visibilia et
suum visum *EP3R* / suum *om. P1* / tunc . . . visibilia *om. P1* 16 fere *om. S* / fuerit:
fuit *P1* 18 illa visibilia *transp. R* 19 visum suum *transp. Er* 20 illa:
ipsa *Er* 21 *post* significant *scr. et del.* que *S* / quod *om. S*

orientes super visum et super aerem inter oculum et rem visam prohibent visum a comprehensione quorumdam visibilium quorum luces sunt debiles.

- 25 [4.11] Et iterum quando aspiciens aspexerit corpus tersum et fuerint in illo corpore sculpture subtiles et non fuerint ille sculpture diversorum colorum a colore corporis sed fuerint ex colore illius corporis, et fuerit aspiciens in loco temperate lucis et fuerit ille locus oppositus soli vel quibusdam parietibus illuminatis lumine forti, deinde oppositum fuerit celo aut parieti
30 illuminato, reflectetur ab eo aliqua lux ad visum, et inveniet aspiciens lucem apparentem in superficie corporis et in loco a quo reflectitur lux fortiolem et magis scintillantem. Et in ista dispositione, si inspiciens fuerit intuens illud corpus tersum,
35 non videbit in eo aliquam sculpturam ex sculpturis que sunt in loco lucis fortis scintillantibus illius corporis. Deinde si inspiciens inclinaverit illud corpus ab illo loco ita quod reflexio fiat ad alium locum extra locum visus sui, et fuerit cum hoc super corpus illud lux temperata, tunc inspiciens comprehendet
40 sculpturas que sunt in eo quas non comprehendebat in reflexione lucis a corpore ad suum visum.

- [4.12] Et similiter quando lux reflectetur a pagina tersa in qua sunt sculpture subtiles ad visum, non distinguet visus illas sculpturas nec verificabit donec sit lux reflexa ad visum ab illa
45 pagina. Et si declinetur superficies pagine ita quod situs eius mutetur et non reflectatur lux ab ea ad visum, comprehendet tunc visus illas sculpturas et distinguet.

- [4.13] Et iterum quando ignis debilis fuerit in lumine debili, apparebit et comprehendetur a visu, et cum fuerit in lumine
50 solis, apparebit corpus in quo est densum coloratum colore scintillante forti.

22 orientes: oriente *Er* 23 visum *mg. E/post a scr. et del. c S/quorumdam: quardam ErP1S; quarumdam P3* 25 tersum: torsum *Er* 27 ante colorum *scr. et del. corporum P1/colorum mg. E/colore . . . sed: corpore coloris si P1/sed . . . corporis (28) om. EErP3R* 29 et . . . forti (30) *om. R* 30 post fuerit *add. corpus illud R/celo: soli R* 31 post illuminato *add. lumine forti R* 32 corporis *om. P1/post in² add. hoc P1* 33 ista: illa *Er* 34 intuens: intuitus *R* 36 post fortis *add. et R/illius corporis om. R/deinde: de P1* 37 inclinaverit: declinaverit *R/illud corpus transp. P3/quod: ut R* 38 cum hoc: praeterea *R* 39 temperata: temporata *S* 40 ante non *add. prius EP3R* 42 ante a *scr. et del. revertetur S/post pagina add. vel tabula a. m. S* 43 qua *om. P3/post sunt scr. et del. soli E* 44 post sculpturas *scr. et del. ita E/ nec: que E; donec P1/verificabit: vivificabit P3/post lux add. non Er; scr. et del. um S* 45 ita quod: itaque *Er/quod: ut R* 46 reflectatur: reflectetur *Er/lux ab ea: ab ea lux R/ea om. P3* 47 post tunc *scr. et del. lux E/sculpturas om. P1*

[4.14] Et si positum fuerit prope illud corpus corpus album
clare albedinis et fuerit illud corpus in umbra et in luce debili,
apparebit super ipsum color corporis, sicut narravimus super-
55 ius. Deinde si appropinquet illud corpus album donec sit in
lumine solis, latebit ille color qui est super eum, et si revertatur
ad umbram, apparebit ille color fulgens super ipsum. Et apud
suum esse in luce forti et apud latitationem corporis quod est
super ipsum, si obumbretur corpus corpore denso et sit in suo
60 loco donec debilitetur lux que est super ipsum, apparebit color
qui est super ipsum. Et si auferatur corpus obumbrans donec
vigorescat lux super corpus album, latebit color qui est super
ipsum.

[4.15] Et similiter quando appropinquaverimus corpus di-
65 afonum coloratum colore scintillante igni vehementer forti et
appropinquaverimus umbre illius corporis pannum album,
apparebit color illius corporis diafoni super illum pannum,
sicut narravimus prius. Deinde si appropinquaverimus illi
panno alium ignem ita quod lux eius oriatur super illum pan-
70 num, latebit ille color qui apparebat super pannum, et non
apparebit nisi albedo panni tantum. Et si auferamus illum
ignem secundus, apparebit color super pannum.

[4.16] Et etiam quedam animalia marina habent conchas et
telas, et cum fuerint in loco obscuro in quo non est lux, appar-
75 ebunt ille conche quasi ignis; et si inspiciens inspexerit eas in
luce diei vel in luce ignis, comprehendet eas et non videbit in
eis lumen vel aliquem ignem. Et similiter quando animal quod
dicitur noctiluca volat de nocte, apparet quasi lampas, et cum
aspiciens inspexerit eum in luce diei vel in luce ignis, apparebit

52 *post et add. tamen EP3; add. tum R/positum om. EP3R/ prope: proprie P1/post*
corpus¹ *add. aliquod R* 53 *illud corpus transp. EP3R/ in² om. EP1P3R* 54 *post*
corporis *add. illius EP3R* 55 *si corr. ex sic S/appropinquet: propinqualis Er;*
moveatur R 56 *ante ille add. iam EEP3R/super eum: in eo R/revertatur:*
reducatur R 57 *ille color transp. R/fulgens: refulgens Er/post fulgens add. qui est*
EEP3R/super: in R/ipsum: eum ErP3; ipso R/post et add. si revertatur ad umbram
apparebit color ille super ipsum et EEP3 (color ille transp. Er); add. apparebit color illo
R/apud: super R 58 *suum esse: ipsum EP3R/post corporis add. vel coloris EP3/*
quod: qui R 59 *post ipsum add. et P1S/corpus om. EP3R/sit: si maneat R/post in*
scr. et del. corpore P3/suo loco (60) transp. P3 64 *appropinquaverimus: appropin-*
quavimus EP3; admoverimus R 66 *appropinquaverimus: admoverimus R*
67 *color om. Er/diafoni: diafonum Er/illum: illam P3* 68 *appropinquaverimus:*
admoverimus R 69 *alium: album Er/ita: in Er/quod: ut R* 70 *qui inter. S*
73 *post et¹ add. si EP3 (scr. et del. E)/etiam: iterum R* 74 *telas: testas R/post et scr. et*
del. cum P3/apparebunt (75): apparebit Er 75 *si: cum P1/eas: illas EP3R*
77 *vel... ignem om. P1S/quando om. P3/quod inter. P1* 79 *aspiciens inspexerit:*
aspexerit P1S/eum: illud R; corr. ex id a. m. EP3

80 animal sine igne.

[4.17] Significant ergo omnes iste dispositiones quas declaravimus quod luces fortes visibilium aliquando occultant res que sunt in quibusdam visibilibus et quod luces debiles aliquando manifestant quasam res que sunt in quibusdam visibilibus.
85 libus.

[CAPITULUM 3]

[4.18] Et iterum visui multotiens latent multe res que sunt invisibiles ex sculpturis subtilibus et scripturis subtilibus quando fuerint in lucibus debilibus vel in locis obscuris, et cum extrahuntur ad loca luminosa fortis luminis vel ponuntur in luce
5 solis, apparebunt res que sunt in eis que latebant in locis obscuris et in lucibus debilibus. Et similiter sculpture subtiles, nequit visus comprehendere earum comprehensiones in locis obscuris et in lucibus debilibus; et cum extrahuntur ad luces fortes, comprehenduntur a visu.

10 [4.19] Significatur ergo per hanc dispositionem quod luces fortes manifestant multas res visibilium et quod luces debiles occultant multas res visibiles.

[CAPITULUM 4]

[4.20] Et iterum invenimus multa corpora densa colorata coloribus scintillantibus, sicut lazuleis, et vinosis, et celestibus, quando fuerint in locis obscuris et lucibus debilibus, apparebunt colores eorum turbidi. Et cum fuerint in luce forti apparebunt colores eorum scintillantes clari, et quanto augmentabi-
5 bunt colores eorum scintillantes clari, et quanto augmentabi-

82 visibilium: visibili P3 84 quibusdam *corr. ex* quibus S 1 visui: visum R/
multe: quedam EP3R 2 invisibiles: visibiles S/*ante ex scr. et del.* latent P1/*ex inter.*
S/subtilibus¹ om. R 3 in¹ . . . obscuris: in locis obscuris vel in . . . debilibus EP3R/
cum extrahuntur (4): si extrahantur R 5 locis *corr. ex* lucis P3/obscuris (6) om. EP3R
6 et¹ om. Er/in om. R/sculpture subtiles: sculpturarum subtilium comprehensiones R
7 earum comprehensiones om. R 8 in om. R 10 significatur: signa
EErP1P3S/ *post* hanc *add.* disputationem vel EP3/dispositionem: disputationem P1/
ante quod *add.* vel disputationem Er 11 *ante* multas *add.* quasdam EP3/multas: vel
multas *inter.* EP3 (mg. a. m. E) 12 *ante* res *add.* res visibilium et quod luces debiles
occultant P1 1 multa . . . colorata: quod colores corporum densorum coloratorum
R/*ante* densa *scr. et del.* colorata P1/colorata: colora P1 2 et¹ om. R 3 *post*
quando *add.* ipsa R/apparebunt (4): apparent R; *corr. ex* apparerebunt S 4 colores
eorum *transp.* EP3; om. R/apparebunt (5): apparent R 5 *ante* clari *add.* et R/*post*
quanto *add.* magis R

tur lux super ipsum tanto augmentabitur super ipsum scintillatio coloris et claritas. Et cum fuerit aliquod istorum corporum in loco obscuro et non fuerit in eis nisi lux parva valde, illud corpus apparebit obscurum, et non distinguet visus colorem eius, et videbitur quasi niger. Et cum extrahitur ad loca luminosa lumine forti, apparebit color eius et distinguetur a visu.

[4.21] Et invenimus etiam corpora turbidi coloris quod, quando lux oritur super ipsa fortis, quod colores eorum clarescunt; et invenimus etiam quod, quando lux fortis oritur super corpora densa alba, augmentabuntur in albedine et scintillatione apud sensum.

[4.22] Et etiam invenimus corpora diafona colorata coloribus fortibus, sicut vina fortia fortis ruboris que sunt in vasis diafonis, quando fuerint in locis obscuris et lucibus debilibus, apparebunt nigra et obscura et quasi non diafona. Et cum fuerint in lucibus fortibus et oriatur super ipsa lux solis, clarescent colores eorum, et apparebit in eis diafonitas.

[4.23] Et similiter lapides diafoni colorati, quando fuerint in locis obscuris, apparebunt colores eorum turbidi et obscuri; et cum super ipsos oritur lux fortis vel ponuntur in oppositione lucis ita quod lux pertranseat ipsos, apparebunt colores eorum clari, et apparebit in eis diafonitas propter penetrationem lucis.

[4.24] Et etiam quando corpora diafona colorata ponuntur in oppositione lucis et fuerit positum ex parte contraria parti lucis corpus album, sicut diximus superius, si lux fuerit fortis, apparebit forma illius coloris in umbra eius super corpus album oppositum ei. Et si lux oriens super ipsum fuerit debilis,

6 ipsum^{1,2}: ipsa R / tanto . . . ipsum om. P1 / post tanto add. magis R / scintillatio (7): scintillant R 7 et¹ om. R / cum: si R / post aliquod scr. et del. ipsorum S 8 eis: eo R / post eis scr. et del. in eis P1 9 illud . . . apparebit: apparebit . . . illud R / visus corr. ex usus E 13 etiam . . . quod: iterum quod coloris corporum ferrei coloris R 14 post lux scr. et del. fortis S / quod . . . eorum om. R / colores . . . clarescunt (15): clarescunt . . . eorum EP3 15 ante et scr. et del. et invenimus etiam quod quando corpora turbidi coloris quod quando lux oritur super ipsa fortis quod clarescunt colores eorum E / quando om. P3 16 augmentabuntur: augmentantur R / post et add. cum P3 18 etiam: iterum R / etiam invenimus transp. EP3R / ante corpora add. quod R 20 quando: que P3 / fuerint: fuerunt E 21 apparebunt: apparent R 22 oriatur: orta R / lux solis transp. Er / clarescent (23): clarescunt P3R 23 apparebit: apparet R 24 lapides . . . colorati: colores lapidum diaphanorum coloratorum R 25 apparebunt . . . eorum: apparent R / obscuri corr. ex obscurum P3 26 oritur om. P1 / oppositione: appositione P1S 27 post lux add. per ipsos R / ipsos om. P3R / apparebunt: apparent R 28 apparebit: apparet R 30 etiam: iterum R 31 ex: in Er / parti corr. ex partis E 32 ante si add. et R 34 et . . . ei (35) om. S

35 apparebit super corpus album oppositum ei umbra tantum, et
non apparebit color.

[4.25] Et iterum invenimus pennas pavonis et pannum qui
dicitur amialmon quod diversatur in colore apud visum in di-
versis temporibus diei secundum diversitatem lucis orientis su-
40 per ipsa.

[4.26] Significant ergo iste dispositiones apparentes in col-
oribus quod colores corporum coloratorum non comprehen-
duntur a visu nisi secundum luces orientes super ipsa.

[CAPITULUM 5]

[4.27] Et cum luces fortes visibilium occultent quasdam res
que sunt in quibusdam visibilibus aliquando et aliquando mani-
festent res quasdam que sunt in quibusdam visibilibus, et
luces debiles visibilium aliquando manifestant quasdam res
5 que sunt in quibusdam visibilibus et aliquando occultant quas-
dam res que sunt in quibusdam visibilibus, et corporum color-
atorum colores aliquando alterantur secundum diversitatem
lucis que oritur super ipsa, et luces fortes orientes super visum
aliquando prohibent visum a comprehensione quorundam
10 visibilium, et visus tamen in omnibus istis nichil comprehendit
ex visibilibus nisi sit illuminata, forma ergo quod comprehendit
visus ex re visa non est nisi secundum lucem que est in illa re
visa, et secundum luces que oriuntur super visum a compre-
hensione illius rei visibilis, et super aerem medium inter visum
15 et rem visam.

[4.28] Quare vero luces fortes prohibent visum a compre-
hensione quorundam visibilium erit declaratum a nobis apud
sermonem nostrum in qualitate visionis.

35 tantum: tertium *Er* 37 iterum *om.* P3/pennas: quod pennae R/pannum: pan-
nus R 38 post dicitur *scr. et del.* al P1/amialmon: amialmon P1/quod *om.* R/ante
diversatur *add.* id est sericus viridis mixtus cum fusco roseo R/diversatur: diversifica-
tur EP3; diversificantur R/in colore *om.* P3 41 iste *om.* *Er* 43 luces: lucis *Er*
2 post visibilibus *add.* et S/manifestent (3): manifestant *Er*P1 3 ante res *add.* nobis
EP3R/res quasdam *transp.* S/quasdam *om.* P1/et . . . visibilibus (6) *mg.* S
4 manifestant: manifestent R 5 occultant: occultent R; occultantur S
7 alterantur: alterentur R 8 ipsa *corr. ex* ipsam E/ante visum *add.* ipsum EP3R
9 aliquando: ante S/prohibent: prohibeant R/ante visum *add.* ipsum EP3R
10 in *om.* *Er*/comprehendit: comprehendat R 11 post comprehendit *scr. et del.* ex
visibilibus S 13 ante visum *add.* ipsum EP3R/a: in R/a comprehensione (14) *corr.*
ex comprehensione a *Er* 16 prohibent: prohibeant R 17 quorundam visibilium
transp. P3R/visibilium *om.* E/erit declaratum: declarabitur R/apud . . . in (18): in ser-
mone nostro de R

[CAPITULUM 6]

[5.1] Oculus autem est compositus ex telis et corporibus diversis, et principium et incrementum eius est ex anteriori cerebri.

[5.2] Quoniam ex anteriori crescunt duo nervi obtici consimiles, et incipiunt oriri ex duobus locis a duabus partibus anterioris cerebri. Et dicitur quod uterque illorum habet tunicas et quod illi crescunt a duabus telis cerebri et perveniunt ad medium exterioris partis cerebri et anterioris. Deinde concurrunt et efficiunt unum nervum obticum; deinde iste nervus dividitur et efficiuntur iterum duo nervi obtici equales consimiles. Deinde extenduntur isti duo nervi donec perveniant ad duo convexa duorum ossium concavorum continentium oculos.

[5.3] Et in duobus mediis istorum duorum concavorum ossium sunt duo foramina equaliter perforata, et situs eorum ex nervo communi est situs consimilis. Illi ergo nervi intrant ista foramina duo et exeunt ad concava duorum ossium, et illic dilatantur et ampliantur, et efficitur extremitas utriusque eorum quasi instrumentum ponendi vinum in doleis. Et uterque oculorum est compositus super istam extremitatem nervi que est sicut rameh, scilicet predictum instrumentum, et consolidatur cum ipso; et situs utriusque oculorum ex nervo communi est situs consimilis.

[5.4] Et totus uterque oculus est compositus ex tunicis multis.

[5.5] Prima ergo illarum est pinguedo alba que implet concavum ossis, et est maximum oculi, et dicitur consolidativa.

1 autem *om. EErP3R/post corporibus inter. vel humoribus a. m. S* 2 anteriori: anteriore *EErRS/post anteriori add. parte R* 4 anteriori: anteriore parte *R*
5 duabus: duobus *Er/post duabus scr. et del. arcubus P1* 6 post habet *add. duas R*
7 illi *om. EP3R* 8 et *om. Er/post anterioris add. cerebri EP3R* 9 efficiunt . . .
nervum: efficiuntur unus terminus *Er* 10 iterum: etiam *Er/post equales add. et EP3R*
12 post duorum *add. oculorum EP3R/ante oculos add. duos EP3R*
13 duobus: duorum *Er/istorum om. P3/istorum . . . concavorum: concavorum . . . duorum Er/post duorum add. etiam EP3/ossium (14) om. P3* 14 duo *inter. a. m. E/*
ex: in R/post ex inter. vel in a. m. EP3 15 ergo: vero *P1/ergo nervi transp. EP3R/post*
ista *add. duo EP3* 16 foramina duo *transp. R* 20 sicut . . . scilicet *om. R/rameh: kameh Er; lameh EP3*
21 situs¹ *inter. a. m. S* 22 post consimilis *add. id est equalis EP3* 23 tunicis multis (24) *transp. Er* 25 prima *corr. ex prim a. m. P3/*
est: et *Er* 26 maximum: maxima pars *R/oculi: oculis Er*

[5.6] Et intra istam pinguedinem est spera rotunda concava nigra pluries et viridis et glauca in quibusdam oculis, et corpus istius spere est tenue et cum hoc densum et non rarum. Et manifestum eius est applicatum cum consolidativa, et interius eius est concavum; et in parte concavitatis est quasi quedam attritio. Et quasi consolidativa continet istam speram preter quam suum anterius quoniam consolidativa non cooperit anterius istius spere sed circulator super anterius eius. Et ista tela dicitur uvea quia assimilatur uve.

[5.7] Et in medio anterioris uvee est foramen rotundum perforatum usque ad eius concavum, et est oppositum extremitati concavitatis nervi super quam componitur oculus.

[5.8] Et cooperit istud foramen et omne anterius uvee in cuius circuitu circulator consolidativa extrinsecus tunica fortis alba diafona, et dicitur cornea quoniam assimilatur cornu albo claro.

[5.9] Et in pectore concavi uvee est spera parva alba humida retentibilis humiditatis, et in ea est diafonitas non intensa valde, sed in ea est aliqua spissitudo. Et diafonitas eius assimilatur diafonitati glaciei, et ideo dicitur glacialis; et nominatur hoc nomine quoniam eius diafonitas assimilatur diafonitati glaciei. Et est composita super extremitatem concavitatis nervi, et in anteriori istius spere est compressio superficialis parva, et assimilatur compressioni superficiali lenticule. Superficies ergo anterioris eius est portio superficiali spere maioris superficie sperica continente duo eius foramina, et ista compressio est opposita foramini quod est in anteriori uvee, et situs eius ab eo est consimilis.

[5.10] Et iste humor dividitur in duas partes diverse dia-

29 pluries: ut plurimum R/quibusdam corr. ex quibus S 30 cum hoc: insuper R 31 consolidativa: solidativa Er; corr. ex consolidatum P3 32 est¹ om. EP3
33 attritio: contritio Er; corr. ex contritio S/consolidativa corr. ex consolidatam a. m. E/
speram: partem EP3 34 quoniam . . . anterius¹ (35) om. P1S 35 circulator corr.
ex circularit P1/post et scr. et del. et P3 36 tela: tunica R/quia om. Er 37 ante uvee
scr. et del. ve P1 38 usque ad eius corr. ex ad eius usque S/extremitati (39) corr. ex
extremitatis EP1 40 cooperit: cooperuit P3/istud: illud P1S 42 cornea corr.
ex cornee S/quoniam: quia P3R/post albo add. et R 43 post claro scr. et del. et S
44 in . . . concavi: intra concavum R/spera parva transp. Er/parva alba transp. EP3R;
corr. ex alba parva S 45 retentibilis: receptibilis R/ante et add. formarum visi-
bilium R 46 in ea est om. R 47 ideo om. Er/et² . . . glaciei (49) om. P1RS/post
et² scr. et del. ideo E 48 assimilatur om. EP3 50 et: etiam S/ante istius scr. et del.
spere S 51 post assimilatur scr. et del. superfi P1 53 superficie: superficiali P1/
eius om. EP3/post et add. in P3 54 opposita om. EP3 55 ab: cum R/ab . . .
consimilis: consimilis est ab eo EP3R/est om. Er 56 duas partes transp. EP3R

fonitatis: et altera illarum sequitur anterieus eius, et altera
sequitur eius posterius. Et diafonitas partis posterioris eius
assimulatur diafonitati vitri quasi frustati, et ista pars dicitur
60 humor vitreus. Et continet duas partes congregatas tela valde
tenuis et quasi aranea quoniam assimulatur texture aranee.

[5.11] Et in pectore concavitatis uvee dicitur quod est for-
amen rotundum, et est super extremitatem concavitatis nervi.
Et glacialis est composita in isto foramine, et rotunditas istius
65 foraminis (et est extremitas nervi) continet medium spere glaci-
alis; et consolidatur uvea cum glaciali ex circulo continenti
istud foramen. Et dicitur quod crementum uvee est ex tunica
intrinseca duarum tunicarum duorum nervorum obticorum et
quod crementum corneae est ex tunica extrinseca duarum tuni-
70 carum istius nervi.

[5.12] Et implet concavitatem uvee humor albus tenuis
clarus diafonus, et dicitur humor albugineus quoniam assimu-
latur albumini ovi in tenuitate, albedine, et diafonitate eius. Et
ipse implet concavitatem uvee, et contingit anterieus glacialis, et
75 implet foramen quod est in anteriori uvee, et contingit concav-
um corneae.

[5.13] Et spera glacialis est composita super concavitatem
nervi, et sequitur concavitatem nervi humor vitreus. Erit ergo
cornea, et humor albugineus, et humor glacialis et vitreus con-
80 sequentes, et omnes iste tunice sunt diafone. Et foramen quod
est in anteriori uvee est oppositum foramini concavitatis nervi.
Erunt ergo inter superficiem corneae et anterieus concavitatis
nervi multe utilitates recte quoniam sunt diafona et contin-
gentia se.

85 [5.14] Et dicitur quod spiritus visibilis emittitur ex anter-
iori cerebri et implet duas concavitates duorum nervorum
primorum coniunctorum cum cerebro; et pervenit ad nervum

57 eius *om. ErP1* 59 vitri *mg. a. m. E/* frustati: frustatim *P3S*; frustratim *EErP1* / pars
om. P1 60 post duas *add. has R* 61 quasi: dicitur *R* 62 pectore: posteriore
parte *R/ante uvee add. sphaere R/* dicitur quod *om. Er* 63 est *om. P3/* concavitatis
nervi *corr. ex nervi concavitatis S* 64 ante glacialis *add. sphaera R*
66 cum *inter. E/ante ex add. in posito Er/ex: in R* 67 crementum: ortus *R*
68 intrinseca: interiore *R* 69 crementum: ortus *R/extrinseca: exteriori R*
71 uvee *corr. ex huve S* 72 humor: homor *Er; om. EP3R* 73 albumini: albugini
EP3/ante albedine add. et EP3R 74 contingit: continget *Er* 78 nervi¹: spere *P1/*
erit: erunt *R* 79 albugineus *corr. ex albuginis S/humor² om. EP3R*
81 oppositum *corr. ex compositum a. m. E* 82 erunt . . . se (84) *om. R/inter*
superficiem: in superficie *Er; corr. ex superficiem inter S/* concavitatis: concavitatem
P3; mg. a. m. E 83 utilitates: utilitatis *P3/et om. Er* 86 ante cerebri *add. parte R*
87 primorum: predictorum *Er*

communem, et implet concavitatem eius, et venit ad duos
nervos secundos obticos. Et implet ipsos, et pervenit ad
90 glaciale, et dat ei virtutem visibilem.

[5.15] Et inter circumferentiam glacialis coniunctam cum
uvea et foramen quod est in concavo ossis ex quo exit nervus
est spatium aliquantulum, et nervus extenditur in isto spatio
ex fine foraminis usque ad circumferentiam glacialis secundum
95 pyramidalitatem et amplificationem. Et quantum elongabitur a
foramine tanto magis amplificabitur quousque perveniat ad
circumferentiam spere glacialis, et consolidatur cum circumfer-
entia eius.

[5.16] Et corpus consolidative continet istam partem pira-
100 midalem nervi, et continet speram uveam, et spera uvea ante-
cedit medium consolidative ad partem manifestam oculi. Et
corpus consolidative est consolidatum cum spera uvea et cum
extremitate pyramidalis nervi et custodiens situm eius. Cum
ergo movetur oculus, movebitur secundum totum. Et sic decli-
105 nabitur nervus super quem componitur oculus apud motum
eius, et erit declinatio apud foramen quod est in concavitate
ossis, quoniam concavitas ossis continet totum oculum, et
oculus movetur secundum totum in ista concavitate.

[5.17] Et consolidativa consolidatur cum eo quod est in
110 anteriori eius ex nervo et ex tunicis residuis, et est custodiens
semper situm eius. Declinatio ergo nervi apud motum oculi
non est nisi a posteriori totius oculi; est ergo apud foramen
quod est in concavitate ossis. Et similiter quando oculus fuerit
quiescens et nervus fuerit declinans, non erit nisi apud foramen
115 quod est in concavitate ossis. Nam non alteratur situs parti-

88 eius: istius nervi *Er* 90 ei: ipsi *Er* 92 foramen *corr. ex foramine E/exit:*
erit *S* 93 aliquantulum: aliquantum *Er* 94 secundum *om. Er* 95 *post et*¹
scr. et del. amplifica P1/post quantum add. magis R/elongabitur: elongatur R 96 *ante*
tanto *add. ossis EP3R/amplificabitur: amplificatur R/ante ad add. usque Er*
97 consolidatur: consolidetur *R/cum om. ErP1* 99 consolidative: consolidata-
tem *Er* 100 *post uveam scr. et del. et spera uveam P1/uvea: uveae R*
101 consolidative: consolidatem *Er/ad ... consolidatum (102) mg. a. m. S/post partem*
scr. et del. magis S 102 consolidative: consolidatem *Er* 103 pyramidalis nervi
transp. P1S/nervi om. R/custodiens: custodiunt P1S; custodit R 104 movetur *corr.*
ex moveatur S/ante totum add. se R/declinabitur (105): declinabit R 105 componi-
tur: apponitur *Er* 108 oculus *corr. ex oculis S/ante totum add. se R/ista concavitate*
transp. P3 109 consolidativa: consolidatam *Er/consolidatur om. P1* 110 eius:
oculi *R/est custodiens: custodit R* 111 semper *alter. in super P3/declinatio:*
declaratio EP3/nervi mg. E/apud ... oculi om. P1 113 *ante ossis add. totius EP3R/*
et om. R/oculus: oculi Er/oculus fuerit transp. P1/fuerit: fuit E/fuerit quiescens (114):
quieverit R 114 fuerit declinans: declinaverit *R/post erit add. declinatio R*
115 alteratur: mutatur *R*

um totius oculi adinvicem nec apud motum nec apud quietem. Declinatio ergo nervi super quem componitur oculus non est nisi apud foramen quod est in concavitate ossis sive moveatur oculus sive quiescat.

120 [5.18] Superficies autem manifesta corneae est superficies spherica et cum hoc est continuata cum superficie totius oculi et cum toto oculo. Et totus oculus est maior sphaera uveae quae est quidam eius. Superficies autem manifesta corneae cum superficie totius oculi est et maior superficie sphaerae uveae. Semidiameter ergo eius est maior semidiametro uveae.

125 [5.19] Et superficies intrinseca corneae superposita foramini uveae est superficies concava spherica equidistans superficiei manifeste ipsius, quoniam iste locus est equalis spissitudinis. Centrum ergo istius superficiei concavae est idem cum centro superficiei manifeste convexae, et ista superficies concava secat superficiem sphaerae uveae super circumferentiam foraminis. Centrum ergo eius est remotius in profundo quam centrum uveae, quoniam hoc est certum in proprietatibus sphaerarum.

135 [5.20] Et etiam quia sphaera uveae non est in medio consolidative et est antecedens ad partem superficiei manifesti oculi, et superficies manifesta oculi est ex sphaera maiori sphaera uveae, erit centrum superficiei manifeste remotius in profundo centro uveae.

140 [5.21] Et linea recta quae continuat duo centra—scilicet centrum superficiei corneae et centrum uveae—quando extrahitur recte, pervenit ad centrum foraminis quod est in anteriori uveae et ad duo media duarum superficierum corneae equidistantium.

116 adinvicem: inter se R 117 declinatio: declaratio EP3/ante ergo scr. et del. eius P3 118 concavitate: concavo Er 120 superficies spherica (121) transp. P3
 121 cum¹ inter. E/cum hoc om. R/continuata: continua Er/cum² inter. S/totius oculi om. Er 122 post sphaera scr. et del. vitrea P1 123 ante cum add. est EP3R
 124 ante est add. est ex superficie sphaerae uveae maior sphaera uveae Er/est et transp. EP3R/et om. Er/post uveae add. sphaera ergo cornea est maior sphaera uveae Er 125 ante ergo scr. et del. e S/est maior transp. P1 126 post et add. quia R 127 concava spherica transp. EP3R/superficiei inter. a. m. E 128 post ipsius add. corneae R/iste: ille EP3/iste locus: tota cornea R 129 ante centrum add. propterea quod R/ergo istius om. R/ante est add. etiam Er; add. corneae R/est idem transp. Er 130 superficiei manifeste transp. EP3R/post superficiei add. eius P1S/ante convexae add. suae R/convexae corr. ex concave E/et ista: sed R/ante secat add. corneae R 131 post sphaera scr. et del. et ista superficies concava P3/post foraminis add. quod est in anteriori parte uveae R
 132 eius om. P1 133 certum: centrum EP1P3; om. R/sphaerarum: centrorum sphaerarum se intersecantium R 134 uveae: uvea EP3R 135 et est antecedens: sed antecedit R/manifesti: manifeste P3R 136 superficies corr. ex superfi P3/manifesta: manifesti Er/maiori: maiore R/maiori sphaera om. P3 137 post manifeste add. oculi R/centro: centri EP3 139 linea recta transp. R 140 superficiei corr. ex superficiei P3/et . . . uveae om. P1 142 superficierum: superficiei P3/equidistantium: equidistantiarum Er

Superficies enim concava corneae et superficies convexa uveae
sunt superficies sphaericae secantes se. Nam linea quae continuat
145 centra eorum transit per centrum circuli sectionis, et erit per-
pendicularis super superficiem eius, nam linea quae exit a cen-
tro circuli et est perpendicularis super superficiem eius transit
per centra duarum sperarum.

[5.22] Et superficies concava corneae contingit superficiem
150 humoris albuginei quae est in anteriori foraminis uveae, et super-
ponitur ipsi. Superficies ergo humoris albuginei etiam est su-
perficies sphaerica cuius centrum est centrum superficiei ei su-
perposite. Superficies ergo manifesta corneae, et superficies
intrinseca ipsius, et superficies humoris albuginei quae contingit
155 concavum corneae sunt superficies sphaericae equidistantes. Et
centrum earum est unum punctum commune, et est remotius in
profundo centro uveae.

[5.23] Et linea quae transit per centrum uveae, et per centrum
corneae, et per centrum foraminis quod est in anteriori uveae,
160 quando extenditur recte, transibit per medium concavitationis
nervi super quem componitur oculus, quoniam foramen quod
est in anteriori uveae est oppositum foramini quod est in pec-
tore uveae quod est extremitas concavitationis nervi.

[5.24] Et superficies anterioris glacialis etiam est sphaerica
165 superficies, et ipsa secat speram uveae; centrum ergo eius est
remotius in profundo centro uveae. Et linea recta quae continuat
duo centra eorum transit per centrum circuli sectionis, et etiam
est perpendicularis super ipsum. Et circulus sectionis inter su-
perficiem anterioris glacialis et superficiem spere uveae est aut
170 circulus distinguens finem consolidationis inter glaciale et
uveam aut equidistans ei. Quoniam superficies quae est in an-
teriori glacialis est opposita foramini quod est in anteriori
uveae, et situs eius est consimilis ex eo. Finis ergo istius super-

143 superficies² om. R 144 sunt superficies *transp.* P1/nam: et R/linea om. ErP1S/
continuat *corr.* ex contini S 145 centra: centrum P1/eorum: earum R/erit: est R
146 nam: quia R/nam . . . eius (147) *mg. a. m. E* 148 centra: centrum Er 149 *post*
et *add.* quia R 150 foraminis: foramine R/superponitur (151): supponitur P3
151 *ante* etiam *add.* convexa R 152 est centrum om. P1/ei: ipsi R; om. P3/super-
posite (153): supposite P3 154 *ante* quae *add.* convexa R 155 et centrum (156):
centrum igitur R 157 profundo *corr.* ex prop Er 158 per² om. P1S 162 quod
corr. ex quod P1/est³ om. Er/pectore (163): posteriore parte R 163 quod . . . nervi *mg.*
a. m. E 165 *ante* ergo *scr. et del.* e S/eius est *transp.* P1 167 duo om. R/eorum:
earum R/et *inter.* P1/et etiam *transp.* EP3/etiam om. ErR 169 aut: autem S; om. Er
172 quod: quae E 173 eius est: eius ex eo est situs Er; *transp.* S/eius est consimilis:
est consimilis eius EP3/ex: cum R/ex eo om. Er

ficiei--et est circulus sectionis inter duas superficies glacialis—
 175 aut est ipse circulus consolidationis aut equidistans ei.
 [5.25] Si ergo circulus sectionis inter duas superficies glaci-
 alis fuerit circulus consolidationis, iste circulus ergo est circulus
 sectionis inter superficiem anterioris glacialis et inter superfici-
 em uvee. Et si circulus sectionis inter duas superficies glacialis
 180 fuerit equidistans circulo consolidationis spere glacialis cum
 uvea (hoc quidem accidit si fuerit consolidatio in parte pos-
 teriori glacialis), erit superficies anterioris glacialis, quando
 fuerit ymaginata extensa super illud super quod est ex sua
 spera, secans speram uvee super circum equidistantem isti
 185 circulo—scilicet circulo sectionis inter duas superficies glaci-
 alis—propter consimilitudinem situs istius circuli ad circumfer-
 entiam spere uvee. Et iste circulus est equidistans circulo con-
 solidationis. Erit ergo circulus sectionis inter superficiem an-
 terioris glacialis et inter speram uveam aut ipse circulus con-
 190 solidationis aut ei equidistans. Si ergo iste circulus fuerit ipse
 circulus consolidationis, linea recta que transit per centrum
 anterioris glacialis et per centrum uvee transibit per centrum
 istius circuli, et erit perpendicularis super ipsum, quoniam iste
 circulus erit circulus sectionis inter duas superficies spericas.
 195 Et si iste circulus fuerit equidistans circulo consolidationis et
 est equidistans circulo sectionis inter duas superficies glacialis,
 est ergo cum circulo sectionis inter duas superficies glacialis in
 superficie sperica—et est superficies anterioris glacialis—et est
 equidistans ei. Linea ergo que transit per centrum uvee et per
 200 centrum superficiei antecedentis glacialis transit per centrum
 circuli consolidationis super omnes dispositiones. Et erit per-
 pendicularis super ipsum sive sit circulus consolidationis ipse
 circulus sectionis inter superficiem anterioris glacialis et inter

174 et om. *Er/post glacialis add.* et uveae *R; add.* aut est ipse circulus sectionis inter duas
 superficies glacialis *EP3* 175 circulus *corr.* ex circula *P1/ ante aut² scr. et del.* ipse
 circulus consolidationis *S* 177 ergo om. *R* 178 post glacialis *scr. et del.* fuerit
 eque *S* 179 ante uvee *scr. et del.* ve *P1* 180 spere . . . glacialis¹ (182) om. *Er*
 181 hoc: quod *R/quidem: quod P1/parte posteriori* (182) *transp. EP3R* 182 erit:
 tunc *R/erit . . . glacialis om. P1/post anterioris add.* partis *EP3* 183 ymaginata:
 mente *R/post illud scr. et del.* quod sunt *P1/super² om. P1* 184 secans: secabit *R*
 186 consimilitudinem: similitudinem *EP3R/istius: illius P1S/ad circumferentiam* (187):
 a circumferentia *Er* 187 post et *add.* quia *R* 189 et om. *Er/inter corr. ex in S*
 190 ei equidistans *transp. EP3R/iste circulus corr. ex circulus iste S* 192 per¹ om. *P1*
 193 istius: ipsius *EP3; om. P1* 194 erit circulus om. *S/post duas add.* illas *R/*
 superficies spericas *transp. R/ante spericas add.* per *EP3* 195 et: sed *R* 196 est
 om. *P3/sectionis corr. ex secta S* 198 ante sperica *add.* una *ErR/et¹:* quae *R*
 199 ei: circulo sectionis *R/uvee . . . centrum¹* (200) om. *P1* 200 antecedentis:
 anterioris *R* 201 super: secundum *ErR/erit: est R* 203 sectionis: sectionis *S*

speram uvee aut sit equidistans isti circulo.

205 [5.26] Et etiam superficies anterioris glacialis et superficies
residui glacialis sunt due superficies sperice secantes se. Cen-
trum ergo superficiei antecedentis est remotius in profundo
centro superficiei posterioris; et linea recta que continuat ista
210 duo centra transit per centrum circuli sectionis, et erit perpen-
dicularis super ipsum. Et iam declaratum est quod transit per
centrum circuli consolidationis et est perpendicularis super
ipsum, nam iste circulus aut est circulus consolidationis aut
equidistans ei. Linea ergo que transit per centrum uvee, et per
centrum anterioris glacialis, et per centrum circuli consolidati-
215 onis (et est perpendicularis super istum circulum) transit per
centrum residui glacialis.

[5.27] Et cum ista linea transit per centrum residui glacialis
et per centrum circuli consolidationis, et est erecta super
superficiem circuli consolidationis secundum angulos rectos,
220 extenditur ergo in medio concavitatis nervi super quem com-
ponitur oculus, quoniam circulus consolidationis est extremitas
concavitatis nervi.

[5.28] Et iam declaratum est quod linea transiens per cen-
trum uvee, et per centrum corneae, et per centrum foraminis
225 quod est in exteriori sive anteriori uvee extenditur in medio
concavitatis nervi. Ista ergo linea que transit per duo centra
superficiei glacialis et per centrum uvee est ipsa linea que tran-
sit per centrum corneae, et per centrum uvee, et per centrum for-
aminis quod est in anteriori uvee. Ista ergo linea transit per
230 centrum corneae, et per centrum uvee, et per duo centra super-
ficiei glacialis, et per centrum foraminis quod est in anteriori
uvee, et per centrum circuli consolidationis. Et transit per duo
media tunicarum omnium oppositarum foramini uvee, et est
perpendicularis super superficies omnium tunicarum opposi-
235 tarum foramini uvee. Et est perpendicularis super superficiem

204 aut: sive R 205 etiam: iterum R/post et² add. etiam EP3 207 antecedentis:
anterioris EP3R 208 continuat: contingit EP3/ante ista inter. vel continuat a. m. E;
mg. vel continuat P3 209 erit: est R 211 circuli mg. P3 212 nam iste: hic
vero R/iste: ipse EP3/consolidationis: sectionis R 213 et: aut Er 215 istum corr.
ex ipsum a. m. E/post per scr. et del. medium P1 217 cum om. P1/ista linea transp.
R/transit: transeat R 218 est: sit R 219 superficiem circuli: circulum R
221 post oculus inter. vel circulus a. m. E/est rep. P1 225 exteriori sive om. Er/in
medio concavitatis (226) rep. P1 228 et . . . uvee om. EP3R 229 est om. EP1S
230 per² om. Er 231 et per transp. Er 232 post uvee add. ista (229) . . .
uvee (232) Er 233 oppositarum foramini: oppositorum foraminum Er/et om. Er
234 super om. Er/superficies . . . super (235) mg. a. m. E

foraminis uvee et perpendicularis super superficiem circuli consolidationis, et extenditur in medio concavitatis nervi super quem componitur oculus.

[5.29] Et cum declaratum sit quod centrum corneae et centrum superficiei anterioris glacialis ambo sunt super istam lineam et ambo sunt remotiora in profundo centro uvee, melius est ut centrum superficiei anterioris glacialis sit ipsum centrum corneae, ita quod centra omnium superficierum oppositarum foramini uvee sint unum punctum commune. Et sic erunt omnes lineae exeuntes a centro ad superficiem oculi perpendiculares super omnes superficies oppositas foramini. Et cum hoc posterius declarabitur apud nostrum sermonem in qualitate visionis quod centrum superficiei corneae et centrum superficiei anterioris glacialis est unum centrum commune. Superficies ergo tunicarum visus oppositarum foramini uvee sunt superficies sperice quarum centrum est unum punctum commune.

[5.30] Et etiam quia istud centrum est centrum superficiei manifeste oculi continuate cum superficie continente totum oculum (et totus oculus est rotundus nisi quantum deficit de completionem spere pinguedinis consolidative a parte anteriori ipsius oculi, et iste defectus non operatur diversitatem in motu oculi quoniam non tangit concavum ossis) istud ergo centrum erit centrum totius oculi. Ergo est intra totum oculum. Centrum ergo superficierum tunicarum visus oppositarum foramini uvee est intra totum oculum.

[5.31] Cum ergo movetur oculus, non mutabitur punctus oculi quod est centrum superficierum tunicarum visus, nec mutabitur situs eius ab istis superficiebus. Sed est custodiens situm eius, nam oculus, quando movetur, non movetur nisi secundum totum, et situs partium totius adinvicem non mutatur apud motum. Et istud centrum est intra; situs ergo eius non mutatur apud suum motum. Et similiter situs tunicarum

236 *post et add. est R/perpendicularis corr. ex perpendicularium S/circuli: speculi P3; om. P1* 239 *sit: est Er* 240 *sunt: sint R* 241 *sunt: sint R* 243 *post ita scr. et del. centrum S/quod: ut R/centra: centrum EP3* 244 *sint: sunt ErS* 246 *cum hoc: hinc R* 247 *in: de R* 248 *quod: quia E/post quod add. centrum visionis et P3* 249 *post unum add. punctum Er* 251 *ante centrum add. cen P3* 252 *etiam: iterum R/quia: quod EP3* 253 *manifeste: manifesti P3/continue: concavitate P3/continente: continenti Er* 254 *nisi . . . ossis (257) om. Er* 255 *consolidative corr. ex consolidatem S/anteriori: inferiori P1S; anteriore R* 256 *ante et scr. et del. et ste P1* 258 *intra om. S* 262 *quod: qui EP3* 263 *est custodiens: custodit R* 264 *eius: suum R* 265 *ante totum add. se R/ante et add. eius EP1P3/post totius add. eius Er/adinvicem: inter se R* 267 *situs tunicarum transp. EErP3R*

visus non mutatur apud totum oculum—id est apud motum
 ipsius visus—situs ergo istius centri apud superficies tunicarum
 270 visus non mutatur nec in motu nec in quiete.

[5.32] Et iam declaratum est quod declinatio nervi apud
 motum visus et apud quietem non est nisi apud foramen quod
 est in concavitate ossis, quoniam non est nisi a posteriori toti-
 us oculi. Declinatio vero nervi apud motum visus et quietem
 275 eius non est nisi a posteriori centri eius.

[5.33] Et etiam non mutatur situs partium totius oculi
 adinvicem nec in motu nec in quiete. Situs ergo centrorum tuni-
 carum oculi apud totum oculum non mutatur nec in motu visus
 nec in quiete. Linea ergo recta transiens per centrum non mu-
 280 tat suum situm apud totum oculum nec apud partes eius, sed
 nec in motu nec in quiete. Et cum situs istius lineae non mutetur
 apud totum oculum nec apud partes eius, situs ergo istius lineae
 non mutatur apud superficiem circuli consolidationis nec apud
 suam circumferentiam. Et iste circulus est extremitas concavi-
 285 tatis nervi. Situs ergo superficiei eius a superficie concavitatis
 nervi est situs consimilis; et declinatio partis pyramidalis nervi
 super superficiem istius circuli est declinatio consimilis, quoni-
 am situs glacialis ab isto nervo est situs consimilis.

[5.34] Et cum situs partium oculi non mutatur adinvicem,
 290 superficies ergo concavitatis nervi a loco circumferentie circuli
 consolidationis usque ad locum declinationis nervi qui est pars
 pyramidalis non mutat situm eius apud totum oculum nec
 apud circumulum consolidationis.

[5.35] Et iam declaratum est quod situs lineae que transit
 295 per centra non mutatur apud circumulum consolidationis et quod
 ipsa extenditur in medio concavitatis nervi. Et cum situs istius
 lineae non mutatur apud circumulum consolidationis, nec superfi-
 cies concavitatis nervi que est a loco circumferentie circuli con-
 solidationis usque ad locum declinationis mutat suum situm

268 visus om. EP3R/id est om. Er 269 ipsius om. Er/superficies: superficiem R
 271 declinatio: declaratio P3 272 motum: motus EP3/ante non add. eius Er/apud
 foramen corr. ex foramen apud S/ante quod add. oculi EP1P3R 274 declinatio:
 declaratio P3/vero: ergo Er; om. P1/ante apud scr. et del. po S 275 eius¹ om. P1R
 276 etiam om. EP3R 277 adinvicem: inter se R 278 totum om. P1S 279 recta
 om. R/transiens corr. ex transiens S 280 post suum add. locum vel EP3R/sed: scili-
 cet EP3R 286 est corr. ex et a. m. E/declinatio: declaratio P3 288 situs¹: sicut P1
 289 cum om. EP1P3R/adinvicem: inter se R 290 nervi corr. ex nervo Er 291 ante
 usque scr. et del. nervi P1 292 eius: suum R 295 centra: centrum Er/ante non
 add. omnia R/et... consolidationis (297) om. Er 296 cum: quod EP3/ante situs inter.
 vel cum a. m. EP3/istius corr. ex ipsius S 297 lineae corr. ex lib S/mutat: mute-
 tur R 299 suum situm transp. P1

300 apud circulum consolidationis, ista ergo linea non mutat suum
situm apud concavitatem nervi quousque pervenit ad locum
declinationis. Linea ergo que transit per centrum tunicarum
visus transit per centrum circuli consolidationis, et erit erecta
super ipsum secundum angulos rectos, et extenditur in medio
5 concavitatis nervi pyramidalis quousque perveniat ad locum
declinationis nervi. Et erit situs suus semper a superficie con-
cavitatis nervi que est intra totum oculum, et ab omnibus par-
tibus oculi, et ab omnibus superficiebus tunicarum visus idem
situs, et non mutatur nec in motu visus aut in quiete eius.

10 [5.36] Isti ergo sunt situs tunicarum visus et situs centro-
rum earum et situs lineae recte transeuntis per centra earum.

[5.37] Oculi autem ambo sunt consimiles in omnibus suis
dispositionibus et in suis tunicis, et in figuris suarum tunica-
rum, et in situ cuiuslibet tunice respectu totius oculi. Et cum
15 ita est, situs cuiuslibet centrorum quorum distinctio declarata
fuit apud totum oculum et apud partes eius est sicut situs cen-
tri respondentis illi centro in alio oculo apud totum illum ocu-
lum et apud partes eius. Et cum situs centrorum in utroque
oculo est similis situi suorum respondentium in oculo reliquo,
20 erit situs lineae transeuntis per centra in uno oculorum apud
totum oculum, et apud partes eius, et apud suas tunicas simi-
lis situi lineae transeuntis per centra alterius oculi apud totum
oculum, et apud partes eius, et apud suas tunicas. Situs ergo
linearum transeuntium duarum per centra tunicarum visus ab
25 utroque oculorum est situs consimilis in omnibus suis dispo-
sitionibus.

[5.38] Et utraque consolidatarum consolidatur cum eis,
cum ex eis exeunt duo lacerti parvuli, et unus eorum est in

300 circulum *corr. ex circumferentiam P1/circulum . . . apud (1) mg. a. m. E* 1 per-
venit: perveniat R 2 centrum: centra R 3 visus *om. R/transit: pertransit P1/
circuli om. EP3R/erit: est R/erecta corr. ex erectum P3; corr. ex recta S* 6 situs . . .
semper: finis situs nervi per Er/semper *inter. E* 7 partibus . . . omnibus (8) *om. P1*
8 *post idem inter. vel idem est a. m. E* 9 aut in quiete: neque motu R 12 suis
dispositionibus (13) *transp. S* 13 in² *om. EP3R* 14 cum *inter. E* 15 est: sit
R/post situs *add. ergo R/ante quorum scr. et del. quousque P3* 16 fuit: aut S/post
eius *add. non P1/sicut situs corr. ex situs sicut Er* 17 illum oculum (18) *transp. EP3R*
19 est: sit R/situi: situs EP1P3R; situm Er; *om. S/suorum . . . reliquo om. R/in: alio
EP3/post in scr. et del. fine P1/oculo² corr. ex loc E/oculo reliquo transp. Er/reliquo
om. EP3* 20 centra: centrum R 21 apud¹ *corr. ex apart E/similis (22) corr. ex si-
mul S* 22 lineae transeuntis *transp. Er/centra: centrum R/oculi om. Er/post totum
add. illum Er* 23 oculum: locum Er 24 linearum . . . duarum: duarum . . .
transeuntium EP3R 25 oculorum: oculo R/ante suis *scr. et del. visibilibus P1*
27 consolidatarum: consolidativa Er; *om. P1/cum eis om. P1* 28 cum *corr. ex et E/
ex inter. P1/exeunt: exeant R/lacerti: lateri Er/et: quorum R/eorum om. P3R/
est: om. P3*

parte lacrimarum oculi et alius in parte posteriori. Et contin-
 30 ent utrumque oculorum palpebre et cilia.

[5.39] Hoc ergo quod declaravimus est dispositio compo-
 sitionis oculi et forma eius et forma suarum tunicarum. Et om-
 ne quod diximus ex tunicis oculi et compositione earum iam
 declaratum est ab anatomicis in libris anatomie, et ista est
 35 forma oculi.

[CAPITULUM 7]

[6.1] Iam declaratum est superius quod ex quolibet corpore
 illuminato cum quolibet lumine exit lux ad quamlibet partem
 oppositam ei. Cum ergo visus opponitur alicui rei vise et fuerit
 res illa illuminata cum quolibet lumine, ex lumine rei vise veniet
 5 lumen ad superficiem visus. Et declaratum fuit quod ex pro-
 prietate lucis est operari in visum et quod natura visus est pati
 ex luce. Dignum ergo est ut non sentiat visus lumen rei vise nisi
 ex lumine veniente ex ea ad visum.

[6.2] Et declaratum fuit iam quod forma coloris cuiuslibet
 10 corporis colorati et illuminati cum quolibet lumine associatur
 semper lumen veniens ab illo corpore ad quamlibet partem
 oppositam illi corpori, et erit lumen et forma coloris semper
 similis. Ergo cum lumine veniente ad visum ex lumine corporis
 visi erit semper forma coloris corporis visi, et cum lumen et
 15 color venient simul ad superficiem visus, et visus sentit color-
 em qui est in re visa ex lumine veniente ei ex re visa, dignius est
 ut non sit sensus visus coloris rei vise nisi ex forma coloris ve-
 nientis ad ipsum visum cum lumine.

[6.3] Et etiam forma coloris semper est admixta cum forma
 20 luminis, et non est distincta ab eo. Visus ergo non sentit lumen
 nisi admixtum cum colore. Dignius ergo est ut non sit sensus
 visus coloris rei vise et luminis quod est in ea nisi ex forma ad-

29 posteriori: posteriore R/continent (30): continuent P1 30 post utrumque scr. et
 del. olo Er/oculorum: oculum R/cilia corr. ex similia P1 31 quod om. Er 33 ex:
 de EP3R 34 anatomicis corr. ex atonatomicis Er/anatomie corr. ex anatomice P1/et
 ... oculi (35) om. R 1 quolibet corpore transp. EP3R 5 post et add. iam P1/fuit
 corr. ex est P1 6 natura: non P3/est² om. P3/post pati mg. nisi P3 7 ergo est
 transp. EP3 9 fuit: est P1/forma: forme P1/cuiuslibet corr. ex cuius P1 11 lumen
 veniens: lumini venienti R 13 similis: simul P1RS 14 semper forma transp. EP3
 15 venient: veniet Er; veniant R/post superficiem scr. et del. ve P1/visus¹ om. P1/
 et om. R 16 ei: ad se R/est²: est ergo EErP3; ergo est R 19 etiam: est Er/om. R
 20 luminis: lucis R/distincta: distantia EErP1P3S/ante ab add. vel distincta EP3S (mg.
 P3S)/eo: ea R 21 dignius: dignum P1S/post ut scr. et del. q S

mixta ex lumine et colore veniente ad ipsum ex superficie rei vise.

25 [6.4] Et etiam tunice visus que situantur ad medium anterioris visus sunt diafone contingentes se, et prima illarum, scilicet cornea, tangit aerem in quo primo venit forma. Et ex proprietatibus lucis est pertransire in quodlibet corpus diafonum, et similiter est proprietas forme coloris que associatur lumini
30 pertransire in corpus diafonum. Et ideo extenditur in aere diafono sicut extenditur lumen. Et ex natura corporum diafonorum est recipere formas lucis et colorum et redere ipsas partibus oppositis illi. Forma ergo veniens ex re visa ad superficiem visus transibit per diafonitatem tunicarum visus ex
35 foramine quod est in anteriori uvee. Perveniet ergo ad humorem glaciale et pertransibit in eo etiam secundum suam diafonitatem. Dignius ergo est ut tunice visus non fuerint diafone nisi ut pertranseant in eis forme lucis et colorum venientium ad ipsum.

40 [6.5] Aggregemus ergo modo quod componitur ex omnibus istis.

[6.6] Et dicemus quod visus sentit lumen et colores que sunt in superficie rei vise, et pertranseunt per diafonitatem tunicarum visus. Et hoc est illud in quo quiescebat opinio
45 naturalium in qualitate visionis.

[6.7] Dicemus ergo modo quod qualitas visionis non asseritur esse huiusmodi tantum, quoniam iste modus destruitur nisi addatur ei aliud, quoniam forma lucis et coloris cuiuslibet corporis colorati et illuminati extenditur in aere diafono continuato cum eo ad omnes partes oppositas. Visus autem op-
50 ponitur in eodem tempore rebus multis visis diversi coloris, et inter quamlibet earum et visum sunt in aere linee recte continu-

23 ex¹: cum R/post ex² scr. et del. circumferentia P1 25 etiam: iterum R/situantur: verticantur P1S/ante ad inter. vel situantur a. m. S 26 se om. EErP3 27 aerem om. EP3 29 associatur: associantur P1 32 colorum: coloris R; corr. ex coloris P3 33 post partibus add. sibi R/illi: illis P3; om. R; corr. ex illis a. m. E 34 ante visus¹ scr. et del. e S/transibit: transit P1/ex foramine (35): per foramen R 35 in anteriori: ex anteriore R/perveniet: pervenit Er 36 etiam om. R/suam diafonitatem (37) transp. EErP3R 37 fuerint: sint EP3R/ante diafone scr. et del. dip P3 42 dicemus: dicamus R/post quod scr. et del. istis P3/que: qui EP3R 43 post et add. quod R/pertranseunt: transeunt P3 44 illud: istud S/opinio corr. ex optio S/opinio . . . in (45): physicorum opinio de R 45 qualitate corr. ex quantitate S 46 modo mg. E/quod: forme que P3/ante visionis scr. et del. qn P1 47 esse inter. E/esse huiusmodi transp. EP3R/destruitur: destruitur S 48 ante forma add. enim R/ante et scr. et del. is P3 49 corporis om. R 50 cum corr. ex et a. m. E 51 in om. R/eodem corr. ex eadem P3/rebus multis transp. R/diversi om. Er

ato medio inter eas. Et cum forme lucis et coloris que sunt in
 re visa opposita visui venient ad superficiem visus, forme lucis
 55 et coloris cuiuslibet rerum visibilium oppositarum visui in eo-
 dem tempore veniunt in illo tempore ad superficiem visus. Et
 cum forme extenduntur ex re visa ad quamlibet partem oppos-
 itam et non perveniunt ad visum nisi propter oppositionem,
 forma que pervenit ex re visa ad visum pervenit ad totam
 60 superficiem visus. Et cum ita est, quando visus opponetur
 alicui superficiem rei vise, et pervenerit forma coloris eius et
 lucis ad superficiem visus, et viderit in illo tempore aspiciens
 alia visibilia diversi coloris opposita visui, tunc forma lucis et
 coloris cuiuslibet illorum visibilium veniet ad superficiem visus.
 65 Et erit forma omnium illorum visibilium perveniens ad totam
 superficiem visus. Perveniet ergo ad totam superficiem visus
 et in tota multa lumina diversa et multi colores diversi, et
 quodlibet illorum implet superficiem visus. Pervenit ergo in
 superficie visus forma admixta ex coloribus diversis et lumini-
 70 bus diversis.

[6.8] Si ergo visus senserit illam formam admixtam, sentiet
 colorem diversum a colore cuiuslibet illarum rerum, et non dis-
 tinguentur ab eo visibilia. Et si senserit unam illarum rerum
 visibilium et non senserit residuas, comprehendet unam rem
 75 visibilem et non alias. Sed ipse comprehendit omnia illa visi-
 bilia in eodem tempore, et comprehendit ipsa distincta.

[6.9] Et si non senserit unam illarum formarum, nichil sen-
 tiet ex ipsis visibilibus oppositis illi. Sed ipse sentit omnia.

[6.10] Et iterum erunt in eodem viso diversi colores et line-
 80 ares secundum ordinem, et a qualibet parte eius exit lumen et
 color secundum omnes lineas rectas que extenduntur in aere
 continuo. Cum ergo fuerint partes unius rei vise diversi coloris,
 veniet ad totam superficiem visus ex unoquoque illorum forma

54 venient: veniant R/forme . . . visus (56) *mg. a. m. E/post forme add. ergo R*
 55 rerum: super Er 56 veniunt: venient EP3R/in . . . tempore *om. EP3R*
 57 extenduntur: extendantur R 58 ante et *add. visui P1/perveniunt: perveniant R*
 59 ad visum *om. Er* 60 est: sit R/opponetur: opponitur EErP3R 61 rei *om. P1S/pervenerit: pervenit EP3R* 63 et *om. Er* 64 coloris cuiuslibet *transp. EP3/*
post coloris add. et ErP1S (inter. et S) 65 erit: ex P1; *om. R/perveniens . . . visus¹ (66)*
om. P1 66 perveniet: pervenient RS/ante ergo *add. et Er* 67 et in tota *om. R/*
multa lumina corr. ex lumina multa P3/colores: coloris Er 68 quodlibet: quilibet
 R/illarum: eorum Er/pervenit: perveniet R 71 visus senserit *transp. R*
 72 a colore: ad calore ErS 73 illarum *corr. ex illam P3* 74 comprehendet:
 apprehendet P1S 78 post ipsis *add. vel ex aliis EErP1R/illi: illis P3; corr. ex illis*
a. m. E 79 erunt: possunt esse R/viso: visu ErP3/et² . . . ordinem (80) *om. R*
 80 ante et¹ *scr. et del. et a qualibet E/exit: extra P3* 83 illorum: illarum R

coloris et lucis; et sic admiscebuntur colores illarum partium in
 85 superficie visus, quare visus comprehendet ipsos aut admixtos
 aut nichil comprehendet ex eis. Si vero comprehendit eos ad-
 mixtos, non distinguuntur nec ordinabuntur ab eo partes sive
 colores partium. Et si nichil comprehendit ex illis formis, nichil
 comprehendit ex partibus; et si nichil ex partibus, nichil com-
 90 prehendit ex re visa. Sed visus comprehendit rem visam illu-
 minatam oppositam sibi, et comprehendit partes eius diversi
 coloris ordinatas et distinctas.

[6.11] Et cum ita est, constat quoniam aut qualitas visionis
 erit alio modo aut erit iste modus pars modi videndi. Debe-
 95 mus ergo considerare utrum iste modus possit convenire con-
 ditionibus per quas distinguuntur colores rerum visibilium, et
 ordinantur partes eorum apud visum et erunt convenientes ad
 esse.

[6.12] Dicemus ergo quod quando visus fuerit oppositus
 100 alicui rei visibili, veniet ex quolibet puncto superficiei rei vise
 forma et coloris et lucis que sunt in ea ad totam superficiem
 visus. Et ex quolibet puncto cuiuslibet rerum visibilium op-
 positarum visui in illa dispositione etiam venient forme coloris
 et lucis que sunt in illo ad totam superficiem visus. Si ergo vi-
 105 sus senserit ex tota eius superficie formas coloris et lucis que
 veniunt ex aliquo puncto superficiei rei vise, sentiet ex tota
 eius superficie formam cuiuslibet puncti superficiei illius rei
 vise et formam cuiuslibet puncti superficierum omnium rerum
 visibilium oppositarum illi in illa dispositione. Et sic non or-

84 et² om. EErP3/admiscebuntur: permiscebuntur R 85 quare: quia P1; inter. a. m. E/visus² inter. a. m. E/visus comprehendet: comprehendit visus EP3R/ipsos: illos EErP3/aut om. EErP3R 86 aut corr. ex ad Er/ante ex scr. et del. ex P3/comprehendit: comprehendit EP3R 87 distinguuntur: distinguuntur R 88 ex: in Er/illis: istis R/formis: forma P3 89 comprehendit: comprehendit ErR/post ex¹ add. illis EP3; add. istis R/ante ex² add. comprehendit R/comprehendit (90): comprehendit P3 90 visam corr. ex viam P3/illuminatam . . . sibi (91): oppositam . . . illuminatam EP3R 93 cum inter. S/est: sit R/quoniam: quod R 94 erit¹ om. P3/post pars add. propositi R/post videndi add. intenti EP3 (videndi intenti corr. ex intenti videndi E) 96 quas om. Er/distinguuntur: distinguantur R; corr. ex distinguitur S/post et inter. per quas a. m. S 97 eorum: earum R/erunt convenientes: conveniunt R/ad esse (98): ad eorum in corpore esse EP3; ad eorum esse in corpore R 98 post esse add. eorum P1 99 dicemus: dicimus EP3R/quando visus corr. ex visus quando S 100 quolibet corr. ex quilibet P1 102 rerum visibilium transp. P3 103 post illa add. dis P1 104 illo: illis R/si ergo visus (105) om. P1 106 puncto: punctorum P1S/superficiei . . . puncti (107) mg. a. m. S 107 formam corr. ex formas Er/superficiei: superficierum EP3/illius om. EP3R 108 post superficierum add. illius (107) . . . superficierum (108) ErP1S (mg. S)/rerum visibilium (109) transp. EErP3R/rerum . . . oppositarum (109): oppositarum . . . visibilium P1S 109 oppositarum: oppositorum Er

110 dinabuntur ab eo partes unius rei vise nec distinguuntur ab eo.

[6.13] Et si senserit formam venientem ex uno puncto superficie rei vise ad totam superficiem visus ex uno puncto tantum ex superficie ipsius visus, et non senserit formam illius puncti ex tota eius superficie, ordinabuntur ab eo partes rei
 115 vise, et distinguuntur omnia visibilia opposita. Quoniam quando comprehenderit colorem puncti unius ex uno puncto tantum superficie eius, comprehendet colorem unius partis rei vise ex una parte superficie sue, et comprehendet colorem alterius partis ex alia parte superficie sue. Et comprehendet
 120 unamquamque partem visibilium ex loco sue superficie diverso ei per quem comprehendet aliam rem visibilem, quare visibilia erunt ab eo ordinata et distincta; et similiter partes cuiuslibet illorum.

[6.14] Modo ergo consideremus utrum hoc sit possibile et
 125 conveniens ad esse. Et dicamus prius quod visio non est nisi per glaciam, sive sit visio per formas venientes ex re visa ad visum sive secundum alium modum. Visio autem non est per unam aliarum tunicarum antecedentium sibi, quoniam ille tunicæ antecedentes non sunt nisi instrumenta glacialis. Quoni-
 130 am si contingit humori glaciali occasio cum salute aliarum tunicarum, destruetur visio; et si acciderit residuis tunicis occasio remanente sua diafonitate cum salute glacialis, non cassabitur visus. Et iterum si in foramine uvee fuerit opilatio et destruatür diafonitas humoris eius, destruetur visus cum
 135 salute corneæ; et si auferatur opilatio, revertetur visus. Et similiter si pervenerit intra humorem albugineum pars grossa non diafona, et fuerit in facie humoris glacialis et medians inter ipsum et foramen uvee, destruetur visio; et cum auferetur illud

110 distinguuntur: distinguuntur EP3 111 si om. P3/formam venientem inter. a. m. E 113 ex superficie: superficie R/illius: ipsius P3 114 ex om. R/rei: res Er 117 comprehendet: comprehenderet P1/rei vise (118) corr. ex vise rei P3
 118 post et scr. et del. com. P1 119 alia: illa Er 120 sue om. P3/sue superficie transp. R/post superficie add. toto ei opposito et EP3 (opposito et alter. ex et opposito E)/diverso ei (121) transp. Er 121 ante ei add. et opposito P1R/ei om. EP3/comprehendet: comprehendit R 124 possibile et conveniens (125): conveniens et possibile EP3R 125 ad om. EP3/visio corr. ex visi a. m. E 126 formas corr. ex mas S
 127 ante visum scr. et del. vi P3/est inter. a. m. E 128 sibi: ei EP1P3; se R/post sibi mg. vel sibi a. m. E 129 antecedentes om. EErP3R/instrumenta: instrumentum R
 130 contingit: contingerit R/occasio: laesio R 131 destruetur: destruitur EP3R/si om. Er 132 occasio: corruptio R/sua: ipsarum R 133 cassabitur: cessabitur P3; corrumpetur R; corr. ex cassabuntur P1/iterum: etiam R 134 ante visus scr. et del. cum Er; scr. et del. est P3 135 opilatio corr. ex opulatio S/revertetur: revertitur EP3
 136 ante intra add. visus P3/grossa: crassa R 137 humoris inter. a. m. S/medians: media R 138 cum: quando R

140 grossum vel declinabitur a verticatione recte que est inter glaci-
alem et foramen uvee ad aliquam partem, revertetur visus. Et
omnibus istis attestatur medicina.

[6.15] Destructio ergo sensus apud corruptionem glacialis
cum salute tunicarum antecedentium illi est significatio quod
sensus non est nisi per istum humorem, non per tunicas residu-
145 as antecedentes illi. Et destructio sensus apud destructionem
diafonitatis que est inter glaciale et superficiem visus per
corpus densum non translucens significat quod diafonitas is-
tarum tunicarum non est nisi ut continuetur diafonitas tunica-
rum visus cum diafonitate aeris et efficiantur corpora que sunt
150 inter glaciale et rem visam diafona continueate diafonitatis.
Et destructio sensus apud abscisionem linearum rectarum que
sunt inter glaciale et superficiem visus significat quod sensus
glacialis non erit nisi ex lineis rectis que sunt inter ipsam et su-
perficiem visus.

155 [6.16] Dicemus ergo si sensus visus ex colore rei vise et lu-
cis que sunt in eo est ex forma veniente ex rebus visis ad su-
perficiem visus, et sensus non est nisi per glaciale, ergo non
per superficiem visus sentiet visus istam formam nisi post-
quam transierit superficiem visus et pervenerit ad glaciale.
160 Et forma que venit ex re visa ad superficiem visus pertransit in
diafonitate tunicarum visus, quoniam ex proprietate diafoni-
tatis est ut transeant in ea forme lucis et colorum et extendan-
tur recte. Et iam declaravimus hoc in aere; et cum fuerint ex-
perimentata omnia corpora diafona, invenietur quod lux non
165 extendetur in eis nisi secundum lineas rectas. Et nos declara-
bimus post apud nostrum sermonem in obliquatione quomodo

139 grossum: crassum R/a inter. S/verticatione: versione EErP1P3R/ante recte add. vel
verticatione EErP3; add. linee R/post recte add. linee EP1P3 140 ante ad scr.
et del. destruetur visio S 141 post istis scr. et del. altere P3/attestatur corr. ex
attestabitur E 142 post sensus add. visus est EP3R; inter. visus a. m. S 143 illi:
illum R/post illi add. et illud EP3R; add. et Er/post est add. etiam P1S/significatio: argu-
mentum R 144 residuas (145) om. P1 145 illi: illum R 146 et om. S/ante
visus scr. et del. et superficiem S 147 post non add. est EP3/significat: est significatio
S; om. Er/quod: et EP3 148 tunicarum (149) mg. E 150 continueate: continuata
Er; continuitate R 151 abscisionem: destructionem EP3R/ante linearum mg. vel
abscisionem EP3 (a. m. E); scr. et del. line P1/rectarum om. R 152 et superficiem rep.
P1/quod rep. Er 153 inter ipsam: intra ipsum Er (alter. ex ipsum intra Er)/ipsam:
ipsum EP3R 155 ante ex add. est EP3R 156 est: et EErP3R 157 ante et scr.
et del. et non P1/non² om. P3 158 sentiet: sensiet S/nisi: sed R 159 ad glaciale
om. P3 160 que: autem Er 161 diafonitatis (162) corr. ex diafonitas S
162 forme corr. ex forma P1/extendantur (163) corr. ex extendatur Er 163 ante hoc
scr. et del. est P1 164 non om. R 165 extendetur: extenditur EErP3R/nisi om. R/
post et scr. et del. n Er/declarabimus (166): declaravimus P3 166 nostrum ser-
monem transp. EP3/in: de R

illud experimentabitur. Si ergo sensus visus lucis et coloris que sunt in re visa est ex forma veniente ad visum ex re visa, apud perventionem ipsius forme ad glaciale erit sensus. Et iam
 170 declaratum est quod non est possibile ut visus comprehendat rem visam secundum suum esse nisi quando comprehenderit formam unius puncti rei vise ex uno puncto tantum sue superficiei. Non est ergo possibile ut glacialis comprehendat rem visam secundum suum esse nisi quando comprehenderit color-
 175 em unius puncti rei vise ex forma perveniente ad ipsum ex uno puncto tantum superficiei visus. Forma autem venit ex quolibet puncto superficiei rei vise, et pertransit totam visus superficiem usque ad interius. Si vero ex eo quod venit ex uno puncto rei vise ad totam superficiem visus et pertransit tunicas visus et pervenit ad glaciale non comprehendit glacialis
 180 nisi quod venit ad ipsam ex uno puncto tantum superficiei visus, et sentit colorem illius puncti tantum ex superficie visus et pervenit ad unum punctum tantum superficiei eius, et non comprehendit illud punctum rei vise ex residua forma perveniente ad superficiem eius ex residua superficie visus, complebitur visio, et ordinabuntur partes rei vise, et distinguuntur res vise apud visum.

[6.17] Et non complebitur visio nisi sit secundum illum modum. Et hoc non potest esse ita nisi quando fuerit unum
 190 punctorum que sunt in superficie visus per quam transit forma unius puncti superficiei rei vise distinctum a punctis residuis que sunt in superficie visus, et fuerit linea super quam venit forma ad illud punctum superficiei visus distincta a residuis lineis super quas venit forma. Et propter hoc potest glacialis
 195 comprehendere formam venientem super illam lineam et ex puncto superficiei visus qui est super illam lineam, et non potest comprehendere ipsam per aliam.

167 illud: hoc R; istud S/experimentabitur: experiendum sit R 169 perventionem: pervenientem P3/post erit scr. et del. erit S 170 est¹ om. S/post est¹ add. ante hoc EP3; add. antea R/est² inter. a. m. E 171 quando corr. ex quoniam Er 172 puncti mg. E/ex . . . vise (175) mg. a. m. E/post uno scr. et del. quoque P1/sue inter. a. m. S 173 ergo possibile transp. Er 175 forma corr. ex forme S/forma perveniente corr. ex perveniente forma Er/perveniente: veniente EP3R 176 ante venit add. aut P3/venit corr. ex pervenit P1 178 eo: ei Er 181 ipsam: ipsum RS/superficiei corr. ex superficiem S 183 post ad scr. et del. illum punctum P1 184 ante illud scr. et del. eius Er 185 ante visus scr. et del. eius P1 187 vise: in se ER/post apud scr. et del. superficiem P1 188 sit om. EP3R/illum: istum EErP3R 189 modum om. P1/quando corr. ex quod P3 190 forma om. P3 193 illud: aliud Er 195 ante super scr. et del. puncto Er/lineam corr. ex lile S/et om. P1 196 qui: quod R/ante et scr. et del. et ex puncto superficiei visus que est super illam lineam E 197 ipsam: ipsum S/aliam: alia E

[6.18] Et cum inducantur luces et experimentetur qualitas transitus earum et extensionis earum in corporibus diafonis, inuenitur quod lux extenditur per corpus diafonum secundum lineas rectas, dum corpus diafonum fuerit consimilis diafonitatis. Et cum occurrerit corpus aliud diverse diafonitatis a diafonitate precedentis corporis in quo extendebatur, non pertransibit secundum rectitudinem linearum super quas extendebatur ante nisi quando ille linee fuerint perpendiculares super superficiem secundi corporis diafoni. Et si ille linee fuerint oblique super superficiem secundi corporis et non perpendiculares, obliquabitur lux apud superficiem secundi corporis, et non extendetur recte. Et cum obliquatur, extendetur in secundo corpore secundum illas lineas rectas super quas obliquabatur; et erunt linee super quas obliquabatur lux in secundo corpore etiam declinantes super superficiem secundi corporis et non perpendiculares. Et si fuerint quedam linee super quas venit lux in primo corpore perpendiculares super superficiem secundi corporis et quedam declinantes, extendetur lux que erit super lineas perpendiculares in corpore secundo secundum rectitudinem. Et que erit super lineas declinantes obliquabitur apud superficiem secundi corporis secundum lineas declinantes, et extendetur in eo secundum rectitudinem illarum linearum declinantium super quas obliquabatur. Et hoc nos declarabimus in sermone de obliuatione, et ostendemus viam per quam poterit quis experimentari istam dispositionem, et apparebit sensui, et cadet super ipsam certitudo.

[6.19] Et cum ita est, forma ergo lucis et coloris que veniunt ex quolibet puncto rei vise ad superficiem visus, quando pervenerit ad superficiem visus, nichil pertransibit ex eis per diafonitatem tunicarum visus secundum rectitudinem nisi illud

198 inducantur: iudicantur P3; inducuntur R/experimentetur: experimentator R; corr. ex experimentur S; corr. ex ex premit Er 199 earum¹: eorum Er 200 secundum: per P3 201 ante dum scr. et del. dum S 202 occurrerit: occurrent Er/aliud: istud Er 203 diafonitate corr. ex diafono P1/precedentis corporis transp. EP3R/non ... extendebatur (204/205) om. S/pertransibit (204): transibit P1 204 secundum: per P3 206 ante diafoni scr. et del. et non perpendiculares E/et corr. ex quia E/post fuerint scr. et del. s P3 208 secundi corporis transp. P3 209 et² corr. ex quia E/in om. S 210 post quas scr. et del. super obliquatur P3 214 venit lux om. P1/primo corr. ex secundo a. m. E/super² om. P3 216 ante in scr. et del. lineas E/corpore secundo (217) transp. EP3R 217 erit: erat R 219 in corr. ex inter P1 220 post super scr. et del. hoc S/post hoc scr. et del. non Er 221 nos declarabimus corr. ex declarabimus nos Er/obliuatione: refractione R 222 poterit corr. ex potuit E/experimentari: experiri R 223 ipsam: istam P1 224 est: sit R 226 ex eis om. R 227 post visus scr. et del. visus S

quod erit super lineam rectam elevatam super superficiem
visus secundum angulos rectos. Et illud quod fuerit super ali-
230 am lineam reflectetur et non pertransibit recte, quoniam dia-
fonitas tunicarum visus non est sicut diafonitas aeris contin-
gentis superficiem visus; et illud quod reflectitur ex istis formis
reflectetur etiam super lineas declinantes, non super lineas
perpendiculares extensas ex locis reflexionis. Et nulla linea
235 recta exit ad aliquod punctum superficiei visus ab uno puncto
superficiei rei vise ita quod sit perpendicularis ad superficiem
visus nisi una linea tantum, et exeunt ad eam lineae infinite
declinantes super superficiem visus. Et forma veniens secun-
dum rectitudinem perpendicularis pertransit tunicas visus
240 secundum rectitudinem perpendicularis, et omnes forme veni-
entes super lineas declinantes ad illud punctum reflectuntur ad
illud punctum, et transeunt in tunicis visus secundum lineas
declinantes etiam. Et nichil transit ex eis secundum latitudi-
nem linearum super quas venerunt nec secundum rectitudinem
245 perpendicularis erecti super illud punctum.

[6.20] Et ad quodlibet punctum superficiei visus veniunt in
eodem tempore forme omnium punctorum que sunt in super-
ficiebus omnium visibilium illuminatorum oppositorum illi in
illo tempore, quoniam inter ipsum et quodlibet punctum op-
250 positum illi est linea recta. Et a quolibet punctorum que sunt
in superficiebus visibilium illuminatorum extenduntur forme
eius super quamlibet lineam rectam que potest extendi ex illo
puncto, et forma unius puncti tantum de numero omnium
punctorum oppositorum visui que venit ad illud punctum
255 superficiei visus in illo tempore venit super perpendicularem
elevatam super illud punctum superficiei visus. Et forme
omnium punctorum residuorum veniunt ad illud punctum
superficiei visus super lineas declinantes. Et in quolibet

230 *ante lineam scr. et del. rem P3/lineam om. EP3R/reflectetur: refringetur R/pertran-*
sibit: transibit P1S 231 *sicut: nisi Er* 232 *reflectitur: refringitur R; corr. ex*
reflectatur P3 233 *reflectetur: reflectitur Er; refringetur R/lineas²: lineam P1*
234 *locis: loco EP3R/nulla: una R* 235 *post recta add. tantum R/aliquod om. EEP3R*
236 *post vise add. spere et Er/quod: ut R* 237 *nisi . . . tantum om. R/post una add.*
puncta Er 240 *omnes mg. E* 241 *super: secundum EP3R/reflectuntur:*
refringuntur R/ad²: apud EP3R 242 *illud: istud S/tunicis visus transp. Er*
243 *etiam om. R/et om. Er/transit ex eis: ex eis transit R/latitudinem (244): extension-*
em R 244 *post nec add. etiam EP3R* 245 *ante perpendicularis add. linearum R/*
perpendicularis: perpendiculariter R; alter. in perpendiculariter a. m. E/erecti: erectarum
R/illud om. P1 246 *ad: quod S* 248 *post visibilium add. etiam EP3; add. et ErR*
249 *post et add. inter Er* 250 *a quolibet: ad quodlibet P1S* 252 *eius om. R/post*
eius scr. et del. vel E/ante lineam add. secundum EP3 253 *omnium om. EP3*
256 *superficiei: superficie P3*

puncto superficiei visus transeunt in eodem tempore forme
 260 omnium punctorum que sunt in superficiebus omnium visi-
 bilium oppositorum in illo tempore. Et forma unius puncti
 tantum transit recte per diafonitatem tunicarum visus, et est
 punctus qui est apud extremitatem perpendicularis exeuntis
 ab illo puncto superficiei visus. Et forme omnium punctorum
 265 residuorum reflectuntur apud illud punctum superficiei visus,
 et transeunt per diafonitatem tunicarum visus secundum lineas
 declinantes super superficiem visus.

[6.21] Et etiam ex quolibet puncto superficiei glacialis exit
 una linea tantum perpendicularis super superficiem visus. Et
 270 exeunt ex eo lineae infinite ad superficiem visus, et erunt decli-
 nantes super ipsam. Punctum ergo superficiei glacialis ex quo
 exit perpendicularis super superficiem visus et pertransit for-
 men uvee, exeunt ab eo lineae infinite que transeunt in foramen
 uvee, et perveniunt ad superficiem visus, preter illum perpen-
 275 dicularem.

[6.22] Et extremitates omnium linearum exeuntium a punc-
 to aliquo superficiei glacialis et transeuntium per foramen uvee
 et pervenientium ad superficiem visus et declinantium super
 illam, quando fuerint ymagine reflecti secundum modum
 280 quem affirmat diversitas diafonitatis que est inter diafoni-
 tatem corporis corneae et diafonitatem aeris, perveniunt ad
 diversa loca et ad puncta diversa de numero punctorum que
 sunt in superficiebus visibilium oppositorum visui in uno
 tempore. Et nulla istarum linearum occurrit puncto quod est
 285 apud extremitatem perpendicularis. Et forme punctorum que
 sunt apud extremitates omnium istarum linearum superfi-
 cierum visibilium extenduntur secundum rectitudinem istarum
 linearum, et perveniunt ad superficiem visus, et reflectuntur ad
 idem punctum superficiei glacialis, preter formam puncti quod
 290 est apud extremitatem perpendicularis, quoniam ipsa extend-
 itur secundum rectitudinem perpendicularis et pertransit ad

260 *post omnium¹ scr. et del. visibilium P1* 261 *illo: illorum EP3* 263 *punctus:*
punctum P3/qui: quod R 265 *residuorum reflectuntur: reliquorum refringuntur*
R/illud: illum P1S 267 *super: ad EP3R* 268 *etiam om. EP3R* 270 *exeunt*
ex eo: ab eo exeunt R/ex eo om. EP3/erunt: sunt R 271 *punctum: a puncto R*
 273 *ab eo om. R* 274 *illum: illam R* 276 *extremitates corr. ex extremitas a. m. S/*
post a scr. et del. puncto P3 279 *illam: ipsam Er/ymaginate reflecti: intellectae*
refringi R 281 *corporis rep. P1/diafonitatem om. P3R; inter. a. m. E/ante aeris add.*
corporis EP3R 282 *diversa loca transp. P1* 284 *occurrit corr. ex occidit E*
 288 *post et¹ scr. et del. pere P3/ante visus scr. et del. s Er/reflectuntur: refringuntur R*
 289 *post superficiei scr. et del. con Er*

illud punctum glacialis. Si ergo glacialis sentit ex uno puncto
in eo omnes formas venientes ad ipsum ex omnibus verticati-
onibus, sentiet ex omni puncto formas admixtas ex multis
295 formis diversis et coloribus multis visibilium oppositorum visui
in illo tempore. Et sic nichil distinguetur ab eo ex punctis que
sunt in superficiebus visibilium nec ordinabuntur forme punc-
torum venientes ad illud punctum. Et si glacialis senserit ex
uno puncto eius illud quod venit ad ipsum ex una verticatione
300 tantum, distinguuntur ab eo puncta que sunt in superficiebus
visibilium.

[6.23] Et nullum punctorum quorum forme perveniunt ad
glacialem super lineas reflexas est dignius alio ex formis reflex-
is, nec ulla verticatio reflexa est dignior alia; et forme reflexe
5 ad unum punctum glacialis in uno tempore sunt multe, non
determinate. Et punctum cuius forma venit secundum recti-
tudinem perpendicularis ad unum punctum glacialis fuit unum
punctum tantum; et nulla alia forma venit cum ea secundum
rectitudinem perpendicularis, quoniam omnes forme reflexe
10 non reflectuntur nisi secundum lineas declinantes. Et etiam
cum centrum superficiei visus sit idem cum centro superficiei
glacialis, linea que est perpendicularis super superficiem visus
est perpendicularis super superficiem glacialis. Forma ergo
que venit super perpendicularem distinguitur ab aliis formis
15 duabus dispositionibus quarum altera est quod ipsa extendi-
tur a superficie rei vise ad punctum glacialis super lineam rec-
tam, et residue veniunt super lineas reflexas. Altera autem est
quod ipsa perpendicularis erecta super superficiem visus est
perpendicularis super superficiem glacialis etiam, et lineae re-
20 sidue super quas veniunt forme residue reflexe sunt declinan-
tes super superficiem glacialis, quoniam sunt declinantes super
superficiem visus.

293 in eo om. R/post eo scr. et del. quod P1 294 sentiet corr. ex sentiat E 295 et:
ex EErP3 297 ante in scr. et del. ex P1 298 et: at R 299 puncto eius: sui puncto
R/post ad scr. et del. punctum S/ipsam Er 300 distinguuntur: distingue-
tur Er 3 reflexas: refractas R/reflexis (4): refractis R 4 ulla: illa S/verticatio
reflexa transp. EP3R/reflexa: refracta R/dignior corr. ex dignor P3/reflexe: refractae R
5 non inter. a. m. S 7 ad . . . perpendicularis (9) mg. a. m. E/fuit: est R 9 reflexe:
refractae R; corr. ex rex P3 10 non reflectuntur om. P3/reflectuntur: refringuntur R/
etiam om. P1R 12 ante glacialis scr. et del. visus S/ante super add. ad unum punctum
glacialis P1S 15 dispositionibus: disputationibus P1; corr. ex disputationibus S/
ipsa om. P1 17 post lineas scr. et del. rectas Er/reflexas: refractas R 18 ipsa: ista
Er/erecta: recta Er/erecta . . . superficiem corr. ex super . . . erecta Er/est . . . superficiem
(19) om. P1/post est add. etiam R 19 etiam om. RS/residue (20) corr. ex residuee S
20 reflexe: refractae R/post sunt add. super P3 21 glacialis . . . superficiem (22) om.
R; mg. a. m. E

[6.24] Et operatio lucis venientis super perpendiculares est
fortior operatione lucis venientis super lineas inclinatas. Dig-
25 nius ergo est ut glacialis non sentiat ex quolibet puncto nisi
formam venientem ad ipsum secundum rectitudinem perpen-
dicularis tantum, et non sentiat ex illo puncto illud quod venit
ad illud punctum secundum verticationes reflexas.

[6.25] Et etiam cum centrum superficiei visus et centrum
30 superficiei glacialis sit idem punctum, omnes perpendiculares
elevate super superficiem glacialis et superficiem visus concur-
runt super centrum commune, et erunt dyametri in superficie-
bus tunicarum visus. Et erit quolibet perpendicularis occurrens
superficiei corneae in uno puncto et occurrens superficiei glaci-
35 alis in uno puncto, et non exit ad illud punctum corneae nisi una
perpendicularis tantum, nec exit ad illud punctum glacialis nisi
illa perpendicularis tantum. Forma ergo que exit ex quolibet
puncto superficiei rei vise super perpendicularem que extendi-
tur ab eo ad superficiem visus occurrit superficiei visus super
40 unum punctum super quod non occurrit ei aliqua alia forma-
rum venientium non super perpendiculares. Et etiam iam
declaratum est quod ex quolibet puncto cuiuslibet corporis
colorati et illuminati cum quolibet lumine exeunt lux et color
super quamlibet lineam rectam que poterit extendi ab illo
45 puncto.

[6.26] Inter ergo quodlibet punctum oppositum alicui su-
perficiei et quodlibet punctum illius superficiei est linea recta
ymaginabilis, et inter illud punctum et totam illam superficiem
est piramis ymaginabilis cuius conus est illud punctum et cuius
50 basis est illa superficies. Et illa piramis continet omnes lineas
rectas ymaginatas que sunt inter illud punctum et omnia punc-
ta illius superficiei.

[6.27] Cum ergo forma lucis et coloris exierint a quolibet
puncto superficiei corporis colorati illuminati super quamlibet

24 inclinatas *corr. ex* declinantes P3 26 *post* ipsum *add.* punctum R/secundum:
super R/*post* rectitudinem *scr. et del.* glacialis P1 27 sentiat: sentit P1S/illud
om. P1S 28 reflexas: refractas R 29 etiam: iterum R 31 *post et add.* su-
per Er 32 super: apud Er 33 *post* visus *add.* perpendiculares super ipsas tunicas
visus R 35 illud: istud S 36 tantum *om.* R/nisi *corr. ex* ubi S 37 illa: ipsa
EP3; una R/*post* illa *add.* ipsa Er/ex: a R; *corr. ex* aq S 40 non . . . ei: ei . . . occurrit
EP3R/aliam: forma Er/formarum (41): forma E 41 venientium non *transp.* R/non
om. S/perpendiculares: perpendicularem P3/etiam: iterum R;*om.* P1S 42 declara-
tum: determinatum P1RS/quod *om.* Er 46 inter ergo *transp.* R/*post* punctum *add.*
visus et quodlibet punctum EP1P3R (*post* punctum *scr. et del.* totum E)/superficiei (47)
om. ES 48 totam *om.* EP3R 49 conus: vertex R 50 est *rep.* P3 51 ymagi-
natas: intellectas R

55 lineam rectam que poterit extendi ab illo puncto ad quodlibet
punctum oppositum corpori illuminato et colorato, forma lucis
et coloris que sunt in superficie illius corporis extenditur a
quolibet puncto superficiei illius corporis ad illud punctum
60 oppositum illi super lineam rectam extensam inter ipsum cor-
pus et illud punctum. Forma ergo lucis et coloris cuiuslibet
corporis colorati et illuminati cum quolibet lumine extenditur a
sua superficie ad quodlibet punctum oppositum illi superficiei
secundum verticationem pyramidis que formatur inter illud
punctum et illam superficiem. Et erit forma ordinata in illa
65 piramide per illas lineas concurrentes ad illud punctum qui est
conus pyramidis sicut est ordinatio in partibus coloris qui est
in superficie illius corporis.

[6.28] Cum ergo fuerit visus oppositus alicui rei visibili,
formabitur inter punctum qui est centrum visus et superficiem
70 illius rei vise pyramis ymaginata cuius conus erit centrum visus
et basis erit superficies illius rei vise. Et cum aer medians inter
illam rem visam et visum fuerit continuus, et non fuerit medi-
um inter rem visam et visum corpus densum, et fuerit illa res
visa illuminata cum quolibet lumine, erit forma lucis et coloris
75 que sunt in superficie illius rei vise extensa ad visum secundum
verticationem illius pyramidis. Et erit forma cuiuslibet puncti
superficiei illius rei vise extensa secundum rectitudinem linee
que est inter illud punctum et conum pyramidis quod est cen-
trum visus.

80 [6.29] Et quia centrum visus idem est cum centro super-
ficiei glacialis, erunt omnes iste linee perpendiculares super
superficiem manifesti oculi, et super superficiem glacialis, et
super omnes superficies visus equidistantes. Et erit pyramis
continua super omnes istas perpendiculares continens omnes
85 istas perpendiculares et aerem in quo extenditur forma a tota

56 *post oppositum scr. et del. illi P1* 57 *extenditur: extendetur R/post extenditur scr. et del. cum E/ante a add. forma EErP3* 58 *punctum oppositum (59) corr. ex oppositum punctum P3* 59 *corpus (60) om. Er* 61 *colorati corr. ex coloratis P3*
62 *sua superficie transp. P1* 64 *post superficiem scr. et del. super Er* 65 *illas om. Er/illas lineas transp. R/qui: quod EP3R* 66 *conus: corpus P3; vertex R* 67 *illius corporis corr. ex corporis illius Er/corporis: coloris P3* 68 *cum: qui P1/fuerit visus transp. ErR* 69 *qui: que P1; quod RS* 70 *ymaginata: imaginabilis R/conus: vertex R* 71 *cum aer corr. ex aer cum S/medians: medius R* 72 *continuus corr. ex continuans P1* 73 *visum: visus S/illa rep. P3* 74 *erit: extendetur R*
75 *extensa om. R* 76 *erit: extendetur R* 77 *extensa om. R/post secundum scr. et del. verticationem vel E* 78 *illud: istud S/conum: verticem R/post conum add. illius EP3R/quod: qui EP3R/post est² add. inter EP3 (scr. et del. E)* 80 *quia om. EErP3/post centro scr. et del. glaciei P1* 81 *iste: ille Er* 82 *manifesti om. R/super om. R* 83 *superficies corr. ex superficicies P3* 85 *a: si Er*

superficie illius rei vise opposite visui secundum verticationes
 perpendicularium. Et erit superficies glacialis secans istam
 piramidem, et sic pervenit forma lucis et coloris que sunt in
 superficie illius rei vise in partem superficiei glacialis quam
 90 distinguit piramis. Et ad quodlibet punctum istius partis su-
 perficiei glacialis veniet forma puncti oppositi superficiei rei
 vise secundum rectitudinem perpendicularis exeuntis ab illo
 puncto superficiei rei vise super superficies tunicarum visus et
 super superficiem glacialis. Et pertransit diafonitatem tunica-
 95 rum visus secundum rectitudinem illius perpendicularis, et non
 pertransit cum illa forma secundum rectitudinem illius perpen-
 dicularis alia forma. Et erit ista forma perveniens ad istam
 partem glacialis ordinata in ea secundum lineas super quas
 pervenit ad ipsam que sunt perpendiculares ad ipsam et con-
 100 currentes apud centrum visus sicut ordinatio partium super-
 ficiei rei vise. Et cum hoc veniunt in illa dispositione ad quod
 libet punctum huius partis superficiei glacialis multe forme a
 multis punctis superficierum visarum in eodem tempore. Per-
 veniunt ergo in ista parte superficiei glacialis que distingueba-
 105 tur a piramide multe forme ex multis coloribus diversis.

[6.30] Si ergo glacialis senserit ex parte distincta per pira-
 midem formam venientem ad ipsam ex verticatione illius pira-
 midis tantum, nec non senserit ex illa parte sue superficiei ali-
 am formam nisi formam venientem super illam verticationem,
 110 sentiet formam illius rei secundum suum esse, et sentiet ordi-
 natam secundum suam ordinationem. Et poterit etiam sentire
 in illa dispositione formas aliarum rerum visarum, preter illam
 rem visam, ex pyramidibus distinguentibus ex sua superficie
 alias partes ab illa parte, et poterit sentire formam cuiuslibet
 115 illarum rerum visarum secundum suum esse et sentire situs ea-

87 erit *om. R*/secans: secabit *R* 88 lucis *corr. ex luci P3* 89 glacialis *om. R*/post
 quam *add. comprehendit vel EP3* 90 distinguit: comprehendit *R*/ante et *scr. et del.*
 et ad quodlibet punctum istius partis superficiei glacialis quam distinguit piramis *Er*/
 partis *om. EP3R* 92 ab: ob *P1*/illo: isto *EP3R* 93 superficies: superficiem *R*
 94 pertransit: pertransibit *R* 95 visus *om. P1S*/non . . . forma (96): cum illa forma
 non pertransit *S* 96 pertransit: pertransibit *R* 97 et . . . forma *om. P3*/erit *om.*
R/perveniens: perveniet *R* 98 post lineas *add. rectas EP3R* 99 post ipsam¹ *inter.*
 vel ipsum *a. m. E*/que . . . ipsam *om. Er* 101 rei vise *corr. ex vise rei P1*/et cum hoc:
 praeterea *R* 104 ista *rep. P1*/ista parte: istam partem *R*/distinguebatur (105):
 distinguetur *Er* 106 post parte *add. diversa P1S* 107 ipsam: se *R*/illius:
 ipsius *Er* 108 non *om. P1R*/sue *om. P1* 109 nisi formam *om. P1* 110 sentiet²
corr. ex senten E 111 poterit *corr. ex potuit a. m. E* 112 ante rerum *add. partium*
P1/rerum visarum *transp. P3* 113 pyramidibus *corr. ex piramide P1* 114 poterit:
 potuit *EP3* 115 illarum *om. R*/illarum rerum *transp. EP3*

rum adinvicem secundum suum esse.

[6.31] Et si glacialis senserit formas venientes ad ipsam ex
 verticationibus reflexis, sentiet ex eadem parte que distingue-
 batur ex sua superficie per illam piramidem formas admixtas
 120 ex formis partium illius rei vise et ex formis multarum rerum
 visarum diversarum, et erunt admixte ex multis coloribus di-
 versis. Et sentiet ex qualibet parte sue superficiei, preter illam
 partem, formam admixtam ex formis multarum rerum visarum
 diversarum, et sic non sentiet formam venientem secundum
 125 piramidis verticationem secundum suum esse, nec aliquam
 formarum venientium super perpendiculares secundum suum
 esse, nec aliquam formarum venientium ex verticationibus re-
 flexis. Non sentiet ergo formam unius rei vise secundum suum
 esse, nec distinguuntur ab ea res vise opposite illi in eodem
 130 tempore.

[6.32] Sed visus comprehendet res visas distinctas, et
 comprehendet partes unius rei vise ordinatas secundum suum
 esse in superficie rei vise, et comprehendet res visas multas
 simul in eodem tempore. Et cum visio est ex formis venienti-
 135 bus ex rebus visis ad visum, nichil sentiet glacialis ex formis
 rerum visarum ex verticationibus reflexis.

[6.33] Et etiam nulla formarum pervenientium ad super-
 ficiem glacialis ex formis rerum visarum ordinabitur in super-
 ficie glacialis secundum suum esse, nec ulla formarum partium
 140 unius rei vise pervenientium ad superficiem glacialis ordinabi-
 tur in superficie glacialis secundum suum esse in superficie rei
 vise nisi forme pervenientes ad eam secundum rectitudinem
 perpendicularem elevatarum super superficiem visus tantum.
 Situs autem formarum reflexarum apud superficiem visus eti-
 145 am perveniunt in superficiem glacialis conversi. Et pervenit
 forma unius puncti cum hoc in portione superficiei glacialis,

116 adinvicem: inter se R 117 ipsam: se R 121 visarum *om.* P1/visarum
 diversarum *transp.* S 123 admixtam: permixtam R/visarum *om.* R/visarum
 diversarum (124) *transp.* S 124 diversarum *om.* P1 125 piramidis *corr.* ex
 piramidem P1 126 formarum: formam EP3R/venientium: venientem R/perpen-
 diculares: perpendicularem R 127 formarum: formam EP3R/venientium: ve-
 nientem R/reflexis (128): refractis R 131 comprehendet: comprehendit EP1P3R/
 res *om.* S 132 comprehendet: comprehendit R/suum esse (133) *transp.* EP3
 133 comprehendet: comprehendit P1RS 134 visio: viso *Er*/est: sit R 136 *ante*
ex scr. et del. i *Er*/reflexis: refractis R 137 etiam: sic EP3R/formarum: forma EP3
 139 nec . . . esse (141) *om.* *Er*/formarum: forma EP3 140 ordinabitur (141) . . .
 glacialis (141) *om.* P1 142 pervenientes: pervenientis P3/eam: eas S
 143 perpendicularem: perpendicularem *Er* 144 reflexarum: refractarum R/etiam
 (145) *om.* *Er*; *corr.* ex et a. m. E 146 *ante* forma *add.* insuper R/cum hoc *om.* R/
 portione: portionem R

non in uno puncto, et illud est quia forma puncti dextri apud
visum, quando extendetur ad punctum superficiei visus, et
fuerit linea super quam extendetur forma declinans super su-
150 perficiem visus, reflectetur ad partem sinistram a perpendicu-
lari que extenditur a centro visus ad illud punctum sue super-
ficiei. Et pervenit forma que reflectitur ab extremitate perpen-
dicularis secundum hunc modum ad punctum sinistram a
puncto superficiei glacialis super quod abscindit illam illa per-
155 pendicularis. Et similiter forma puncti sinistri a visu que ex-
tenditur ad illud idem punctum superficiei visus et declinat
super ipsam reflectetur ad punctum dextrum a perpendiculari
et a puncto superficiei glacialis quod est super illam perpen-
dicularem. Quoniam forme reflexe non appropinquant post
160 reflexionem perpendiculari exeunti a loco reflexionis, et non
perveniant per applicationem forme perpendiculari, nec per-
transeunt ipsam nec procedunt, quoniam hec est proprietas
formarum reflexarum.

[[6.34] Et similiter forme duorum punctorum que sunt in
165 eadem parte a visu que exeunt ad unum punctum superficiei
visus et declinant super ipsam in eadem parte perveniunt in
superficie glacialis converse, quoniam due linee super quas
extenduntur due forme punctorum secant se ad punctum su-
perficiei visus super quod concurrunt due forme, et occurrunt
170 perpendiculari exeunti ad illud punctum superficiei visus su-
per illud punctum. Cum ergo iste due linee fuerint declinantes
a superficie visus in eadem parte a perpendiculari exeunti a
centro visus ad illud punctum, reflectuntur forme duorum
punctorum ad partem oppositam illi parti. Et etiam quia due
175 linee super quas extenduntur due forme ad unum punctum
superficiei visus secant se super illud punctum, oportet quod,

147 uno puncto: unum punctum R/quia: quod EErP3R 148 ad: apud P3/punctum
corr. ex visum P3 149 fuerit om. R/declinans: obliqua R 150 reflectetur:
refringetur R; corr. ex extendetur P3 151 extenditur: extendetur EP3R 152 post
que scr. et del. ex P1/reflectitur: refringitur R 154 superficiei glacialis transp. EP3R/
abscondit: abscondit Er 155 extenditur (156): extendetur R 157 reflectetur:
reflectitur EP3; refringetur R 159 reflexe: refractae R/non om. Er 160 reflexi-
onem: refractionem R/reflexionis: refractionis R/non inter. a. m. S 161 per: ad Er/
perpendiculari: ad perpendicularem R/post nec add. post reflexionem EP3; add. post
refractionem R 162 post ipsam add. post reflexionem P1/procedunt: precedunt
EERs/hec S 163 formarum: forma P1/reflexarum: refractarum R; corr. ex
reflexia P1 167 superficiei: superficiem R 168 ante due scr. et del. duorum
punctorum P3/punctorum: puncti Er/ad: apud Er 169 post et scr. et del. conti P1/
occurrunt lac. Er 173 reflectuntur: refringuntur R 174 partem: punctum EP3R/
oppositam: oppositum EP3R/ante illi scr. et del. in eadem parte a perpendiculari Er/
etiam quia transp. P3/quia inter. E 175 extenduntur: extendentur P1 176 secant
om. P3/quod om. R

quando extenduntur secundum suam rectitudinem post sectionem, ut appareat situs eorum conversus in respectu eius qui est in re visa et etiam respectu perpendicularis. Et efficitur
 180 linea que erat dextra ante suam perventionem ad superficiem visus ex illis duabus lineis sinistra post suum pertransitum in superficie visus et sinistra dextra.

[6.35] Et similiter erit situs duarum linearum super quas reflectentur due forme ex uno puncto superficiei visus, quoniam
 185 am due forme que reflectuntur ex uno puncto appropinquant ambo perpendiculari, et extenditur forma que erat super lineam remotiorem a perpendiculari post sectionem super lineam remotiorem etiam a perpendiculari, sed minoris remotionis quam linea super quam erat. Et extenditur forma que erat
 190 super lineam propinquiorem perpendiculari etiam post sectionem super lineam propinquiorem perpendiculari etiam, sed maioris propinquitatis quam linea super quam erat, et similiter omnes forme que reflectuntur ab uno puncto.

[6.36] Et cum hoc fuerit experimentatum experimentatione
 195 subtili, inveniatur secundum quod diximus. Et nos ostendemus viam per quam experimentabitur hoc experimentatione vera apud nostrum sermonem in reflexione, et tunc discooperientur omnia dependentia a reflexione. Et nos non utemur illic in declaratione rerum quibus usi fuimus in isto tractatu ex illis
 200 que declaravimus in isto tractatu per istas res.

[6.37] Duo ergo puncta declinantia ad unam partem a re visa, quando forme eorum extenduntur ad unum punctum superficiei visus, secabunt se super duas lineas quarum situs erit apud visum in respectu rei vise econverso a situ duarum linearum
 205 primarum super quas extendebantur due forme ad superficiem visus. Erit ergo situs duorum punctorum superficiei

178 appareat *corr. ex apparet E* 179 etiam respectu *transp. EP3R/respectu inter. a. m. E* 181 ex . . . visus (182) *mg. a. m. S/illis . . . lineis: lineis . . . duabus EP3/pertransitum corr. ex transitum E* 184 reflectentur: refringetur *R; corr. ex refel P3/*
due corr. ex de a. m. S 185 que reflectuntur *inter. a. m. S/reflectuntur: refringuntur R* 186 forma *inter. a. m. E* 187 ante post *scr. et del. sed minoris S* 188 remotiorem: propinquiorem *Er/minoris: maioris Er* 190 propinquiorem *om. P1/perpendiculari corr. ex perpendicularem P1/etiam om. P1/sectionem (191) corr. ex lineam P3* 191 propinquiorem *om. P1/perpendiculari etiam transp. R/ante etiam scr. et del. et S/sed: si Er* 194 hoc *om. EP3R/experimentatione: experimentum P3*
 196 experimentabitur hoc *om. P3* 197 in reflexione: de refractione *R/ante et scr. et del. vera P3* 198 reflexione: refractione *R/nos corr. ex no S/illic: illi S* 199 declaratione: demonstratione *P1R; declinatione S/rerum: rebus R/usi corr. ex nisi S/ex . . . tractatu (200) mg a. m. S/ex . . . res (200) om. R* 204 econverso: econtrario *EErP3S; contrarius R/a situ: situi R*

glacialis ad que perveniunt due forme econtrario situi duorum
 punctorum ex quibus veniunt due forme. Omnes ergo forme
 que reflectuntur ab uno puncto superficiei visus perveniunt in
 210 superficiei glacialis converse.
 [6.38] Et etiam forma cuiuslibet puncti oppositi visui venit
 ad totam superficiem visus; igitur reflectetur a tota superficie
 visus. Et forma que reflectitur a tota superficie visus reflecti-
 tur ad partem alicuius quantitatis superficiei glacialis, non ad
 215 unum punctum, quoniam forme reflexionis, si concurrerint post
 reflexionem super unum punctum, secarent perpendiculares
 apud quarum extremitates reflectebantur, aut pertransirent
 ipsas, aut exiret forma a superficie in qua reflectebatur. Sed
 nulla forma reflexa occurrit perpendiculari apud cuius extre-
 220 mitatem fuit reflexa post reflexionem, nec pertransit illam, nec
 exit a superficie in qua fuit reflexa. Et omnia ista manifestan-
 tur apud experimentationem. Forma ergo unius puncti rei vise
 que pervenit in superficie glacialis per reflexionem non erit in
 uno puncto sed in parte alicuius quantitatis superficiei glaci-
 225 alis. Et non erit situs formarum punctorum diversorum super-
 ficiei rei vise que perveniunt in superficie glacialis per reflexi-
 onem adinvicem sicut situs earum secundum suum esse in su-
 perficiebus rerum visarum, sed econtrario. Nulla ergo forma-
 rum reflexarum rerum visarum pervenientium ad superficiem
 230 glacialis est secundum suum esse in superficiebus rerum visa-
 rum. Et iam declaratum est quod forme venientes super per-
 pendiculares ordinantur in superficie glacialis secundum suum
 esse, quoniam extenduntur recte a superficiebus rerum visarum
 ad superficiem glacialis. Nulla ergo formarum rerum visarum
 235 venientium ad superficiem glacialis ordinatur in superficie

209 reflectuntur: refringuntur R 210 superficiei: superficiem R 211 etiam:
 iterum R 212 igitur reflectetur: ergo refringetur R 213 reflectitur¹: reflectetur
 Er; refringitur R/reflectitur (214): refringitur R; reflectetur S 215 post punctum scr.
 et del. ?? Er/reflexionis: refractionis R/concurrerint: concurrerent R 216 reflexio-
 nem: refractionem R 217 reflectebantur: reflectabantur P1S; refringeabantur R/
 pertransirent corr. ex pertransierent S 218 reflectebatur: reflectabatur E; refringeba-
 tur R 219 reflexa: refracta R/occurrit: concurrit P1; corr. ex accidit a. m. E; corr. ex
 concurrit a. m. S 220 fuit: fuerit EP3R/reflexa: refracta R/post . . . reflexa (221) mg.
 a. m. S/reflexionem: refractionem R 221 exit: erit P1/reflexa: refracta R/manif-
 estantur (222): mani P1 222 apud: per R/ergo: igitur P1 223 per: post R
 225 post formarum add. rerum diversarum vel EP3R/superficiei (226): superfici-
 erum P3 226 perveniunt: veniunt P1S/superficie: superficiem R/reflexionem
 (227): refractionem R 227 adinvicem: inter se R/situs corr. ex. finis a. m. E
 228 sed . . . visarum (230/231) mg. a. m. E/econtrario: contrarius R 229 reflexarum:
 refractarum R; om. Er 234 post glacialis add. et (231) . . . glacialis (234) Er (om. super/
 quoniam: quia/om. recte/om. rerum); scr. et del. et (231) . . . glacialis (232) E
 235 venientium: pervenientium Er

glacialis secundum suum esse in superficiebus rerum visarum nisi forme extense super verticationes perpendicularium tantum.

[6.39] Si ergo sensus rerum visarum sit ex formis venientibus ad ipsum ex superficiebus rerum visarum, nichil comprehendet visus ex formis rerum visarum pervenientium ad ipsum nisi ex verticationibus linearum quarum extremitates concurrunt apud centrum visus tantum, quoniam visus nichil comprehendit ex formis rerum visarum nisi ordinatum secundum suum esse in superficiebus rerum visarum.

[6.40] Et etiam cum centrum superficiei visus non est centrum superficiei glacialis, lineae recte quae exeunt a centro superficiei visus, et extenduntur in foramine uveae, et perveniunt ad res visas non erunt perpendiculares super superficiem glacialis sed declinantes super ipsam; nec situs earum super superficiem glacialis erunt situs consimiles nisi una linea tantum, et est quae transit per duo centra. Formas ergo venientes a superficiebus rerum visarum ad superficiem glacialis non potest sentire glacialis nisi ex verticationibus istarum linearum tantum—scilicet quae sunt perpendiculares super superficiem visus quae est superficies corneae. Quoniam forme quae sunt super istas perpendiculares tantum sunt ordinate in superficie glacialis secundum ordinationem earum in superficiebus rerum visarum.

[6.41] Si ergo glacialis comprehendat res visas ex formis venientibus ad ipsam et non comprehendat formam nisi ex verticationibus istarum linearum, et iste lineae non sunt perpendiculares super superficiem eius, comprehendet tunc formas ex verticationibus quarum situs a sua superficie sunt diversi situs et declinantes super suam superficiem. Et comprehendit formas ex verticationibus diversorum situum declinantibus, et comprehendit omnes formas reflexas ex verticationibus diver-

236 *post esse add. quod habent EP3R/post rerum scr. et del. rerum S* 237 *extense:*
extente P3 240 *ad ipsum inter. a. m. S/ipsam: ipsam Er* 241 *pervenientium:*
pervenientibus R/ipsam: ipsam Er 242 *linearum om. EP3R* 244 *post ex scr. et*
del. ex Er/ordinatum: ordinatarum P3 246 *etiam: iterum R; om. EP3/cum: si R*
248 *in inter. a. m. S* 249 *erunt om. S* 250 *post super¹ scr. et del. superficiem*
glacialis (251) P1 251 *post nisi add. in Er/una inter. a. m. S/et est: scilicet R*
252 *post duo scr. et del. for P1* 253 *sentire corr. ex seire Er* 255 *ante super scr. et*
del. super P1 256 *istas perpendiculares (257): istam perpendicularem EP3*
258 *earum: eorum P3* 259 *glacialis mg. a. m. E/comprehendat: comprehendit EP3R*
260 *ipsam: ipsum P3S; se R/comprehendat: comprehendit EP3R* 261 *post iste scr.*
et del. no S/post non scr. et del. I E/sunt: sint Er 263 *sua superficie transp. EP3R*
264 *comprehendit: comprehendet R* 265 *et om. Er* 266 *reflexas: refractas R*

sorum situum apud suam superficiem. Et si comprehendisset
omnes formas reflexas ex verticationibus diversorum situum,
nichil distinguetur ab ea ex rebus visis, propter hoc quod de-
270 claratum est superius. Et cum non est possibile ut comprehen-
dat formas reflexas ex verticationibus diversorum situum, non
est possibile ut comprehendat formas rerum visarum ex verti-
cationibus linearum que sunt perpendiculares super superfici-
em visus nisi quando lineae iste fuerint perpendiculares super
275 superficiem eius et fuerint situs eorum in superficie eius con-
similes. Et iste lineae non erunt perpendiculares super super-
ficiem suam nisi quando centrum sue superficiei et centrum
superficiei visus fuerint idem punctum. Si ergo sensus visus
rerum visarum est ex formis venientibus ad ipsum ex coloribus
280 rerum visarum et lucibus earum, oportet ut centrum superficiei
visus et centrum superficiei glacialis sit unum punctum com-
mune, et nichil comprehendat visus ex formis rerum visarum
nisi ex verticationibus linearum rectorum quarum extremitates
concurrunt apud istud centrum tantum.

285 [6.42] Et non est impossibile ut duo centra sint idem, quo-
niam iam declaratum est quod duo centra sunt ex posteriori
centro uvee et sunt super unam lineam rectam transeuntem per
omnia centra. Et cum non est impossibile ut duo centra sint
idem et ut lineae recte que exeunt a centrīs sint perpendiculares
290 super duas superficies—scilicet super superficiem glacialis et
superficiem visus—non est etiam impossibile ut sit compre-
hensio visus rerum visarum ex formis venientibus ad ipsum
coloris et lucis que sunt in superficie rerum visarum, cum com-
prehensio istarum formarum sit ex verticationibus perpendicu-
295 larium tantum. Et illud est ut natura visus sit recipiens ea que
veniunt ad ipsum ex formis rerum visarum, et etiam ut sit na-

267 comprehendisset: comprehendit R 268 omnes *om.* EErP3/reflexas: refractas R/
diversorum: duorum EP3 269 distinguetur: distingueretur Er/ea: eo R 270 est¹:
fuit EErP3R/est²: sit R 271 reflexas: refractas R/reflexas . . . formas (272) *om.* Er
273 linearum que sunt *corr.* ex que sunt linearum E 274 lineae iste *transp.* Er/iste: ille
EP3; *om.* R/perpendiculares *om.* EP3 275 fuerint: fiunt P1S/eius² *om.* EP3R/post
eius² *add.* et . . . eius² P1 (fuerint: fiunt) 278 visus² *om.* Er 279 est . . . visarum (280)
om. Er; *scr. et del.* S 280 ante et *scr. et del.* est S/post earum *add.* et hoc distincte EP3R
283 verticationibus *corr.* ex verticatione P1/linearum rectorum *transp.* R 284 ante
istud *add.* unum et R/istud centrum: idem punctum EP3R 285 post et *add.* tamen
EP3/sint *corr.* ex sunt S/quoniam (286) . . . idem (289) *mg. a. m.* E 286 iam *om.* R
287 sunt *om.* EErP3R 288 cum: quoniam EP3R/sint *corr.* ex sunt S 289 sint:
sunt P1 290 duas *om.* Er/duas superficies *transp.* P3/super² *om.* Er 291 est
om. EP3/impossibile *corr.* ex possibile S 293 coloris et lucis: lucis et coloris R
294 istarum formarum *transp.* R 295 natura: non P3/sit recipiens: recipiat R
296 ipsum: ipsam ErP1; se R; *corr.* ex ipsam P3

tura visus cum hoc appropriata ut non recipiat ea que veniunt
ad ipsum ex formis nisi ex propriis verticationibus, non ex om-
nibus verticationibus; et sunt verticationes linearum rectarum
300 quarum extremitates concurrunt apud centrum visus tantum,
et iste lineae appropinquantur in centro quia sunt dyametri (ei-
us visus scilicet) et perpendiculares super superficiem sentien-
tis. Et sic erit sensus ex formis venientibus ex rebus visis, et
erunt iste lineae quasi instrumentum visus per quod distinguen-
5 tur a visu res vise et per quod ordinabuntur partes cuiuslibet
rerum visarum.

[6.43] Et quod esse visus appropriatur aliquibus verticati-
onibus tantum habet similia in rebus naturalibus. Quoniam lux
oritur ex corporibus luminosis, et extenditur super verticatio-
10 nes rectas tantum, et non extenditur super lineas arcuales aut
curvas; et corpora ponderosa moventur ad inferius motu na-
turali super lineas rectas, non super lineas curvas aut arcuales
aut tortuosas. Et non movebuntur super omnes lineas rectas
que sunt inter eas et superficiem terre, sed super lineas rectas
15 proprias que sunt perpendiculares super superficiem terre et
dyametrum terre. Et corpora celestia moventur super lineas
spericas et non super lineas rectas nec super lineas diversi or-
dinis. Et cum fuerimus intuentes motus naturales, inueniemus
quod quilibet eorum est appropriatus aliquibus verticationi-
20 bus. Non est ergo impossibile ut sit visus appropriatus in re-
ceptione operationum lucis et coloris aliquibus verticationibus
rectis que concurrunt apud eius centrum tantum, et sunt super
perpendiculares super superficiem eius. Comprehensio autem
visus de rebus visis ex verticationibus linearum rectarum qua-
25 rum extremitates concurrunt apud centrum visus est conces-
sum a mathematicis, et nulla diversitas est inter eos in hoc. Et
iste lineae vocantur ab eis lineae radiales.

[6.44] Et cum hoc sit possibile, et forme lucis et coloris

297 cum hoc: insuper R 298 ipsum: se R/ex² om. EP3 300 visus om. EP3/post
tantum mg. vel visus a. m. E 1 in centro om. S/quia: quoniam Er 2 post
superficiem add. visus P1R (scr. et del. P1) 5 ante partes add. a visu EP3R 7 quod
om. P1S/appropriatur: appropinquantur EP3; appropriantur Er 8 tantum:
quoniam P1S 11 curvas: tortuosas R 12 non . . . rectas (13) mg. a. m. S
13 et non: nec tamen R 14 sed . . . terre (15) om. S/post rectas add. et P1 16 terre:
eius EP3 17 spericas . . . lineas¹ om. P1 18 intuentes: intuiti R 19 ante
aliquibus scr. et del. visui P1 20 ante non add. tantum R/est om. P3 22 rectis corr.
ex erectis Er/super om. EP3R 24 ante visus scr. et del. eius Er/ex corr. ex de a. m. S
25 concessum (26): concessa R 27 vocantur om. P1/linee² om. P1/radiales corr. ex
radices a. m. S

veniant ad visum et pertranseant per diafonitatem tunicarum
 30 visus, et visio non completur ex receptione istarum formarum
 nisi quando visus receperit istas ex verticationibus perpendi-
 cularium tantum, visus ergo non comprehendit luces et colores
 superficierum rerum visarum nisi ex formis venientibus ad ip-
 sum ex superficiebus rerum visarum. Et non comprehendit is-
 35 tas formas nisi ex verticationibus linearum rectarum quarum
 extremitates concurrunt apud centrum visus tantum.

[6.45] Aggregemus modo ea que possunt aggregari ex omni
 quod diximus.

[6.46] Et dicamus quod visus sentit lucem et colorem que
 40 sunt in superficie rei vise ex forma extensa et luce et colore que
 sunt in superficie rei vise per corpus diafonum quod est medi-
 um inter visum et rem visam, et nichil comprehendit visus ex
 formis rerum visarum nisi ex verticationibus linearum rectarum
 extensarum inter rem visam et centrum visus tantum. Et de-
 45 claratum est cum hoc quod hoc sit possibile et non impossibile.

[6.47] Nos vero exponemus questionem, dicendo quod vi-
 sio non potest esse nisi secundum hunc modum. Quoniam vi-
 sus, quando senserit rem visam postquam non sentiebat ip-
 sam, aliquid accidet ei quod non erat, et nichil accidet post-
 50 quam non erat prius nisi per aliquam causam. Et invenimus
 quod, quando fuerit visus oppositus rei vise, sentiet ipsam; et
 cum auferetur ab eius oppositione, non sentiet ipsam, et cum
 revertetur ad oppositionem, revertetur sensus. Et similiter
 invenimus visum, quando senserit rem visam deinde clausurit
 55 palpebras, quod sensus destruetur; et cum aperit palpebras et
 res visa fuerit in oppositione, revertetur sensus. Sed causa est
 illud quod, quando destruetur, destruetur causatum; et quan-

29 tunicarum visus (30) *corr. ex visus tunicarum E* 30 completur: compleatur RS;
 compleatur *alter. ex complectetur S/receptione corr. ex reptione a. m. S* 31 perpen-
 dicularium (32) *om. ER; mg. P3* 33 superficierum *om. R* 37 ante modo *add.*
 ergo *EErP3R* 39 et dicamus *om. P3/colorem: colores EP3R/que: qui E* 40 post
 et¹ *add. ex EP3R* 41 post vise *scr. et del. ex forma extensa E* 43 rerum *om. P1/*
 rectarum *om. R* 44 post visus *scr. et del. s P1/post et² add. cum ErP3* 45 cum *om.*
EErP1P3S/cum hoc om. R/hoc¹ om. P1S/hoc² om. P1; inter. a. m. S/et non impossibile
om. P1R 46 post vero *add. modo EP3R/post questionem add. quare fiat visio*
secundum hunc modum EP3R (ante quare add. qua E; post qua scr. et del. queretur E/
hunc modum transp. R) 48 non *om. P3* 49 accidet¹: accidit R/post erat *add. prius*
P1R/accidet²: accidit ErS/postquam (50): post quod Er 50 per *om. Er*
 51 quando . . . visus: visus . . . fuerit R/fuerit visus *transp. Er* 53 sensus: visus R
 54 visum quando: quando visus R 55 destruetur: destruitur *EP3R* 56 fuerit
corr. ex fuerint P3/revertetur: convertetur P1S; revertitur R 57 destruetur¹: destru-
 itur *EP3R/post destruetur¹ add. causa R/destruetur²: destruitur P3R; alter. in destru-*
 itur *E*

do revertitur, revertetur causatum. Causa ergo que facit con-
tingere rem visam in visu est res visa apud oppositionem suam
60 visui. Visus ergo non sentit rem visam nisi propter illud quod
facit rem visam contingere in visu apud suam oppositionem
visui.

[6.48] Et etiam visus non comprehendit rem visam nisi
quando corpus quod est medium inter ea fuerit diafonum.
65 Nam comprehensio visus de re visa ex posteriori aeris qui est
medius inter eos non est propter humiditatem aeris sed prop-
ter diafonitatem eius, quoniam si medius fuerit inter visum et
rem visam aliquis lapis aut aliud corpus diafonum quodcum-
que, etiam comprehendet tunc visus rem visam. Et erit com-
70 prehensio secundum diafonitatem corporis mediantis, et quan-
to corpus medium fuerit magis diafonum tanto magis erit sen-
sus visus de illa re visa manifestior. Et similiter quando fuerit
inter visum et rem visam aqua clara diafona, comprehendet
visus rem visam a posteriori aque; et si illa aqua fuerit intincta
75 aliqua tinctura forti ita quod destruat diafonitas, quamvis
remaneat in ea humiditas, tunc visus non comprehendet illam
rem visam que est in aqua.

[6.49] Declarabitur ergo ex istis dispositionibus quod visus
non completur nisi per diafonitatem corporis medii, non per
80 suam humiditatem. Illud ergo quod res visa operatur in visum
apud suam oppositionem contra illum ex quo est sensus non
completur nisi per diafonitatem corporis medii inter visum et
rem visam. Lux ergo et color rei vise non comprehenditur a
visu nisi ex aliquo quod sit ex illa luce et colore in visu, et illud
85 non accidit ex colore et luce in visu nisi quando corpus medi-
um inter visum et rem visam fuerit diafonum.

[6.50] Diafonitas autem non appropriatur alicui ex eis que
pendent ex luce et colore quo diversificetur a non diafonitate

58 *ante* revertitur *scr. et del. re P1* / revertitur: revertetur *S/post* revertitur *add. causa R/*
revertitur: revertitur *EP3* 59 visam: illam *ErP3/apud . . . suam: quando opponi-*
tur *R* 60 illud *corr. ex* illam *S* 61 rem: res *EErP3R/visam: visa EErP3; visas R/*
apud . . . oppositionem: quando scilicet opponuntur *R* 63 etiam: iterum *R*
64 quod *om. P3* 65 *post re scr. et del. re P3* 66 *post medius add. punctus P1*
67 *post medius add. terminus P1/fuerit: fuit Er* 68 aliquis . . . visam (69) *mg.*
a. m. S 69 etiam: et *EEr; om. P3R* 71 magis¹: maius *Er/ante tanto add. in EP3/*
magis² *om. R* 72 illa re visa: re illa *EP3R* 74 intincta: tincta *R* 76 com-
prehendit *corr. ex* comprehendent *P3* 77 visam . . . aqua: que est in aqua visam *EP3*
79 completur *corr. ex* complectetur *S/post* medii *add. et R; scr. et del. inter visum et rem*
visam *E* 80 suam *om. R/post* suam *scr. et del. medi P3/humiditatem: diamidita-*
tem *Er* 82 completur *corr. ex* complectetur *S* 83 comprehenditur: comprehen-
detur *EErP3R* 84 sit: fit *EErP3* 85 colore et luce: luce et colore *EP3R*
88 diversificetur *corr. ex* diversatur *P1/a non: ante S/diafonitate: affonitatem Er*

nisi quia forma lucis et coloris pertranseunt per diafonum, et
 90 non pertranseunt in non diafonum, et quia corpus diafonum
 recipit formam lucis et coloris et redit ipsam partibus opposi-
 tis luci et colori; corpus autem non diafonum non habet istam
 proprietatem. Et cum visus non sentit lucem et colorem que
 sunt in re visa nisi ex aliquo contingente ex luce et colore in
 95 visu, et illud non contingit in visu nisi quando corpus medium
 inter visum et rem visam fuerit diafonum, et corpus diafonum
 nullo appropriatur quo distinguatur a corpore non diafono ex
 eis que pendent a luce et colore nisi per receptionem formarum
 et colorum et reditionem eorum ad partes oppositas, et declar-
 100 atum est quod, visus quando fuerit oppositus rei vise, forma
 lucis et coloris que sunt in re visa redentur visui et perveniunt
 in superficie sentientis, visus ergo non sentit lucem et colorem
 rei vise nisi ex forma extensa per corpus diafonum inter rem
 visam et visum et ex re quam facit contingere res visa in visu
 105 apud suam oppositionem illi mediante corpore diafono.

[6.51] Et licet nobis dicere quod corpus diafonum recipit a
 visu aliquid et redit ipsum rei vise, et per continuationem istius
 rei inter visum et rem visam evenit sensus. Et hec est opinio
 ponentium radios.

110 [6.52] Ponatur ergo quod ita sit et quod radii exeant a visu
 et pertranseant per corpus diafonum pervenientes ad rem vi-
 sam, et per istos radios sit sensus. Et cum ita fuerit sensus,
 quero per istos radios aut redetur visui aliquid aut non rede-
 tur. Si vero sensus fuerit per radios, et non redunt visui ali-
 115 quid, visus nichil sentiet. Sed visus sentit rem visam, et cum
 sentit rem visam et non sentit nisi mediantibus radiis, isti ergo
 radii qui sentiunt rem visam redunt visui aliquid per quod vi-

89 pertranseunt: pertransit R 90 pertranseunt: pertransit R/in: per R; om. Er/post
 in inter. vel per a. m. E 91 post partibus scr. et del. coi S 92 luci: lucis P3
 93 cum: quia R 94 visa om. Er 95 post quando scr. et del. medius S
 97 apropiatur corr. ex propriatur a. m. S 100 quod inter. E/visus om. P1/visus
 quando transp. EP3R/forma: forme R 101 perveniunt: pervenient R
 102 superficie: superficiem R/colorem corr. ex clorem Er 104 et visum om. P3/visu:
 visum EP3 105 apud . . . oppositionem: dum opponitur R 106 recipit: respi-
 cit Er 107 rei inter. a. m. S 108 post rei add. visae R/hec: hoc P1/est om. P3
 109 radios om. P1/post radios add. exire a visu R 110 et om. EP3R/exeant corr. ex
 hexeant E 111 per: ad P1 112 sit: fiat R/cum inter. a. m. S/fuerit: fiat R/sensus²
 corr. ex sensus P3 113 post quero add. an R/aut¹ om. R; corr. ex autem S/redetur:
 reddatur R/visui . . . redetur (114) inter. a. m. S/redetur (114): reduntur Er; reddatur R
 114 fuerit: fiat R/post fuerit scr. et del. fuerit S/redunt: reduntur ErP1; redent P3; red-
 dant R/aliquid (115) om. ErP1S 115 nichil: non R/sentiet: sentiret P1S/et . . . visam
 (116) om. R/cum sentit (116) corr. ex consentit E 117 aliquid mg. E

sus sentit rem visam. Et cum radii redunt visui aliquid ex quo
erit sensus visus rei vise, visus non sentiet lucem et colorem
120 que sunt in re visa nisi ex aliquo veniente a luce et colore que
sunt in re visa ad visum, et radii redunt illud. Secundum ergo
omnes dispositiones non erit visus nisi per adventum alicuius
rei vise a re visa, sive exierint a visu radii sive non.

[6.53] Et iam declaratum est quod visio non completur nisi
125 per diafonitatem corporis medii inter visum et rem visam, et
non completur quando fuerit medium inter eos corpus non dia-
fonum. Et est manifestum quod corpus diafonum in nullo dis-
tinguitur a non diafono nisi secundum modum predictum. Et
cum ita est, ut diximus, et fuit declaratum quod forma lucis et
130 coloris que sunt in re visa perveniunt ad visum quando fuerit
opposita visui, illud ergo quod venit ex re visa ad visum per
quod visus comprehendit lucem et colores que sunt in re visa
secundum omnem dispositionem non est nisi ista forma, sive
exeat radii sive non.

[6.54] Et iam declaratum est quod forme lucis et coloris
135 semper generantur in aere et in omnibus corporibus diafonis, et
semper extenduntur in aere et in corporibus diafonis ad partes
oppositas, sive oculus fuerit presens sive non. Exitus ergo ra-
diorum est superfluous et otiosus. Visus ergo non sentit lucem
140 et colorem rei vise nisi a forma veniente a luce et colore que
sunt in re visa.

[6.55] Et iam declaratum est quod forma cuiuslibet puncti
rei vise oppositi visui pervenit ad visum secundum verticatio-
nes multas diversas, et quod visus non potest apprehendere
145 formam rei vise secundum suam ordinationem in superficie rei
vise nisi quando receptio formarum fuerit ex verticationibus
linearum rectarum que sunt perpendiculares super superficiem
visus et super superficiem membri sentientis, et quod linee rec-
te perpendiculares non erunt super istas superficies nisi quan-

118 redunt: reddant R/ex . . . vise (119): per quod visus sentit rem visam EP3R (visus
sentit *transp.* R) 120 que¹: qui EP3/post visa *scr. et del.* ad visum et radii redunt visui
aliquid S/nisi *om. Er* 121 post illud *scr. et del.* a visu P3 123 a visu *om. R; mg.*
a. m. E 126 post quando *add. non Er/eos: ea R/post eos scr. et del. non E/non*²
mg. E 127 est *om. P1S/in nullo om. Er/in . . . diafono* (128): a non diaphano in nullo
distinguitur R 128 nisi *om. Er* 129 est: sit R; *inter. a. m. S/fuit: fuerit EP1P3;*
sit R 130 perveniunt: perveniant R 131 opposita: oppositae R; per *inter. P1*
132 colores: colorem P1 133 post nisi *add. ist ita P1 (scr. et del. ist)* 136 post
semper *scr. et del. perveniunt P1/generantur: generentur R* 137 extenduntur:
extendantur R 139 lucem: lumen S 140 a¹: ex EP3R/que: qui P3 142 post
et *add. etiam Er/iam om. EP3R* 143 oppositi *corr. ex. opposita EP3 (a. m. E)*
146 post receptio *add. visus EErP3* 147 ante que *add. et P3/sunt: sun S* 148 et
. . . superficiem *inter. a. m. E/super om. EP3/post quod scr. et del. lux P1*

150 do centrum istarum superficierum fuerit unum punctum, et
quod hoc est possibile. Et cum hoc totum sit sicut dictum est,
oportet quod centrum superficiei glacialis et centrum superfici-
ei visus sint unum punctum. Visus ergo nichil potest compre-
hendere ex formis rerum visarum nisi ex verticationibus linea-
rum rectarum quarum extremitates concurrunt apud hoc cen-
trum tantum. Et hoc est quod promissimus ante declarare in
hoc capitulo in precedenti sermone de forma visus, et iam
declaratum est: scilicet quod centrum glacialis et centrum
superficiei visus sunt idem punctum commune.

160 [6.56] Et cum hoc declaratum est, remanet ergo modo con-
siderare opinionem ponentium radios et declarare quid sit ex
ea falsum et quid verum. Dicamus ergo si visio sit ex re exeun-
te ex visu ad rem visam, illa res aut est corpus aut non est cor-
pus. Si est corpus, quando nos aspexerimus celum et videri-
mus stellas que sunt in eo, oportet quod in illa hora exeat a
nostro visu corpus, et impleat illud quod est inter celum et
terram, et quod nichil diminuatur a visu; et hoc est falsum.
Visio ergo non est per corpus exiens a visu ad rem visam. Et si
illud quod exit a visu fuerit non corpus, illud non sentiet rem
visam, sensus enim non est nisi in corporibus. Nichil ergo exit
a visu ad rem visam sentiens rem illam.

[6.57] Et manifestum est quod visio est per visum. Et cum
hoc est, et visus non comprehendit rem visam nisi quando exit
ab eo aliquid ad rem visam, et illud quod exit non sentit rem
illam visam, illud ergo quod exit a visu ad rem visam non redit
ad visum aliquid quo visus comprehendit rem visam. Et hoc
quod exit a visu non est sensibile sed opinabile, et nichil debet
putari nisi per rationem. Ponentes autem radios opinantur hoc
quia illi invenerunt quod visus comprehendit rem visam et inter
eos est spatium; et magnum est hominibus quod sensus non est

150 *post fuerit add. in P1/et . . . possibile* (151) *om. R* 151 *quod om. P3; scr. et del. E/*
possibile: impossibile EP1P3 152 *quod: ut R; om. EP3/superficiei corr. ex superfi-*
cialis P3 157 *et . . . est* (158) *om. R* 158 *est om. P3* 160 *est: sit R/ergo*
om. P1S 161 *post radios add. exire a visu R/ex: in R* 163 *ex: a Er/illa: ista R/*
post res scr. et del. a S/est² om. EP3R 164 *si est corpus om. P3/nos om. R/aspexer-*
imus: inspexerimus P1S 165 *sunt in eo: in eo sunt P3/in² om. P3* 166 *nostro*
visu transp. EP3R/impleat: implet Er 168 *per om. P3; inter. a. m. E* 169 *fuerit:*
est EP3/fuerit non: non est R 170 *enim: ergo EP3* 172 *est¹ inter. P3*
173 *est: sit R/comprehendit: comprehenderit Er; comprehendat R/nisi om. P3*
174 *eo corr. ex ea E/aliquid om. R* 175 *illam om. Er/visam om. P1S* 176 *com-*
prehendit: comprehendat ErR 177 *exit: dicitur exire Er* 178 *post radios add.*
exire a visu R 179 *quia: quod EErP3R/post illi add. non S; scr. et del. opinantur hoc*
quod E/invenerunt: invenerunt S 180 *eos: illos EP3; illa R/magnum: manum P1*

nisi per contactum, quare illi opinati sunt quod visio non sit nisi per aliquod exiens a visu ad rem visam, ita quod illud exiens sentiat rem visam in suo loco aut accipiat aliquid a re visa, et redet ipsum visui, et tunc sentiet illud visus.

- 185 [6.58] Et cum non potest exire a visu corpus sentiens rem visam, et nichil sentit rem visam nisi sit corpus, non remansit opinari nisi quod illud quod a visu exit ad rem visam recipit a re visa aliquid et redit ipsum visui. Et cum declaratum est quod aer et corpora diafona recipiunt formam rei vise et red-
 190 unt ipsam visui et omni corpori opposito rei vise, tunc illud quod opinatur quod redit visui aliquid ex re visa non est nisi aer et corpora diafona inter visum et rem visam. Et cum aer et corpora diafona redunt visui aliquid ex re visa, in quolibet tempore redunt et secundum omnes dispositiones quando
 195 visus fuerit oppositus rei vise sine indigentia alicuius rei exeuntis a visu. Ratio ergo que induxit ponentes radios ad dicendum radios esse est superflua, quoniam illud quod induxit eos ad dicendum quod radii essent est sua opinatio quia visio non potest compleri nisi per aliquod extensum inter visum et rem
 200 visam ut redat visui aliquid ex re visa. Et cum aer et corpora diafona faciant hoc sine indigentia alicuius rei exeuntis a visu, et sunt cum hoc extensa inter visum et rem visam, sine indigentia tunc ad apponendum aliam rem redentem visui aliquid de re visa nulla est opinio. Dicere ergo esse radios est nichil.
- 205 [6.59] Et etiam omnes mathematici dicentes esse radios non utuntur in demonstrationibus eorum nisi lineis ymaginatis tantum, et vocant ipsas lineas radiales. Et iam declaravimus nos quod visus nichil comprehendit ex rebus visis nisi ex verticationibus istarum linearum tantum. Opinio ergo opinantis
 210 quod linee radiales sunt ymagine est opinio vera, et opinio

181 contactum: tactum *P1* 182 aliquod: aliquid *EP3R/post visam scr. et del. per S/ ita . . . visam (183) om. P1/quod: ut R/illud corr. ex aliud S* 183 sentiat *corr. ex sensit P3/visam om. EP3R/accipiat: accipiet Er* 184 redet: reddat *R/sentiet: sentiat R*
 185 cum: quia *R* 186 et . . . visam *rep. P1/post sentit scr. et del. se Er/sit om. P3R*
 187 quod¹: ut *R/a visu exit: exit a visu Er/recipit: recipiat R* 188 re visa: viso *R/redit: reddat R/cum: quia R* 191 opinatur *corr. ex opponitur S* 194 *post dispositiones scr. et del. et E/quando: quoniam Er* 195 exeuntis (196) *om. Er*
 198 essent *corr. ex esset a. m. S/post sua add. opinio vel EP3; add. illorum opinio R/quia: quod Er* 199 compleri *corr. ex impleri S/aliquod: aliquid EP3R* 200 ut: quod *R/visui corr. ex visio P1/visui aliquid transp. ErS/et² inter. S* 201 faciant: faciunt *P3*
 202 sunt cum hoc: sint insuper *R/sine om. Er* 203 apponendum: ponendum *ErR/visui aliquid transp. EP3R* 204 opinio *om. Er/esse om. P1; inter. E/esse . . . nichil: radios esse nichil est S* 206 eorum *om. EP3R/ymaginis: imaginariis R*
 207 *post lineas add. et Er* 208 quod visus *corr. ex visus quod Er/comprehendit om. P1* 209 opinantis: opinantium *EP3R* 210 ymagine: imaginariae *R; corr. ex ymagines P3; corr. ex opinate P1*

opinantis quod aliquid exit a visu est opinio falsa. Et iam declaravimus quod hoc esse non affirmat eos nec ratio induxit.

[6.60] Iam ergo declaratum est ex omnibus que diximus quod visus non sentit lucem et colorem que sunt in superficie
 215 rei vise nisi per formam extensam a superficie rei vise ad visum per corpus diafonum medium inter visum et rem visam, et quod visus nichil comprehendit ex formis nisi ex verticationibus linearum rectarum que ymaginantur extense inter rem visam et centrum visus tantum que sunt perpendiculares super
 220 omnes superficies tunicarum visus. Et hoc est quod volumus declarare.

[6.61] Ista ergo est qualitas visionis generaliter, quoniam visus non comprehendit ex re visa sensu spoliato nisi lucem et colorem que sunt in re visa tantum. Res autem residue quas
 225 comprehendit visus ex rebus visis, sicut figuram, et magnitudinem, et sibi similia, non comprehenduntur a visu spoliato sensu sed per rationem et signa. Et hoc nos declarabimus post in secundo tractatu post declarationem completam apud nostrum sermonem in distinctione rerum visibilium quas comprehendit visus. Et hoc quod declaravimus—scilicet qualitatem
 230 visionis—est conveniens opinioni verificantium mathesim et naturam. Et declaratum est ex hoc quod due secte dicunt verum et quod due opiniones sunt recte et convenientes, sed non completur altera earum nisi per alteram, nec potest esse visio
 235 nisi per illud quod aggregatur ex duabus.

[6.62] Sensus ergo non est nisi ex forma et ex operatione forme in visum et ex passione visus ex forma, et visus est paratus ad patiendum ex ista forma secundum situm proprium, scilicet situm verticationum perpendicularium super suam
 240 superficiem. Natura autem visus non appropriatur ista propri-

211 opinantis: opinantium R/et . . . induxit (212) om. R 212 quod hoc esse: hoc esse quod S (hoc inter. a. m.)/ante non scr. et del. hoc S; add. esse inter. a. m. S 213 omnibus que: omni quod Er 215 per inter. S 216 post diafonum scr. et del. a superficie rei vise P1 218 ymaginantur: intelliguntur R/extense om. Er 220 volumus: volumus EP3 222 ergo est transp. ErR/quoniam: quod R 223 post visus scr. et del. com Er/post sensu add. ex P3 224 autem: aut Er 225 post et add. sicut Er; scr. et del. i P1 226 sibi om. R/spoliato sensu (227) transp. R 227 sed: immo EP3/signa corr. ex figuram P3/nos declarabimus transp. EP3/post declarabimus scr. et del. cum E 228 completam corr. ex com a. m. S/nostrum sermonem (229) transp. EP3R 229 sermonem om. Er/in: de R/quas corr. ex qua S/comprehendit (230): comprehendet Er 230 hoc om. P3 231 conveniens: communicans P3; corr. ex communicans a. m. E/verificantium: verificatum Er 232 naturam: naturalem P1; verum P3/post est scr. et del. hoc Er/dicunt: dicant R 233 sunt: sint R 235 quod om. P3/post duabus add. sectis EP3R 237 post in add. sensum EP3/ex²: a EP3R 238 situm: suum EP3 240 visus om. P1/appropriatur: congregatur R/ista proprietate (241): isti proprietati R

etate nisi quia non distinguuntur visibilia nec ordinantur partes
cuiuslibet eorum apud visum nisi quando sensus eius fuerit ex
istis verticationibus tantum. Linee ergo radiales sunt linee
ymaginabiles, et figuratur per eas qualitas situs super quam
245 patitur visus ex forma.

[6.63] Et iam declaratum est quod, visus quando fuerit op-
positus rei vise, figurabitur inter rem visam et centrum visus
piramis cuius conus erit centrum visus et basis eius superficies
rei vise. Et erit inter quodlibet punctum superficiei rei vise et
250 inter centrum visus linea recta ymaginata perpendicularis su-
per superficies tunicarum visus, et sic erit piramis continens
omnes istas lineas. Et erit superficies glacialis secans istam
pyramidem, quoniam centrum visus quod est conus pyramidis
est a posteriori superficie glacialis; et cum aer qui est inter vi-
255 sum et rem visam fuerit continuus, erit forma extensa ab illa re
visa secundum verticationem ipsius pyramidis in aere quam
distinguit ipsa piramis et in tunicis visus diafonis usque ad
partem superficiei glacialis que distinguitur per istam pyrami-
dem. Et erit piramis continens omnes verticationes que sunt
260 inter visum et rem visam ex quibus comprehendit visus for-
mam rei vise, et erit forma ordinata in ista piramide sicut est
ordinata in superficie rei vise et in ista parte superficiei gla-
cialis.

[6.64] Et iam declaratum est quod sensus non est nisi per
265 glaciale. Sensus ergo visus ex lumine et colore que sunt in su-
perficie rei vise non est nisi ex parte glacialis quam distinguit
piramis figurata inter illam rem visam et centrum visus. Et iam
predictum est quod in isto humore est aliquantule diafonitatis
una pars et aliquantule spissitudinis, et propter hoc assimula-
270 tur glaciei. Quia ergo est in ea aliquantule diafonitatis, recipit

242 cuiuslibet *corr. ex cuiuscumque P1/visum corr. ex visibilium E/eius om. P1S*
243 istis verticationibus *transp. P1RS* 244 situs *om. Er/quam: quem EP3*
246 *post quod scr. et del. forma E/visus . . . oppositus (247): quando visus . . . fuerit R*
247 *post centrum scr. et del. eius s E* 248 piramis: pyramidis *P1/conus: vertex R*
250 ymaginata: intellecta *R/perpendicularis: perpendiculariter P3R; alter. in perpen-*
diculariter a. m. E/super (251) om. Er 251 superficies *corr. ex superficia P3/post*
superficies scr. et del. perpendicularis P1/et sic erit om. P3/erit om. R/continens: con-
tinebit R 252 *erit om. R/secans: secabit R/istam om. P3* 253 conus: vertex *R*
254 qui: quod *ErP1S/inter: in E; corr. ex in a. m. P3* 256 ipsius: illius *EP3/*
pyramidis: piramis Er 257 ipsa: illa *P3* 259 erit: ista *R/continens: contine-*
bit R 261 in ista piramide *om. EP3R* 262 ista parte *transp. R* 265 lumine:
luce *R* 268 predictum: declaratum *R/aliquantule . . . pars (269): una pars . . .*
diafonitas Er/aliquantule . . . spissitudinis (269): aliquantula diaphanitas et aliquantu-
la spissitudo R/diafonitatis . . . aliquantule (269) inter. a. m. S 270 glaciei: glaciali
P3/est in ea: in earum est Er/ea: eo R/aliquantule: aliquantulum R/diafonitatis corr.
ex diafonitas P1/recipient: respicit Er

formas, et pertranseunt in ea cum eo quod est ex ea de diafonitate; et quia in ea est aliquantule spissitudinis, prohibet formas a transitu in ea cum eo quod est ex ea de spissitudine. Et figuntur forme in eius superficie et corpore. Et similiter
 275 quodlibet corpus diafonum in quo est aliquid spissitudinis, quando super ipsum oritur lux, pertransibit in eo secundum id quod est in eo de diafonitate, et figitur lux in superficie eius secundum quod est in eo de spissitudine.

[6.65] Et etiam glacialis est preparata recipere istas formas
 280 et ad sentiendum ipsas. Forme ergo pertranseunt in ea propter virtutem sensibilem recipientem.

[6.66] Et cum forma pervenit in superficie glacialis, operabitur in ea, et glacialis patietur ex ea, quoniam ex proprietate lucis est ut operetur in visu et ex proprietate visus est ut patiat
 285 atur ex luce. Et ista operatio quam operatur lux in glaciali pertransit corpus glacialis secundum rectitudinem linearum radialium tantum, quoniam glacialis est preparata ad recipiendum formas lucis ex verticationibus linearum radialium. Et cum lux pertransit in corpus glacialis, color pertransit cum ea,
 290 color enim est admixtus cum luce. Et glacialis recipit istam operationem et istum pertransitum, et ex ista operatione et passione erit sensus glacialis ex formis rerum visarum que sunt in sua superficie. Et pertranseunt per totum suum corpus, et ex ordinatione partium forme in sua superficie et in suo toto
 295 corpore erit sensus eius ex ordinatione partium operantis.

[6.67] Et ista operatio quam operatur lux in glaciale est ex genere doloris. Tamen quidam dolores sunt passibiles et

271 *post et add. hae R/ea¹²; eo R/est om. P1/de om. ErP3* 272 *aliquantule: aliquantulum R* 273 *ea¹²; eo R/ex: in Er* 274 *figuntur corr. ex figurantur EP3 (a. m. E)/post superficie add. sed debiliter E/corpore: corpora S/post corpore add. sed debiliter P3R/post similiter add. est R* 276 *oritur lux transp. P1/post eo scr. et del. quod P1/id om. R; corr. ex aliquid EP3 (a. m. E)* 277 *in¹ . . . est (278) mg. a. m. S/ diafonitate: diafone Er/figitur: figetur R* 278 *ante quod add. id EP3R/quod om. Er* 279 *preparata recipere: praeparatus ad recipiendum R* 280 *forme ergo pertranseunt: figure pertranseunt ergo P3/ea: eo R* 282 *pervenit: pervenerint ErR/superficie: superficiem R/operabitur (283) operatur EP3R* 283 *patietur: patitur R* 284 *lucis est corr. ex visus est P1/visu: visum R/et om. P1/est² om. P3R/ut² corr. ex aut P3* 285 *ex: a EP3R/in om. P1* 286 *glacialis om. P1* 287 *est preparata transp. P3/preparata: praeparatus R* 288 *formas corr. ex tres S/linearum radialium transp. Er* 289 *pertransit¹ corr. ex fuerit P1/post glacialis scr. et del. color pertransit in corpus glacialis P3* 290 *enim est transp. Er/post enim add. in EP3 (inter. a. m. E)/ admixtus . . . luce: permixtus luci R/recipit corr. ex respicit Er/istam: illam EP3* 291 *ista: illa S* 292 *post rerum add. visibilium vel EP3/visarum: visibilium R* 293 *sua om. EP3/sua superficie transp. R* 294 *et om. S/in² om. EP3R/suo toto transp. S* 296 *quam: quoniam S* 297 *tamen: cum R/sunt: sint R*

non angustiat membrum propter eos, et tales dolores non
 manifestantur sensui, nec iudicat dolens quod sit dolor. Et
 300 significatio super hoc est quod lux inducit dolorem, quia luces
 fortes angustiant visum et ledunt manifeste, sicut lux solis,
 quando aspiciens aspexerit corpus ipsius, et sicut lux solis
 reflexa a corporibus tersis ad visum, quoniam iste luces induc-
 unt dolorem manifestum in visum. Et operatio omnis lucis in
 5 visum est ex uno genere, et non diversatur nisi secundum mag-
 is et minus. Et cum omnes sunt ex uno genere, et operatio forti-
 orum lucium est ex genere doloris, omnes ergo operationes luci-
 um sunt de genere doloris, et non diversantur nisi secundum
 magis et minus. Et propter levitatem operationum lucium de-
 10 bilium temperatarum in visum, latet sensus eas inducere dolor-
 em. Sensus ergo glacialis ex operatione lucis est de genere sen-
 sibilis dolorosi.

[6.68] Deinde iste sensus qui cadit apud glaciale exten-
 ditur in nervo obtico et venit ad anterius cerebri, et illic est
 15 ultimus sensus et sentiens ultimum quod est virtus sensitiva
 que est in anteriori cerebri, et ista virtus comprehendet sensibi-
 lia. Visus autem non est nisi quoddam instrumentum istius
 virtutis, quoniam visus recipit formas rerum visarum et redit
 eas sentienti ultimo, et sentiens ultimum comprehendit illas
 20 formas et comprehendit ex eis res visibiles que sunt in eis. Et
 illa forma in superficie glacialis extenditur in corpore glacialis,
 deinde in corpus subtile quod est in concavo nervi quousque
 perveniat ad nervum communem. Et apud perventum forme
 ad nervum communem completur visio, et ex forma pervenien-
 25 te in nervo communi comprehendet ultimum sentiens formas
 rerum visarum.

298 angustiat: laeditur R; corr. ex angustiantur P1/membrum: membrorum Er/post
 eos add. dolores S 299 iudicat corr. ex indicat EP3 (a. m. E) 300 est om. P1
 1 angustiant: offendunt R 2 post quando add. lux EP3 (scr. et del. lux E)/et om. P1
 3 ad rep. Er 4 dolorem manifestum: dolores manifestos EP3R 5 ex inter. a. m.
 S/uno: eodem EP3R/diversatur: diversantur Er; diversificatur R 6 sunt: sint R/
 post genere scr. et del. et non diversantur Er 7 lucium . . . operationes om. P1/
 operationes: generationes S 8 non om. Er/diversantur: diversificantur R
 9 operationum: operationis Er 10 eas corr. ex eorum P1 11 ergo inter. P1/post
 lucis add. et coloris P1/sensibilis (12): sensus Er/sensibilis dolorosi (12): sensibili do-
 lorosi P3 16 que: quod S/post ista scr. et del. est P3/comprehendet: comprehendit R;
 corr. ex comprehendit P3 18 recipit corr. ex respicit Er 19 sentiens corr. ex
 sensit P3 20 comprehendit: comprehendet EE 21 post illa scr. et del. illa Er/
 corpore: superficie E; superficiem P3/glacialis: glaciali P1S 23 et . . . communem
 (24) rep. P1 24 ad: apud R/post communem scr. et del. et apud S/perveniente (25):
 veniente EP3R; corr. ex pervenientia P1 25 nervo communi: nervum communem
 R/ultimum sentiens transp. Er

[6.69] Sed aspiciens comprehendet res visas duobus oculis;
et sic oportet ut forma rei vise perveniat in utroque visu, quare
pervenient in visu ab una re visa due forme. Tamen aspiciens
30 comprehendet unam rem visam, et hoc est quia due forme que
pveniunt in duobus visibus ex uno viso, quando perveniunt
ad nervum communem, concurrunt due forme, et superponetur
una alii, et efficietur una forma. Et ex illa forma adunata ex
duabus formis comprehendet ultimum sentiens formam illius
35 visi.

[6.70] Et significatio super hoc quod due forme que per-
veniunt in duobus oculis ab uno viso adunantur et efficiuntur
una forma antequam comprehendat ipsam ultimus sensor et
quod ultimus sensor non comprehendit formam nisi post
40 adunationem duarum formarum est quod aspiciens, quando
mutaverit situm sui oculi unius et alius fuerit immotus, et mo-
tus oculi mutati secundum situm fuerit ad anterius, videbit de
re una opposita duas. Et si elevaverit unum oculum et cooper-
uerit unum oculum, non videbit nisi unum.

[6.71] Si ergo sentiens comprehendisset unum quia unum,
45 deberet comprehendere ipsum semper unum; et si venissent ad
ipsum semper due forme ab uno viso comprehenderet semper
unum visum duo. Et cum ultimum sentiens non comprehendit
visum nisi ex forma veniente ad ipsum et aliquando compre-
50 hendet unam rem visam duo et aliquando unum est signum
quod id quod venit ad ipsum, quando comprehendit ipsum
duo, veniunt due forme, et quando comprehendit unam rem

27 sed: et R 28 perveniat *corr. ex* perveniant S/in . . . visu: ad utrumque visum R/
quare: quia Er 29 in visu: ad visum R/tamen: cum R 30 comprehendet:
comprehendat R 31 in: ad R/duobus visibus: duos visus R/visibus: visis P3/viso:
visu P3/pveniunt: pervenerint Er 32 due forme *om. R*/superponetur: suppose-
tur P3; superponitur R 33 efficietur: efficitur R 34 comprehendet: comprehen-
dit R/sentiens *corr. ex* sens P1 35 visi *corr. ex* visus P1 36 hoc *inter. a. m. E*/post
hoc *add. est EP3R (inter. a. m. E)* 37 in . . . oculis: ad duos oculos R/adunantur:
ordinatur P3R/ante et *scr. et del.* visam S/efficiuntur: efficiantur P3 38 ipsam . . . et:
ipsas ultimum sentiens R/ipsam . . . comprehendit (39) *mg. a. m. S* 39 quod . . .
sensor *om. P1*/ultimus sensor: autem ultimum sentiens R/comprehendit: compre-
hendat EP3RS; comprehendet P1 40 aspiciens *om. EP3*/aspiciens quando
transp. R 41 sui *om. P1R*/immotus *corr. ex* non S 42 ante oculi *add. unius EP3R*/
mutati: mutari S 43 una: visa Er/elevaverit: aperuerit R/post oculum *scr. et del.*
non videbit nisi unum S/cooperuerit (44): cooperierit EP3; cooperuit S 44 unum
oculum: alterum R; *transp. EP3*/post nisi *scr. et del.* oculum Er 46 comprehendere
ipsum *transp. R* 47 comprehenderet: comprehendet EP3/semper: super P3
48 comprehendet: comprehendat R 49 post ex *scr. et del.* verti P1/comprehendit
(50): comprehendat R 50 duo: duas R/unum: unam R 52 ante due *add. est*
forma duplex R;*scr. et del. d Er*

visam unam, quod venit ad ipsum est forma una. Et cum in
 utraque dispositione perveniunt ab uno viso in duos oculos
 55 due forme, et illud quod reditur ultimo sentienti aliquando est
 due forme et aliquando una forma, et forma que reditur ultimo
 sentienti non reditur nisi a visu, tunc illud quod reditur ultimo
 sentienti ex duabus formis que perveniunt in duobus oculis ab
 uno viso, quando comprehendit ipsum unum, est una forma.

60 [6.72] Et cum ita est, due ergo forme predictae extenduntur
 a duobus oculis et concurrunt antequam comprehendat ipsas
 sentiens ultimus, et post concursum adinvicem comprehendet
 sentiens ultimus formam adunatam ex eis. Et due forme que
 perveniunt in duobus oculis ab uno viso, quando comprehendit
 65 ipsum duo, extenduntur a duobus oculis et non concurrunt, et
 perveniunt ad ultimum sentiens et sunt due forme.

[6.73] Et etiam comprehensio unius visi apparentis ali-
 quando unum aliquando duo significat quod visio non est per
 oculum solummodo, quoniam si ita esset, apud comprehensio-
 70 nem unius visi apparentis comprehenderent duo oculi ex dua-
 bus formis provenientibus in eos unam et eandem formam. Et
 si ita esset, comprehenderent semper ex duabus formis unam.

[6.74] Et cum unum visum comprehendatur aliquando un-
 um et aliquando duo, et in utraque dispositione sint in duobus
 75 oculis due forme significat quod illic est alius sentiens preter
 duos oculos apud quem perveniunt ab uno viso quando com-
 prehenduntur per unum due forme unum et apud quem com-
 prehenduntur due forme quando comprehenduntur due, et
 quod sensus non completur nisi per illud sentiens tantum, non
 80 per oculum tantum.

[6.75] Et etiam sensus non extenditur a membris ad ulti-
 mum sentiens nisi in nervis continuatis membris et cerebro.

53 unam *scr. et del. P3/*forma una *transp. Er* 54 ab *corr. ex ad S/in:* ad R 55 redi-
 tur *corr. ex reduntur E/post* sentienti *scr. et del. non reditur S* 56 due: duplex R/
 forme: forma R/*et¹ om. EP3R/*forma¹ *om. R* 57 *post tunc add. enim EP3/quod om. P1*
 58 in . . . oculis: ad duos oculos R 59 comprehendit: comprehenditur EP3;
 comprehenderit R 60 est: sit R 61 a: ad Er 62 sentiens ultimus: ultimum
 sentiens R/adinvicem: inter se R 63 ultimus: ultimam R/formam *inter. P3*
 64 in . . . oculis: ad duos oculos R/*post duobus scr. et del. formis Er/post* quando *add.*
 ultimum sentiens R/comprehendit: comprehenderit P1 65 extenduntur *corr. ex*
 extenditur *a. m. E* 67 etiam *om. R/apparentis: quod apparet R* 70 unius *om.*
 R/unius visi *transp. EP3/apparentis: quod unum apparet R/comprehenderent: com-*
 prehendent EP3 71 provenientibus: pervenientibus RS/*in: ad R/et eandem om.*
Er/eandem: eadem S 72 si ita: sive P1/esset: essent E; *corr. ex essent P3/post* formis
scr. et del. pervenientibus in eos S/post unam *add. formam EP3R* 74 *et¹ om. EP3R/*
 aliquando: a natura P1/*sint: sunt Er* 75 significat: significatur R/*alius: aliud EP3R;*
 alicuius *Er* 76 quem: quod R 77 quem: quod R; *corr. ex quod S* 79 sentiens:
 sentientis S 82 *post et add. in S*

Due ergo forme extenduntur ab oculo in nervo extenso inter
oculum et cerebrum quousque perveniant ad ultimum sentiens.
85 Iste ergo due forme extenduntur a duobus oculis et concurrunt
in loco concursus duorum nervorum.

[6.76] Et significatio manifesta quod forme rerum visarum
extenduntur in concavo nervi, et perveniunt ad ultimum senti-
ens, et post perventum completur visio est quod, quando fuerit
90 opilatio in isto nervo, destruetur visio, et cum destruetur opi-
latio, revertetur visio. Et ars medicinalis testatur hoc.

[6.77] Quare vero aliquando concurrunt due forme et ali-
quando non est quia, quando situs duorum oculorum fuerit
naturalis, erit situs eorum ab uno viso situs consimilis, et sic
95 perveniet forma unius visi in duo loca consimilis situs. Et cum
fuerit declinans situs unius oculorum, diversabitur situs oculo-
rum ab illo viso, et sic perveniunt due forme illius visi diversi
situs. Et iam predictum est in forma oculi quod situs nervi
communis a duobus oculis est situs consimilis, et sic erit situs
100 duorum locorum consimilis situs a duobus oculis ab eodem
loco nervi communis situs consimilis, et ex duobus nervis con-
cavis fit unus in quo uniuntur due forme visus.

[6.80] Et licet dicere quod forme pervenientes in oculo non
perveniunt ad nervum communem, sed sensus extendetur ab
105 oculo ad nervum communem sicut extenditur sensus doloris et
sensus tactus, et tunc comprehendit ultimum sentiens illud
sensibile.

[6.81] Et nos dicemus quod sensus ipse veniens ad oculum
pervenit ad nervum communem omnino; tamen sensus qui per-
110 venit ad oculum non est sensus doloris tantum, sed est sensus
operationis de genere doloris, et sensus lucis et coloris, et sen-
sus ordinationis partium visi. Sensus autem diversitatis color-
is et ordinationis partium visi non est de genere doloris. Et

84 perveniant: perveniat *Er* 85 concurrunt *corr. ex* concurcurrunt *P3* 87 mani-
festa: manifestatur *P3*; *corr. ex* manifestatur *E* 89 completur: compleatur *R*/est *om.*
EP3/est . . . visio (90) *mg. a. m. S* 90 destruetur¹: destruitur *R*/cum destruetur:
quando destruitur *R*/opilatio (91) *om. ErP1*; *inter. a. m. S* 91 ante revertetur *add. et*
ErS/revertetur: revertitur *RS* 92 aliquando concurrunt *transp. Er*/concurrunt:
concurrant *R*/et *om. R* 94 post uno *scr. et del. eorum Er*/viso: visio *Er*
95 perveniet: perveniret *S* 96 declinans: declinatus *S*/situs . . . diversabitur *om. P1*/
oculorum¹: oculi *R*/situs² *mg. P3* 97 illo: isto *P1S*/et *corr. ex* quia *E*/perveniunt:
perveniunt *R* 99 post oculis *scr. et del. ab eodem loco S* 100 situs *inter. a. m. E*
101 communis *corr. ex* communi *S*/consimilis *corr. ex* consimis *S* 103 pervenientes:
venientes *EP3R*/in oculo: ad oculum *R* 104 extendetur: extenditur *EP3R*
106 et . . . sensibile (107) *om. P3* 109 tamen: cum *Er* 111 post et¹ *add. est EP1P3R*
112 visi *corr. ex* isi *S*/coloris (113): colorum *Er* 113 de: in *EP3R*

115 nos declarabimus post quomodo erit sensus visus ex omnibus
rebus istis. Sensus ergo perveniens in nervo communi est sen-
sus lucis et coloris et ordinationis, et illud a quo comprehendit
sentiens ultimum lucem et colorem est aliqua forma.

[6.83] Et remanet modo dicere questionem que est: Quan-
do forme lucis et coloris extenduntur in aere et in corporibus
120 diafonis et perveniunt ad visum, et aer et corpora diafona
recipiunt omnes colores, et forme cuiuslibet lucis que sunt pre-
sentes in eodem tempore extenduntur in eodem tempore et in
eodem aere, et perveniunt ad unum oculum et pertranseunt
diafonitatem tunicarum visus, quare oportet ut admisceantur
125 isti colores et lux in aere et in corporibus diafonis et perveniant
ad visum omnia mixta, et sic non distinguuntur a visu colores
rerum visarum. Et si ita est, sensus ergo visus non potest esse
ex istis formis.

[6.84] Dicamus ergo quod aer et corpora diafona non im-
mutantur a coloribus nec alterantur ab eis alteratione fixa, sed
130 proprietas coloris et lucis est quod forme eorum extenduntur
secundum verticationes rectas, et ex proprietate corporis dia-
foni est quod non prohibet formas lucis et coloris transire per
suam diafonitatem. Et illud non recipit formas istas nisi re-
ceptione ad redendum, non receptione ut alteretur. Et declar-
atum est quod forme lucis et coloris non extenduntur in aere
135 nisi secundum lineas rectas. Forme ergo lucis et coloris que
sunt in corporibus presentibus simul in eodem aere extendun-
tur secundum lineas rectas, et erunt ille linee super quas ex-
tenduntur forme diverse quedam equidistantes, et quedam
140 secantes se, et quedam diversi situs; et quolibet verticatio ea-
rum est distincta per corpus a quo descenditur forma super

114 declarabimus post *transp.* Er 115 nervo communi: nervum communem R
118 dicere: explicare R/quando (119) quoniam EP3R 119 forme: forma EP3/
corporibus *corr.* ex corpore E 120 et³ *inter.* P1 121 post forme *add.* et coloris EP3/
post lucis *add.* et coloris Er 122 in . . . extenduntur *om.* P1S/et *inter.* P1/in³ *om.* ES
123 et⁴: etiam P1/ante ad *add.* usque EP3/post ad *add.* visum vel ad EP3/unum ocu-
lum: visum R 124 post quare *scr.* et *del.* erunt S 126 omnia mixta *transp.* R/non
om. P3/distinguuntur: distinguuntur R 128 istis *corr.* ex eis P1 129 aer et *om.*
EP3R/corpora diafona: corpus diafonum Er 131 et *inter.* P3/quod: ut R/extendun-
tur: extendantur EP1P3R 132 secundum: per P1; super S/post proprietate *add.* est
ER/diafoni (133): diafono Er 133 est *om.* EP3R/quod: ut R/prohibet: prohibeat R/
formas: forma P1/coloris transire: color transito P1 134 et *om.* Er/illud: etiam P3/
post illud *add.* vero Er/istas *om.* R 135 ante non *scr.* et *del.* re P1/ante ut *scr.* et *del.* ad
red P1/ut alteretur: ad alterandum R/alteretur: alterentur EP3 140 quedam¹
om. EP1S 141 et quedam *om.* Er/diversi situs *transp.* P3 142 est: et P3; *inter.*
a. m. ES/descenditur: distenditur Er; descenditur P1S; extenditur R; *alter.* ex distingui-
tur in distenditur EP3 (a. m. E)

illam verticationem. Forme ergo extense a corporibus diversis
in eodem aere extenditur quelibet earum super suam verticati-
145 onem et pertransit ad formas oppositas.

[6.85] Et significatio quod luces et colores non admiscuntur
in aere nec in corporibus diafonis est quod, quando in uno loco
fuerint multe candelae in locis diversis distinctis, et fuerint om-
nes oppositae uni foramini pertranseunti ad locum obscurum, et
150 fuerit in oppositione illius foraminis in obscuro loco paries aut
corpus non diafonum, luces illarum candelarum apparent su-
per corpus vel super illum parietem distincte secundum nu-
merum candelarum illarum; et quelibet illarum apparet op-
posita uni candele secundum lineam rectam transeuntem per
155 foramen. Et si cooperiatur una candela, destruetur lux op-
posita illi candele tantum, et si auferatur coopertorium rever-
tetur lux.

[6.86] Et hoc poterit omni hora probari.

[6.87] Et si luces admiscerentur cum aere, admiscerentur in
160 aere foraminis; et debent transire admixte et non distinguuntur
postea. Et nos non invenimus ita. Luces ergo non admiscuntur
in aere, sed quelibet illarum extenditur super verticationes rec-
tas; et ille verticationes sunt equidistantes, et secantes se, et
diversi situs. Et forma cuiuslibet lucis extenditur super omnes
165 verticationes quae possunt extendi in illo aere ab illa, et cum
hoc non admiscuntur in aere, nec aer tingitur per eas; sed per-
transeunt per suam diafonitatem tantum, et aer cum hoc non
admittit suam formam.

[6.89] Et quod diximus de luce et colore, et quod de aere,
170 intelligendum est in omnibus corporibus diafonis et tunicis vi-
sus diafonis.

[6.90] Membrum vero sentiens, scilicet glacialis, non recipit

143 forme: formarum R/extense: extensarum R 144 extenditur ... earum: quelibet
extenditur R 145 pertransit: pertransibit P1S 146 admiscuntur: admittentur
ErP1; permisceantur R 147 quando: quandoque P3 148 post diversis add. et R
149 uni inter. a. m. S 150 fuerit: fuerint EP3/illius: uni Er 152 distincte corr. ex
distant S/post distincte add. mihi EP3 154 rectam om. R 155 si: ut Er/
cooperiatur corr. ex cooperitur E 156 illi: uni EP3 158 omni ... probari: probari
... hora P1 159 et: quod R/admiscerentur^{1,2}: admiscuntur Er/cum ... admiscer-
entur inter. a. m. S/in: cum R 160 debent: deberent R/transire: pertransire EErP3/
distinguentur: distinguerentur EP1P3R 161 postea: post Er/post nos scr. et del. post
Er/ergo om. P1 162 rectas (163) ... verticationes (163) inter. a. m. S 163 et³: etiam
P3; inter. E 164 diversi situs: diversitas S/omnes verticationes (165) transp. Er
165 et ... non (166): hora nec tamen R 166 tingitur: tangitur Er 167 suam:
ipsius R/cum inter. a. m. E/cum hoc om. R 168 admittit: admittit P1S/post admittit
add. vel amittit S/suam formam transp. P1/post suam scr. et del. suam Er 169 post
et² add. de Er/quod de om. R 170 in: de EP3R/post et add. in S 172 vero corr.
ex non S/recipit corr. ex respicit Er

formam lucis et coloris sicut recipit aer et alia diafona non
 sentientia, sed secundum modum diversum ab illo modo,
 175 quoniam istud membrum est preparatum ad recipiendum istam
 formam. Recipit ergo istam in quantum est sentiens et in
 quantum est diafonum. Et iam declaratum est quod passio
 eius ex ista forma est ex genere doloris. Qualitas ergo recep-
 tionis eius ab ista forma est diversa a qualitate receptionis
 180 corporum diafonorum non sentientium. Sed tamen istud
 membrum cum sua receptione ab ista forma in quantum est
 sentiens et cum sua alteratione vel mutatione, non tingitur per
 istam formam sua tinctura, nec remanent forme coloris et lucis
 post recessum eius ab earum oppositione vel recessum earum.
 185 [6.91] Et potest contradici huic sermoni, scilicet dicendo
 quoniam iam predictum est quod colores fortes scintillantes
 super quos oriantur luces fortes operantur in oculo, et rema-
 nent sue alterationes in visu post recessum, et remanent forme
 coloris in oculo tempore aliquanto; et quodcumque comprehen-
 190 derit visus post hoc erit admixtum cum illis coloribus. Et hoc
 est manifestum, et non dubitatur. Et cum ita est, visus ergo
 tingitur a colore et luce, et sequitur ut corpora diafona tingan-
 tur a coloribus et lucibus.

[6.92] Et nos dicemus respondendo quod hoc ipsum signi-
 195 ficat quod visus non tingitur a colore et luce, nec remanent in
 eo alterationes coloris et lucis, quoniam iste alterationes quas
 diximus non accidunt nisi extranea fortitudine lucis et coloris.
 Et manifestum est quod iste alterationes non remanent in visu
 nisi modico tempore et post auferuntur, et tunc debiles immu-
 200 tationes non remanet aliquid. Tunc ergo visus non tingitur ab
 istis alterationibus alteratione fixa, nec remanent in eo post

175 preparatum *corr. ex* temperatum EP3 (*a. m. E*) 176 istam *om. EP3* / in quantum:
 quatenus R / quantum: quam E / in quantum (177): quatenus R 177 quantum:
 quam E 180 diafonorum *corr. ex* dyaphorumno P3 / non sentientium *om. P3* / istud:
 illud S 181 in quantum: quatenus R 182 cum *inter. a. m. E* 183 sua: illius
 R; *om. Er* / tinctura *a. m. E* / post tinctura *add. fixa Er* / coloris et lucis: lucis et coloris *Er*
 184 ab earum: a sua EP3R / oppositione: appositione P3 / recessum: recessu *ErS* / earum²:
 eorum EP3 185 huic *corr. ex* hic *a. m. S* / scilicet: in EP3; *om. R* 186 post quod
add. luces vel EP3 / colores: luces *Er* / post fortes *add. vel P3* 187 oriantur: oriun-
 tur *EErP3R* 188 sue: illarum R / sue... remanent *mg. a. m. E* 189 quodcumque:
 quantumcumque *EEr*; quomodocumque P3 190 coloribus: corporibus S
 191 et²: quod R / est²: sit R 192 post et² *scr. et del. co P3* / ut: quod R
 193 coloribus: corporibus P1S / coloribus et lucibus: lucibus et coloribus EP3R
 194 ante quod *add. ad hoc EP3R* 195 post quod *scr. et del. n P1* / post et *scr. et del. loi*
 P1 / remanent *corr. ex* remaneant E 197 ante lucis *add. scilicet fortitudine EP3R*
 199 post debiles *add. sunt EP1P3R* 200 ante non¹ *add. et P1* / non¹: nec EP3R /
 remanet: remanent *ErS* / tingitur: tingatur E

recessum. Et ex hoc declarabitur quod luces et colores operan-
 tur in visum, nec remanent alterationes eorum post recessum,
 nec parvo tempore. Glacialis ergo alteratur a luce et coloribus
 205 tantum quod sentit, deinde aufertur immutatio post recessum.
 Alteratio ergo eius a colore et luce est necessaria, sed natura
 non fixa.

[6.93] Et etiam visus est preparatus ad patiendum colores
 et luces et ad sentiendum eas, et cum hoc non remanet in eo
 210 alteratio. Et aer, et corpora diafona, et tunice diafone anteri-
 ores glacialis non sunt preparate ad patiendum lucem et color-
 em et sentiendum ea, et non sunt preparate nisi ad redendum
 luces et colores tantum.

[6.94] Iam ergo declaratum est quod visus non tingitur ex
 215 coloribus et formis lucis tinctura fixa. Et declaratum est quod
 forme lucis et coloris non admiscuntur in aere et in corporibus
 diafonis et quod visus multi comprehendunt ipsos in aere et in
 eodem tempore; et quilibet eorum comprehendit ipsos secun-
 dum piramidem que distinguit inter ipsam et centrum visus.

[6.95] Quare vero non apparent omnes forme omnium
 220 colorum super omnia corpora illa, sed quedam apparent et
 quedam non, non est nisi quando color fuerit fortis, et lux que
 est in colore fuerit fortis, et lux que est in corpore super quod
 apparet forma coloris debilis? Et hoc pertinet ad visum, quo-
 225 niam iste forme non oriuntur super corpora opposita illis sed
 super corpora illuminata cum quolibet lumine colorato. Quo-
 niam forma lucis et coloris eius semper oriuntur super omnia
 corpora opposita illis quorum remotio non est extranea multa
 fortis longa. In lucibus vero hoc manifestatur, quoniam, quan-
 230 do fuerit experimentatum omne corpus illuminatum quolibet
 lumine (ita quod non fuerit lux valde debilis), et fuerit experi-
 mentatum secundum modos quos declaravimus--scilicet ut sit

202 et¹: sed P1S; om. P3/et¹ . . . recessum (203) mg. a. m. S 203 visum: visu P3/
 alterationes eorum transp. R 205 ante tantum add. in P1S/quod sentit: ut sentiat R/
 post sentit add. et EP3R 206 colore: calore Er/colore et luce: luce et colore P3R/
 natura alter. in tinctura a. m. S 208 post patiendum scr. et del. l P1 209 et² inter.
 S/ad om. P3/eas: eos R/et³ . . . non: nec tamen R/post remanet scr. et del. not P3
 210 post tunice add. visus R/anteriores (211): ante res Er; anterioris R 211 glacialis:
 glaciali EP3 212 et²: sed R/non . . . nisi om. R 215 declaratum: determinatum
 EP3/est: etiam Er 216 in² om. EP3R 218 quilibet: quodlibet ErP1S/ipsos:
 ipsas ErP1 219 ipsam: ipsos R 220 apparent: appareant R/post omnium add.
 corporum vel EP3R 221 illa: opposita R/apparent: appareant R 222 non est
 om. S/color fuerit transp. P1S 223 post fuerit scr. et del. fuit P3 225 post forme
 add. colorum EP3R/post illis add. nisi illuminentur EP3R 226 colorato om. R
 227 forma: forme R 231 non om. EP1P3R/fuerit² corr. ex fuerint P3 232 ante
 secundum scr. et del. omne corpus P3/declaravimus: declarabimus Er

positum in sua oppositione corpus album, et illud corpus sit in
loco obscuro, et fuerit inter corpus illuminatum et illum locum
235 obscurum foramen strictum--quoniam super illud corpus tunc
apparebit lux. Colores autem non apparebunt nisi secundum
modum proprium, quoniam declaratum est per inductionem
quod forme colorum semper sunt debiliores ipsis coloribus, et
quanto forme fuerint magis remote a suo principio tanto erunt
240 debiliores.

[6.96] Et declaratum est etiam per inductionem quod fortes
colores, quando fuerint in locis obscuris et fuerint luces que
sunt super ipsos valde debiles, illi colores apparebunt obscuri,
et non distinguuntur visui. Et quando fuerint in locis illumina-
245 tis, et fuerit lux que est super eum fortis, apparebunt colores et
distinguuntur visui.

[6.97] Et declaratum est etiam per inductionem quod,
quando lux fortis fuerit super formas colorum apparentes
super corpora opposita illis, latebunt visum, et non appare-
250 bunt nisi quando lux non fuerit fortis vel remota.

[6.98] Et etiam declaratum est quod, quando lux fuerit
fortis et pervenerit ad visum, prohibebit ipsum ab apprehen-
sione rerum visarum non apparentium in se multum opposi-
tarum illi tunc.

[6.99] Et etiam est declaratum quod visus non compren-
255 dit colores nisi ex forma veniente ad ipsum ex illo colore et
quod comprehensio eius erit secundum verticationes proprias.
Quando ergo inspiciens aspexerit corpus densum super quod
oriebatur forma coloris, non comprehendet illam formam nisi
260 ex forma secunda veniente ad ipsum ex illa forma. Et ista
forma secunda est debilior prima forma que est super illud
corpus, et prima forma est debilior ipso colore. Et visus non
comprehendit ipsum corpus densum super quod apparet

234 illum locum *transp. R* 235 strictum *corr. ex structum S/quoniam: inveniet*
quod *R/super . . . lux (236): tunc apparebit lux super illud corpus Er* 236 *post nisi*
add. sint EP3 237 proprium: praedictum *R* 238 *post et scr. et del. q S*
239 magis remote: remotiores *R* 241 *post et scr. et del. erunt P1/etiam om. EP3R/*
fortes colores (242) *transp. Er* 242 *ante colores scr. et del. erunt P1/locis corr. ex lucis*
P1/fuerint²: fiunt P1 243 *sunt om. Er; corr. ex fiunt P3/ipsos: ipsas EP3/illi:*
isti EP3R 244 *et² . . . visui (246) om. Er* 245 *eum: ipsum EP3; ipsos R*
246 *visui: a visu R* 250 *non om. EEP3RS/post fuerit scr. et del. fortis et pervenit ad*
visum Er/fortis: debilis Er/fortis vel om. EP3R/vel remota om. Er; inter. a. m. S
251 *lux fuerit transp. P1* 253 *in se: vise Er; corr. ex vise S/post multum add. et R*
255 *est declaratum transp. R* 257 *eius: ipsius EP3R/proprias om. P1*
259 *comprehendet: comprehendit EP3R* 260 *forma secunda transp. ErR*
261 *est debilior transp. Er* 263 *ipsum: illud R; om. Er*

265 forma nisi quando in ea apparet aliqua lux, sive lux veniens
 cum forma coloris super ipsum orientis, sive illa lux cum alia.
 Forma ergo secunda que venit ad visum ex prima forma coloris
 venit ad ipsum cum forma lucis que est in illo corpore denso.
 Et color illius corporis densi super quod est forma comprehen-
 270 detur a visu etiam in illa dispositione. Forma ergo eius coloris
 venit ad visum cum forma secunda veniente ad ipsum ex for-
 ma coloris que est super ipsum, et forma coloris istius corporis
 que venit ad visum in illa dispositione est prima forma. Visus
 autem non comprehendit illud quod comprehendit nisi ex ver-
 ticationibus propriis, et verticatio propria que est inter ipsum
 275 et corpus densum secundum quam comprehendit formam
 coloris illius corporis densi est eadem cum verticatione secun-
 dum quam comprehendit formam secundam venientem ex
 forma coloris orientis super illud corpus, quoniam illa forma
 est in superficie illius corporis. Visus ergo comprehendit ip-
 280 sam ex verticationibus que sunt inter ipsum et illud corpus, et
 ipse comprehendit colorem illius corporis ex verticationibus
 que sunt inter ipsum et illud corpus. Et similiter comprehendit
 visus lucem que est in illo corpore ex illis eisdem verticationi-
 bus. Tres ergo forme venientes ex illo colore ad visum compre-
 285 henduntur a visu ex eadem verticatione.

[6.100] Et cum hoc est, comprehenduntur admixte, et for-
 me secunde que veniunt ad visum ex forma coloris que sunt
 super corpus oppositum illi comprehenduntur a visu semper
 admixte cum forma coloris illius corporis et forma lucis eius.
 290 Ipsum ergo comprehendit ex congregatione duorum colorum
 formam diversam a forma cuiuslibet earum. Si ergo corpus
 densum super quod est forma habuerit fortem colorem, erit
 forma eius que venit ad visum fortis, et est prima forma, et est
 admixta cum secunda forma que venit ad ipsum ex forma

264 apparet: apparuerit R 265 ante alia scr. et del. fuerit P1 267 cum . . . visum
 (270) mg. a. m. E/illo corpore transp. P3 268 post est add. ista R 269 in inter. S/
 eius om. R 271 istius corr. ex ipsius P3 272 post ad add. ipsum EP3R
 273 illud corr. ex istud P1 275 quam: quem P3; quod R 276 coloris om. R/
 coloris . . . formam (277) mg. a. m. S/post verticatione add. sua R 277 quam: quem
 P3/formam: forma P3 279 ergo om. Er 280 corpus om. P1/et² . . . corpus (282)
 mg. a. m. E 281 illius corporis: ipsius EP3R 282 illud om. EP3 284 colore:
 corpore EP3R/visum: visus Er 286 cum . . . comprehenduntur om. R/comprehen-
 duntur admixte corr. ex admixte comprehenduntur Er/ante admixte add. quidem R/
 post admixte scr. et del. item P1 287 secunde om. P3/sunt: est R
 288 comprehenduntur: comprehenduntur P1R 289 corporis corr. ex coloris S/post
 et add. cum R 290 ipsum: visus R 291 earum: eorum EP3R 292 densum
 om. R

295 coloris orientis super illud corpus. Et ista forma est debilis,
 quare non apparet visui quoniam, quando cum colore debili
 fuerit admixtus color fortis, vincet color fortis debilem. Et
 similiter inveniuntur semper colores et tincture quando admis-
 centur adinvicem. Forma vero coloris non latet quando lux que
 300 est super ipsam fuerit fortis nisi quia forma secunda venit ad
 visum cum forma lucis fortis et cum albedine corporis.

[6.101] Et iam declaratum est quod lux fortis, quando
 venit ad visum, prohibet visum a comprehensione formarum
 debilium. Quando ergo veniet ad visum lux fortis cum albedi-
 5 ne corporis supra quod est, prohibebit ipsum a comprehensio-
 ne secunde forme debilis que venit ad ipsum cum ea. Et si
 corpus super quod est forma coloris fuerit album, et lux que
 est super ipsum fuerit debilis, et forma etiam coloris que est
 super ipsum fuerit debilis, tunc forma lucis que est in illo cor-
 10 pore, quamvis sit debilis, cum albedine corporis forte vincet
 formam coloris que est valde debilis. Et cum venerit ad visum,
 non distinguetur illa forma visui. Et si corpus super quod est
 lux fuerit album, et color cuius forma oritur super ipsum fuerit
 niger aut obscurus, non eclipsabitur illa forma nisi ab albedine
 15 illius corporis tantum; et erit quasi umbra, et comprehendet
 visus illud corpus non valde album, sicut comprehendet cor-
 pus album in umbra, quare non distinguetur ab eo forma.

[6.102] Et omne hoc erit ita quando lux que est in corpore
 colorato fuerit fortis, et forma que oritur ab eo super corpus
 20 oppositum fuerit albedinis debilis. Si autem lux que est in
 corpore colorato fuerit debilis, tunc forma que exit ex eo super
 corpus oppositum erit obscura, et erit apud visum sicuti color-
 es quos comprehendit in locis obscuris in quo est lux debilis
 valde et quasi colores corporum diafonorum super que oritur

295 coloris *corr. ex lucis P1 / orientis: venientis R* 297 *post fortis¹ scr. et del. debilem S; add. ipse scilicet EP3R (inter. a. m. E) / vincet . . . fortis: color . . . vincet P3R / color fortis: calor fortis E (inter. a. m.)* 299 *adinvicem: inter se R / vero: ergo P1 / que om. EP3R* 300 *fuerit om. EEP3R / nisi . . . fortis (1) om. R / forma secunda transp. Er*
 1 *cum . . . fortis: fortis lucis Er* 2 *quando: cum P1S* 5 *supra: super EP3R / est: cadit R / post est add. cadens EP3 / prohibebit: prohibet R* 6 *secunde corr. ex secundum P3* 8 *et . . . debilis (9) mg. a. m. E / etiam om. EEP1P3R / etiam coloris transp. S*
 9 *post ipsum add. etiam P1* 11 *valde om. Er* 12 *illa . . . visui: forma illa a visu R* 13 *cuius: cum EEP3R / post forma add. que EEP3R* 14 *eclipsabitur: obscurabitur R / illa corr. ex a. m. E / ab om. EP3R* 15 *comprehendet corr. ex comprehenduntur P1* 16 *sicut: sed P1S / comprehendet: comprehendit ErR*
 17 *post album add. ut P1S* 19 *fuerit fortis corr. ex fortis fuerit Er / fortis om. P1 / forma: formetur P1 / oritur ab: exit ex P1S* 20 *est corr. ex fuerit p E* 21 *post forma scr. et del. erit Er / exit: erit Er / ex: ab R* 22 *obscura corr. ex obscura a. m. E / sicuti: sicut R* 23 *quo: quibus R / debilis valde (24) transp. R*

25 lux debilis. Forme ergo colorum que sunt in corporibus colora-
tis, quando lux que est super ipsas fuerit debilis, quando ori-
untur super corpora opposita sibi, non erunt nisi umbre tan-
tum quoad sensum visus. Et si corpus oppositum colori quod
est huiusmodi fuerit in loco obscuro, nichil apparebit super
30 ipsum propter suam obscuritatem et obscuritatem forme veni-
entis ad ipsum. Et si corpus oppositum isti colori fuerit in
illuminato loco, et fuerit super ipsum lux preter lucem illius
forme, et fuerit illud corpus illuminatum, apparebit color eius
super illam formam; et apparebit visui color istius corporis, et
35 non apparebit forma, quoniam est sicut umbra, et non distin-
guetur visui ista diminutio. Et si istud corpus super quod est
forma fuerit album et cum hoc fuerit illuminatum cum alio lu-
mine preter lumen forme, tunc forma eclipsabit albedinem isti-
us corporis et lucem eius tantum propter suam obscuritatem,
40 sicut faciunt umbre in corporibus albis.

[6.103] Et forme que sunt huiusmodi tantum comprehen-
duntur a visu super corpora opposita coloribus.

[6.104] Visus ergo non comprehendit formam coloris super
corpus oppositum colori nisi quando forma secunda veniens
45 ad ipsum ex forma coloris fuerit fortior et magis vincens prima
forma venienti ad ipsum cum ea ex luce et colore que sunt in
corpore super quod est forma. Et iste modus est valde rarus,
et propter hoc raro apparet huiusmodi forma, et non apparet
ex ea nisi illud quod est ex coloribus fortibus scintillantibus, et
50 quando lux que est super ipsos colores fuerit fortis, et quando
iste forme fuerint super corpora opposite albedinis, et quando
lux que est super ista corpora fuerit debilis in respectu illarum
formarum. Et quod non est huiusmodi non apparet.

[6.105] Et similiter lux debilis que non apparet super cor-
pus oppositum sibi est quia corpus oppositum luci debili,
55 quando fuerit illuminatum ab alio lumine, admiscebuntur due

25 corporibus: coloribus *P1* 26 ipsas: ipsa *EP3R* 27 umbre: umbra *EP3*
28 corpus *om. Er*/quod . . . huiusmodi (29) *om. R* 29 super *inter. E* 30 ob-
scuritatem et obscuritatem: obscurationem. *P1S* 31 isti: illi *R* 33 illud . . .
illuminatum: istud coloratum *Er* 34 illam: istam *R* 36 visui: a visu *R*
37 cum hoc: praeterea *R*/alio *corr. ex ergo a. m. S* 38 eclipsabit: obscurabit *R*
39 obscuritatem *corr. ex obscuritatem P3* 40 albis: aliis *R* 41 comprehenden-
tur (42): comprehenduntur *EERP3R* 42 coloribus: corporibus *P1S* 45 fuerit
inter. a. m. E/fortior *corr. ex fortiori S*/magis vincens: potentior *R* 46 venienti:
veniente *R*/ipsum: ipsam *EP3R* 49 scintillantibus *corr. ex sintillantibus P3*/et . . .
apparet (53) *om. R* 50 que *inter. a. m. E* 51 opposite: posite *EERP3* 53 et
om. EP3/huiusmodi *rep. EP3*; *corr. ex huius P1* 54 ante lux *add. quod R*/que *om. R*
55 luci: sibi et *EP3*; loci *S* 56 post quando *scr. et del. e Er*

lucis, et sic non distinguetur lux debilis visui. Et cum corpus
 oppositum luci debili fuerit obscurum, non apparebit forma
 lucis debilis super ipsum, quoniam forma lucis est debilior ipsa
 60 luce, et forma secunda veniens ad oculum ab ista forma, ex
 qua oportet visum comprehendere istam formam super corpus
 oppositum luci, est debilior ista forma. Cum ergo lux fuerit
 debilis et corpus oppositum fuerit obscurum, erit forma que est
 super corpus oppositum valde debilis, et erit forma secunda
 65 que venit ex illa ad visum in fine debilitatis. Visus autem non
 comprehendit lucem que est in fine debilitatis.

[6.106] Forme ergo omnium colorum illuminatorum et forme
 omnis lucis oriuntur super corpora opposita, et non appar-
 ent plures illarum visui propter causas quas diximus. Et que-
 70 dam apparent quando fuerint secundum modum quem narra-
 vimus. Iam ergo declarata est causa propter quam non com-
 prehendit visus formas omnium colorum que sunt in corpori-
 bus coloratis super omnia corpora opposita illi, et comprehen-
 dit quasdam, et cum hoc comprehendit omnes colores qui sunt
 75 in corporibus coloratis. Et causa est quia comprehendit color-
 es qui sunt in corporibus coloratis ex propria forma venienti
 ad ipsum ex eis que est fortior forma secunda venienti ad ip-
 sum ex formis colorum qui sunt super corpora opposita illi. Et
 comprehendit formam colorum etiam singularem non admix-
 80 tam cum alia, et comprehendit secundam formam provenien-
 tem ad ipsum ex formis colorum earum admixtam cum alia.

[6.107] Et hoc est quod promisimus declarare in fine capi-
 tuli tertii, et declaratum est modo quod colores quos compre-
 hendit visus ex rebus visis non comprehendit ipsos nisi admix-
 85 tos cum formis lucis que sunt in eis et admixtos cum omnibus
 formis orientibus super ipsos ex coloribus corporum opposito-
 rum. Et si in corpore diafono quod est medium inter ipsos et
 visum fuerit aliqua spissitudo, admiscebitur color eius etiam

57 *post lucis add. debiles S/non om. Er/visui: a visu R* 58 *forma mg. P3* 59 *est om. EErP3/est debilior transp. R/ipsa om. Er* 62 *ergo: igitur P1* 63 *erit: exit P1*
 64 *corpus oppositum transp. Er* 65 *ad visum om. R* 66 *comprehendit: comprehendet P1S* 69 *plures: pleraeque R/visui om. R* 71 *non om. P1P3*
 72 *in om. EP3* 73 *corpora om. Er/et . . . quasdam (74) om. Er/comprehendit (74) comprehendet S* 75 *quia corr. ex qui a. m. E* 76 *ex inter. a. m. E/venienti: veniente EP3R* 77 *venienti: veniente R; corr. ex veniente E; venientis alter. in veniente P3*
 79 *formam . . . etiam: etiam . . . colorum EP3R/formam corr. ex formas a. m. E/etiam: et Er/singularem corr. ex singularem S* 80 *secundam: secundum P1/provenientem (81): venientem EP3R; pervenientem Er* 81 *ante ad scr. et del. p S/earum om. R*
 82 *capituli (83): capitis R/capituli tertii (83) transp. Er* 83 *post est add. hoc P1*
 84 *ipsos om. R* 87 *ipsos: eos Er*

cum eis, et visus non comprehendit illum colorem singularium.
 90 Sed tamen forme que oriuntur super corpora colorata sunt in
 maiori parte valde debiles, et forme secunde que veniunt ex eis
 ad visum sunt in fine debilitatis. Et propter hoc erunt colores
 corporum ipsorum pluries vincentes super formas orientes su-
 per ipsa. Et similiter si in corpore diafono quod est medium
 95 inter visum et rem visam fuerit modica spissitudo, non distin-
 guetur visui color eius a colore visi venientis cum eo quando
 color visi venientis cum eo fuerit fortior colore illius.

[6.108] Quare vero lux fortis prohibet visum a compreen-
 sione quarundam rerum visarum est quia forme que veniunt
 100 ad visum super unam verticationem non comprehenduntur a
 visu nisi admixte. Et cum quedam forme admixte fuerint fortis
 scintillationis et quedam debilis, superabit forma fortis for-
 mam debilem, et sic non comprehendetur forma debilis a visu.
 Et cum forme admixte fuerint propinque in fortitudine, com-
 105 prehendentur a visu, et erit comprehensio cuiuslibet illorum
 secundum illud quod admiscebitur cum eis ex formis admixtis
 cum eis, quoniam forme admixte non comprehenduntur a visu
 singulariter sed admixte.

[6.109] Stelle ergo non comprehenduntur a visu in luce diei
 110 quia lux que pervenit in aere est fortior luce stellarum. Cum
 ergo inspiciens aspexerit celum in luce diei, erit aer qui est inter
 ipsum et celum illuminatus a lumine solis et continuatus cum
 visu, et erunt stelle ex posteriori illius lucis. Erunt ergo forma
 stelle et forma lucis que est in aere medio inter visum et illam
 115 stellam venientes ad visum super unam verticationem, et sic
 comprehenduntur admixte. Sed forma lucis diei in aere est
 fortior multo forma lucis stelle, quare superabit lux aeris lucem
 stelle, et sic non distinguetur forma stelle.

89 comprehendit: comprehendet S/singularium: singularem R 90 que: qui S
 93 corporum ipsorum *transp.* EP3R/pluries: plerunque R/vincentes: venientes EErP3/
 vincentes . . . orientes: fortiores formis orientibus R/orientes *inter. a. m. E* 94 est *om.*
P1/medium *om. P1RS* 96 visui: a visu R/color eius *om. EP3*/visi: nisi *P1*; *corr. ex*
 visu S 97 illius *corr. ex illis a. m. S* 98 prohibet: prohibeat R 100 com-
 prehendentur: comprehenduntur Er 101 forme . . . fuerint: sit forma P1S
 104 comprehenduntur (105): comprehenduntur Er 105 illorum: illarum R
 106 admiscebitur: permiscebitur EP3R 107 forme *om. P1* 109 stelle: selle E/
post diei add. nisi EErP3 110 quia . . . diei (111) *mg. a. m. S*/aere: aerem R
 111 qui: quod ErP1S 112 illuminatus: illuminatum P3; *corr. ex illuminatorum P1*/
 lumine: luce EP3R/continuatus: continuatur R 113 visu: visum Er/erunt²: erit
 ErP1S; venient R/forma stelle (114) *transp. EP3* 114 *post et² scr. et del. rem visam P1*/
 illam *om. EErP3R* 115 venientes *om. R* 116 comprehenduntur: compreen-
 duntur Er/forma: forme P3/diei *om. EErP3*/*post diei add. vel S (inter. a. m.)*/in aere
inter. a. m. S/in aere est: est in aere EErP3R

[6.110] Et similiter lux debilis que est in medio fortis lucis—
 120 sicut ignis debilis in luce solis, et sicut noctiluca in luce diei, et
 sibi similibus; ista visibilia quando fuerint in luce solis aut diei,
 venient forme eorum ad visum admixte cum forma lucis fortis
 orientis super ipsas. Et comprehendet visus formam huius-
 modi rerum visarum admixtam cum forma lucis fortis, quare
 125 superabit forma lucis fortis super formam debilem.

[6.111] Et multotiens latet lux debilis et forma rei vise de-
 bilis quando pervenerit in visum lux fortis, quamvis non sit
 perventus duarum formarum ad visum ex una verticatione. Et
 hoc erit quando perventus duarum formarum fuerit ex duabus
 130 verticationibus vicinantibus et pervenerit in visum in duabus
 partibus vicinantibus. Et hoc apparet nocte in luce ignis, quo-
 niam visus, quando comprehenderit lucem ignis, et fuerit ignis
 propinquus visui, et fuerit lux eius fortis, et fuerit in oppositi-
 one visui in illa dispositione aliquod visibile in quo est lux de-
 135 bilis accidentalis, et fuerit illud visibile remotius a visu igne, et
 fuerit super verticationem vicinantem verticationi ignis et pro-
 pinquum verticationi ignis, tunc visus non comprehendet illud
 visibile comprehensione vera. Et si aspiciens cooperuerit ig-
 nem a suo visu aut removerit se a verticatione ignis ita quod sit
 140 verticatio a qua comprehendit illud visibile remota a verticati-
 one ignis, tunc comprehendet illud visibile comprehensione
 manifestiore.

[6.112] Et causa illius est quod visibile in quo est lux debi-
 lis accidentalis habet formam obscuram, et cum ipsam com-
 145 prehenderit visus et non comprehenderit cum ea lucem fortem,
 sentiet lucem debilem in quo est aliquid obscuritatis inter vi-
 sum aut privationem lucis fortis a parte eius in quam pervenit
 forma lucis debilis. Et cum visus comprehenderit formam lucis
 debilis et comprehenderit cum ea lucem fortem, tunc etiam

119 *post lux add. est R/fortis lucis transp. EP3* 120 *luce¹ corr. ex aere E* 121 *sibi om. R/sibi similibus transp. EP3/post ista add. enim R* 122 *venient: veniet Er/fortis om. P3* 123 *formam corr. ex formas P1* 126 *ante et² scr. et del. fortis P1*
 130 *et . . . vicinantibus (131) om. P1P3R; scr. et del. E/in duabus om. Er* 131 *post nocte add. et EErP3R* 134 *visui: visus R; corr. ex visus P1/aliquod: ad EP3* 135 *igne: quam ignis R* 136 *verticationi corr. ex verticationem P3/et . . . ignis (137) om. R*
 137 *ignis: igni P3; corr. ex igni a. m. E/illud visibile (138) transp. R* 138 *ignem (139): igne P3* 139 *suo visu transp. P3/removerit: removebit P3; corr. ex removebit a. m. E/quod: ut R* 140 *comprehendit: comprehendet EP3R/illud visibile corr. ex visibile illud Er/remota . . . visibile (141) om. Er* 144 *cum inter. E/comprehenderit (145): comprehendit EP3* 145 *et non: non autem EP3R* 146 *quo: qua P1R*
 147 *ante aut scr. et del. et i P1/aut om. S* 148 *forma om. EP3/lucis¹: lux EP3/comprehenderit: comprehendit P1S* 149 *etiam: et EP3*

150 comprehenderit lucem fortem in parte ipsius contingenti par-
tem qua comprehendebat formam obscuram. Non comprehen-
det visus lucem debilem que est in forma obscura propter duo:
quorum unum est quod lux fortis, quando pervenerit in visum,
illuminatur totus visus, et cum totus visus fuerit illuminatus,
155 non apparebit in eo lux debilis, et maxime quando lux debilis
fuerit proportionis minime respectu lucis fortis; et alterum est
coniunctio lucis debilis cum luce forti in duabus partibus vici-
nantibus visus. Et lux debilis respectu lucis fortis est fere ob-
scuritas, et cum lux vicinabitur ad formam obscuram debilem,
160 et forma lucis fortis fuerit in visu, non comprehendet visus for-
mam que est in luce obscura, nec comprehendet etiam formam
obscuram nisi obscuritatem tantum; et sic non distinguetur ab
eo forma, nec comprehendet eam comprehensione vera.

[6.113] Et occultatio formarum debilis lucis propter vicini-
tatem lucis fortis habet simile in coloribus, quoniam color fus-
cus, quando intinguetur cum eo corpus album punctatim, puncta
apparebunt nigra propter fortitudinem albedinis. Et si ead-
em puncta fuerint posita super corpora valde nigra, apparent
fere alba, et non apparebit obscuritas que est in eis. Et quando
170 illa tinctura fuerit in corporibus que non sunt multum alba nec
multum nigra, apparebit color secundum suum esse.

[6.114] Et similiter quando color viridis segetalis fuerit
super corpus citrinum, apparebit illa tinctura obscura; et
quando fuerit in corpore nigro, apparebit illa tinctura similis
175 colori origani, et similiter omnis tinctura media inter duas
extremitates.

[6.115] Visibilia ergo vicinantia quando fuerint remota in
fortitudine et debilitate coloris, quod est debilis coloris latebit
visum, quoniam qualitates lucis et coloris non comprehendun-

150 comprehenderit: comprehendit EP3; comprehendet R/ipsius om. EErP3R/contingenti: contingente R 151 ante qua add. visus EErP3R/qua: et Er; quia S/obscuram corr. ex obscurum P3 152 ante visus add. autem R 153 quando: cum P3/in: ad R 154 totus¹ corr. ex totius S/cum inter. E 155 quando om. E; si P3 (inter. a. m.) 156 post fuerit add. debilis Er/et om. R/post et add. aliquando EP3 (mg. a. m. E)/alterum: altera EP3 157 vicinantibus visus (158) transp. EP3R 158 post et add. quia R 159 vicinabitur: appropinquabit R 160 comprehendet: comprehendit EErP3 161 nec... obscuram (162) om. P3; scr. et del. E/comprehendet: comprehendetur EEr/etiam om. Er/formam obscuram (162): forma obscura EEr 162 post nisi add. in EEr/obscuritatem: obscuritate EErP3/ab eo forma (163): forma ab eo Er 164 propter... lucis (165) mg. a. m. S 166 quando: si R/intinguetur: intingetur EP3 (alter. ex intingetur a. m. E); intingat R/cum eo: super P3/eo... album: corpore albo R/puncta (167) om. EP1RS 167 ante nigra add. ipsa puncta R 168 super: supra R/apparent: apparebunt EP3R 172 similiter corr. ex super P3/color corr. ex corpus S 175 ante omnis add. est R 178 debilis coloris transp. P3 179 comprehenduntur (180): comprehenduntur EP3

- 180 tur a visu nisi ex respectu eorum adinvicem. Et lux fortis non
prohibebit visum a comprehensione visibilium lucis debilis nisi
propter admixtionem forme lucis debilis cum formis earum, et
propter victoriam formarum lucis fortis super formas lucis de-
bilis, et debilitatem sensus ad comprehendendum illud quod
185 est minime proportionis respectu fortis.
[6.116] Iam ergo complevimus declarationem omnium
rerum dependentium ab isto capitulo.

[CAPITULUM 8]

[7.1] Tunice quas diximus in declaratione forme visus sunt
instrumenta per que completur visio.

- [7.2] Tunica vero prima, que dicitur cornea, est tunica dia-
fona et cum hoc fortis, et est superposita foramini quod est in
5 anteriori uvee. Et prima utilitas eius est quia cooperit foramen
uvee, quare retinet humorem albugineum quod est in anteriori
uvee. Et est diafona ut transeant in ea forme lucis et coloris
ad interius visus, quoniam non transeunt nisi per diafona.
Fortitudo autem eius est ut non corrumpatur cito, quoniam est
10 exposita aeri et potest cito corrumpi ex fumo, et pulvere, et
sibi similibus.

- [7.3] Humor autem albugineus est diafonus, et est hic hu-
midus fluxibilis. Diafonitas autem est ut pertranseant in eo
forme et perveniant in eo ad humorem glaciale. Humiditas
15 autem eius est ut semper humefaciat humorem glaciale, ita ut
eius natura sit custodita, quoniam tela que est super glaciale
est valde tenuis, et minima siccitate poterit corrumpi.

- [7.4] Tunica autem nigra continens humorem albugineum,
que est uvea, est nigra, et fortis, et spissa, et spherica, et in an-
20 teriori eius est foramen rotundum, sicut narravimus. Nigredo

180 ex om. R/adinvicem: inter se R 181 post debilis add. lucis P3 182 admix-
tionem corr. ex admixtione S/forme mg. a. m. E/post debilis add. et fortis EP3/ante cum
add. vel mg. a. m. E/cum formis om. P3; mg. a. m. E/earum: eorum EP1P3R 183 post
victoriam add. lucis S/formarum om. Er/lucis . . . lucis mg. a. m. E 184 sensus: vi-
sus P1; lucis debilis S 187 isto: illo P3R 1 sunt: sicut Er 2 instrumenta corr.
ex instrumentum E 4 cum hoc: nonihil R/ante est¹ scr. et del. s Er/superposita: sup-
posita P1; superpositata P3 5 ante uvee add. tunice P3/post eius scr. et del. eius S/
quia: quod EP3R 6 uvee corr. ex uve S/quare . . . uvee (7) om. Er/quare: quarum P3/
quod: qui R; alter. in. qui EP3 (a. m. E)/est om. EP3 9 eius est corr. ex est eius P3
10 exposita: opposita Er 11 sibi om. ErR/sibi similibus transp. EP3 12 albugi-
neus: albuginens Er/hic om. R 13 ante fluxibilis add. et R/diafonitas: diafonus P3R
15 ita: prima S 16 natura: non P3/custodita: custodia ErS 17 minima: nimia
R/poterit: potest R 18 humorem corr. ex humor a. m. P3 19 et² om. R

vero eius est ut obscuretur humor albugineus et glacialis ita
quod appareant in ea forme lucis debilis, quoniam lux debilis
valde apparet in locis obscuris et latet in locis luminosis. Et
est aliquantulum fortis ut retineat humorem albugineum et ut
25 non resudet ex eo aliquid ad exterius. Et est spissa ut sit ob-
scura, quoniam si esset rara, esset diafona; et cum erit spissa,
obscurabitur anterior pars eius. Et est sperica quia est magis
temperata figurarum, et est magis remota ab occasionibus, et
habens angulos citius alteratur per angulos. Foramen autem
30 quod est in anteriori istius tunice est ut pertranseant ipsam
forme ad interius visus, et est rotundum quia rotunditas est
simplicior figurarum et amplior ysoperimetrorum.

[7.5] Humor autem glacialis habet multas proprietates per
quas completur sensus. Quoniam est humidus et subtilis, et
35 est in eo aliquid diafonitatis et spissitudinis. Et super ipsum
est tela valde rara, et figura superficiei eius est composita ex
duabus superficiibus spericis diversis, et anterior illarum est
maioris spericitatis altera. Est autem humidus ut citius pati-
atur a luce, et est subtilis quia talia corpora sunt subtilis sen-
40 sus. Et est aliquantulum diafonum ut recipiat formas lucis et
coloris et ut pertranseant per ipsum lux et color, et est ali-
quantulum spissus ut remaneant in eo diu forme lucis et coloris
ita quod appareat virtuti sensibili forma lucis et coloris que
figebantur in eo. Et si esset diafonum in fine diafonitatis, per-
45 transirent forme in eo, et non pateretur a formis passione que
est ex genere doloris, et sic non comprehenderet formas.

[7.6] Tela autem que est super istum humorem est ut re-
tineat ipsum quatinus non fluat, quoniam humores nisi retine-
rentur aliquo, fluere et non remanerent secundum unam figu-
50 ram. Et ista tela est valde rara ut non occultet formas venien-
tes. Et est sperica propter causam quam diximus, et superfici-
es anterioris eius est ex spera maiori ut sit equidistans super-

21 eius *om.* S 22 quod: ut P3R/ea: eis R 23 luminosis *corr.* ex luominosis P3
24 retineat: retina Er 25 resudet *corr.* ex restidet a. m. Er/ad exterius: foras R/est
om. P1 26 et cum erit: sed cum fuerit R/cum *inter.* a. m. E 27 anterior . . . eius:
anteriorius Er/anterior pars *transp.* EP3/quia *om.* Er/est² *om.* EP3R/post est² *add.*
enim Er 28 ante et¹ *add.* est sperica EP3R/et² *om.* R 29 post habens *add.* enim R
30 est¹ *om.* EP3/pertranseant: transeant Er 31 forme *inter.* a. m. E 32 simplicior:
simplicissima R/amplior: amplissima R/ysoperimetrorum: isoperimetrarum R
36 superficiei: superficies S 38 spericitatis: speritatis EEP3 40 diafonum:
diaphanus R 43 quod: ut R/appareat: apparet Er/que: qui Er 44 figebantur:
figebantur E/et: nam R/diafonum: diaphanus R 48 quatinus non: ne R/nisi:
non R 49 ante aliquo *add.* sed R/remanerent: remanebunt Er;*corr.* ex remearent a. m.
E;*corr.* ex remanent S/figuram (50) *corr.* ex formam S 50 occultet *corr.* ex occultat P1

fici ei anteriori visus, ita quod centra illarum sit unus punctus.

[7.7] Nervus autem obticus super quem componitur oculus
 55 totus est obticus ut currat per ipsum spiritus visibilis a cere-
 bro, et perveniat ad glaciale, et det ipsi virtutem sensibilem
 successive, et ut pertranseant etiam forme in corpore subtili
 currenti in suo concavo quousque perveniant ad ultimum sen-
 tiens quod est in anteriori cerebri.

60 [7.8] Et principia duorum nervorum super quos compo-
 nuntur oculi duo sunt in duabus partibus anterioris cerebri ut
 situs duorum oculorum a suis duobus principiis sit situs con-
 similis. Et non fuit principium eorum a medio anterioris cere-
 bri, quia iste locus est proprius sensui ordinatus.

65 [7.9] Quare enim fuerint duo oculi est benignitas operatoris
 ita quod, si uni illorum accideret occasio, remaneat alter, et ut
 forma faciei sit etiam pulcior.

[7.10] Causa autem propter quam concurrunt isti duo nervi
 iam fuit dicta in qualitate visionis.

70 [7.11] Superficies vero tunicarum oculi sunt sperice et equi-
 distantes, et centrum illarum est unum punctum ita quod per-
 pendicularis que est super primam illarum est perpendicularis
 etiam super omnes. Et sunt sperice ut exeant omnes perpen-
 diculares ab uno puncto quod est centrum illarum, deinde dis-
 75 tent apud extremitates secundum remotionem a centro ita
 quod piramis extensa a centro contineat omnes perpendicu-
 lares exeuntes ab illa re visa et distinguat ex superficie visus et
 membri sentientis partem parvam continentem, quamvis
 sit parva, totam formam venientem a re visa ad visum. Et si
 80 superficies tunicarum visus essent plane, non veniret forma
 visi ad visum super perpendiculares nisi esset visus equalis
 viso. Et nulla figura est in qua adunantur perpendiculares et
 concurrunt in unum punctum eius, et est superficies super
 quam eleventur equalis ordinationis, nisi figura sperica.

53 quod: ut R/unus punctus: unum punctum R 55 obticus: cavus R 56 ipsi:
 ipsum EP3 58 currenti: corrente EP3R/suo om. P3 62 situs¹: sicut P1/duobus
 om. R 65 fuerint: sint R/duo oculi transp. P3 66 ita quod: ut R/illarum: eorum
 Er/occasio: interitus R 67 sit: esset R/etiam om. EP3R 68 concurrunt:
 concurrant R 71 post centrum add. etiam P1S/quod: ut R 72 ante que scr. et del.
 etiam super omnes S/est²: sit R 73 etiam: et P1; om. Er/omnes² om. ErS/perpendic-
 ulares (74) om. EP3R 75 post secundum scr. et del. quod P1 76 quod: ut R/a
 centro om. P1S 78 post partem add. licet R/quamvis sit parva (79) om. R 79 sit
 rep. P1/post parva add. tamen R/ante a add. quod P3/si corr. ex situm P1 81 visi om.
 EP3; corr. ex visus P1/esset: essent P3 82 viso corr. ex visio Er 83 concurrunt:
 concurrent S/eius . . . ordinationis (84) om. R/est superficies transp. EP3/superficies
 super corr. ex super superficies Er 84 eleventur: elevatur EP1P3

85 [7.12] Et cum ista dispositione possunt exire a centro visus
 multe piramides ad multa visa in eodem tempore, et quelibet
 illarum distinguet partem parvam superficiei membri sentientis
 continentem formam illius visi. Et omnes tunice habent unum
 centrum propter illud quod prediximus, et est ut perpendicu-
 90 lares exeuntes a re visa ad unam illarum sint perpendiculares
 super omnes et ut pertranseant etiam forme omnes secundum
 unam verticationem.

[7.13] Quare vero nichil comprehendit visus ex rebus visi-
 bilibus nisi ex verticationibus istarum perpendicularium tan-
 95 tum est quia per istas perpendiculares tantum ordinantur par-
 tes vise rei in superficie membri sentientis. Et hoc fuit iam
 manifestum ante quoniam non potest ordinari forma rei vise in
 superficie membri sentientis nisi sit receptio eius ad formam ex
 istis verticationibus tantum. Et propter hoc appropriatur na-
 100 tura visus ista proprietate, et naturatur quod non recipiat
 aliquam formam nisi secundum situm istarum verticationum
 tantum. Et appropriatio visus habita hac proprietate est una
 rerum ex quibus apparet maxima discretio operatoris et boni-
 tas preparationis nature in preparando instrumenta visus et
 105 formam per quam completur sensus et per quam distinguuntur
 visibilia.

[7.14] Consolidativa autem continet omnes istas tunicas;
 et in ea est aliquid humiditatis, et cum hoc habet aliquid reten-
 tionis, et est aliquantulum fortis. Et continet istas tunicas ut
 110 congreget et conservet illas, et est aliquantulum humida ut pre-
 parentur loca tunicarum ex ea et ut non accidat siccitas veloci-
 ter illis tunicis. Et est aliquantulum retentiva et fortis ut con-
 servet situs et figuras tunicarum ut non alterentur cito. Et est
 alba ut sit per ipsam forma faciei pulchra.

115 [7.15] Et totus oculus est rotundus quoniam rotunditas est
 melior figurarum et maior et levioris motus. Oculus autem in-
 diget motu et velocitate motus ita quod sit oppositus per mo-

86 multe piramides *mg. a. m. E* 87 superficiei *om. EP3R* 88 unum: idem *EP3R*
 89 prediximus: diximus *EP3R/ut om. Er* 90 illarum: istarum *R/ante sint add. ut*
EP3 (mg. a. m. E)/sint: sit P1S/perpendiculares: perpendicularis EP1P3S 93 com-
 prehendit: comprehendat *R* 96 vise rei *transp. EP3R/fuit iam transp. Er/iam om. P3*
 97 ante: antea *R/ante quoniam: antequam S* 100 quod: ut *R* 102 hac *om. ErS*
 103 operatoris: operationis *Er* 104 in *om. EP3R* 105 completur *corr. ex*
copulatur P1 107 omnes *om. P1* 108 cum hoc: praeterea *R* 109 post et² *add.*
 continet *P3* 110 conservet: conservaet *P3; conservat S/illas: ipsas Er; om. P1/*
parentur (111): prepararentur S 111 ut *om. P1* 114 ipsam: ipsum *S/post*
faciei scr. et del. alba P1 115 quoniam rotunditas *inter. a. m. S* 116 figurarum:
figuris R/post et² scr. et del. letus oculus S 117 quod: ut *R/oppositus . . . sit (118) mg.*
a. m. S

tum multis visibilibus in eodem tempore, et ut sit oppositus
propter motum omnibus partibus rei vise medium aspicientis
120 ita quod comprehendat ipsum comprehensione vera et cum
hoc consimili, quoniam sensus per medium membri sentientis
est manifestior (et hoc declarabimus post in loco convenienti).
Velocitas autem motus visus est ut sit aspiciens omnes partes
rei vise et visibilia sibi opposita in modico tempore.

125 [7.16] Palpebre autem sunt ut conservent oculum apud
sompnum et ut faciant oculum quiescere quando fatigatur a
lumine, quoniam luces fortes nocent oculis, et si continue aper-
irentur oculi supra modum, debilitarentur. Et hoc apparet
quando oculi aspiciunt lucem fortem longo tempore. Et simi-
130 liter nocet visui aer quando in eo fuerit fumus aut pulvis. Pal-
pebre ergo cooperiunt oculum a luce, quando indigent hoc, et
conservant ipsos ab aere, et abstergunt ab eis multa nocumen-
ta. Deinde quando fatigantur, superponuntur palpebre ita
quod completur in eis sua requies, et sunt velocis motus ut
135 citius superponantur oculis apud appropinquationem nocu-
mentorum oculis.

[7.17] Cilia autem sunt ad temperandam quandam partem
lucis quando dolebit visus propter fortitudinem lucis, et prop-
ter hoc adunat aspiciens oculum suum et constringit ita quod
140 possit aspicere ab angusto quando lux fortis nocuerit ei.

[7.18] Ista ergo que diximus sunt utilitates instrumentorum
visus ex quibus manifestatur magna discretio operatoris. Sit
ergo nomen eius benedictum et bonitas preparationis nature.

[CAPITULUM 9]

[8.1] Iam ergo declaratum est superius quod visus nichil
comprehendit ex rebus visis que sunt cum eo in eodem aere (ita

118 oppositus: oppositum *ErS* 119 aspicientis: aspiciens *EP3R* 120 quod: ut
R/cum hoc (121) om. R 122 est *om. P3/convenienti: conveniente R; corr. ex venien-*
ti Er 123 sit aspiciens: aspiciat *ErR* 125 apud sompnum (126): in somno *R*
127 quoniam: quando *Er/continue corr. ex continuem P1* 130 aut *corr. ex autem S*
131 cooperiunt *corr. ex coperiunt P3/quando: quoniam S/indigent: indiget EEP3R*
133 quando: quoniam *P1S/ante ita add. eis EP3R* 134 quod completur: ut complea-
tur *R* 135 superponantur: superponuntur *P3/post oculis scr. et del. propinquitationi*
S/apud . . . nocumentorum (136): dum appropinquant nocumenta R 138 post lucis¹
scr. et del. et propter hoc S/dolebit corr. ex dolebis P1S/propter: per Er 139 post
oculum *scr. et del. o Er/suum om. EP3R/quod: ut R* 140 post fortis *scr. et del. fo S*
143 post ergo *scr. et del. est declaratum superius quod visus nichil comprehendit ex*
rebus *S* 1 declaratum est *transp. S/nichil om. P1*

quod comprehensio eorum ab eo non sit secundum reflexio-
nem) nisi quando aggregabuntur iste res, et sunt: [1] ut sit in-
5 ter ea aliquid spatii, [2] et ut sit opposita visui illa res--scilicet
ut sit inter quodlibet punctum eius superficiei quam compre-
hendit visus et inter aliquod punctum superficiei visus linea
recta ymaginabilis, [3] et ut sit in ea lux, [4] et ut sit corpus
eius aliquantulum in respectu virtutis sensus visus, [5] et ut sit
10 aer medius diafonus continue diafonitatis, et ut non sit in eo
aliquod corpus non diafonum, [6] et ut sit res visa resistens
visui--scilicet ut non sit in ea diafonitas, aut si sit, sit spissior
diafonitate aeris medii inter ipsam et visum; sed tale non po-
test esse nisi cum colore aut eius simili. Visus autem non com-
15 prehendit rem visam nisi quando congregabuntur iste sex in-
tentiones, et si res visa caruerit istarum una intentionum, non
comprehendetur a visu.

[8.2] Indigentia autem visus ab unaquaque istarum intenti-
onum non est nisi propter aliquam causam.

20 [8.3] Quare ergo non comprehendit visus rem visam nisi
quando inter ea fuerit distantia aliqua, et non comprehendit
ipsam quando applicabitur ei est propter duas causas, qua-
rum una est quod visus non comprehendit rem visam nisi
quando fuerit in ea aliqua lux. Et quando fuerit applicata
25 visui et non fuerit illuminata per se, non erit in sua superficie
vicinanti visui lux, quoniam corpus oculi secundum situm su-
um tunc prohibetur a visu. Res autem lumine per se non
possunt applicari superficiei visus, quoniam res illuminate per
se sunt stelle et ignis que non possunt applicari superficiei vi-
30 sus. Causa autem secunda est quod visio non erit nisi ex parte
opposita foramini uvee ex medio superficiei visus, et cum res

3 quod: ut R/eorum: earum R/reflexionem (4): refractionem R 4 post quando scr.
et del. comprehensio S/aggregabuntur: aggregatae fuerint R 5 ut om. R/sit om. P1/
scilicet: ita R; et EP3 6 post ut scr. et del. inter Er/eius superficiei transp. Er/quam:
quem P3 7 aliquod: aliud R/visus² corr. ex eius E 8 ut² om. ErP1S 9 post
eius add. id est rei vise EP3/aliquantulum: aliquantum Er/visus corr. ex eius E/post et
add. ut R 10 et... diafonum (11) om. S/ut om. R 11 aliquod: aliquid P1; ad P3;
aliud R 13 sed... simili (14) om. R 14 comprehendit (15): comprehendit ErP1
15 quando om. P3/congregabuntur: aggregabuntur EP3R 16 istarum una transp.
R/intentionum: intentione P1S 17 comprehendetur: comprehende E; comprehen-
det P3 18 intentionum (19): intentionem Er 20 comprehendit: comprehen-
dat R 21 fuerit: fuit P1S/comprehendit: comprehendat R 22 post ipsam add.
rem P1S/applicabitur: applicatur R 23 quod: quia R/post rem scr. et del. rem P1
24 fuerit in ea: in ea fuerit R/in: inter ErP1S/aliqua lux transp. EP3R/fuerit applicata
transp. Er 26 vicinanti: vicinante R 28 applicari... visus: superficiei...
applicari Er 30 causa... visus (31) mg. a. m. S/quod: quia R/erit: fit R 31 cum:
si R

visa applicabitur visui, non superponetur isti parti visui nisi
 pars equalis illi tantum ex re visa. Et si visus comprehendet
 rem visam per applicationem, non comprehendet nisi partem
 35 applicatam parti opposite foramini tantum, et non compre-
 hendet residuum rei vise. Et si moveatur res visa super super-
 ficiem visus quousque contingat totam superficiem rei vise
 secundum partem mediam visus, comprehendet partem post
 aliam, et dum comprehendet partem secundam non compre-
 40 hendet partem primam, et sic non poterit comprehendere to-
 tam rem in simul. Et cum ita est, non figurabitur in eo forma
 rei vise ita quod, si aliqua res visa esset super corpus densum
 et esset in illo corpore denso foramen minoris quantitatis re
 vise, et res visa esset applicata foramini, non comprehenderet
 45 ex ea nisi partem superpositam foramini tantum. Deinde si
 res visa moveatur super foramen quousque comprehendatur a
 visu pars post aliam, non figuratur in visu tota forma eius.

[8.4] Si ergo visio esset per contactum, non comprehende-
 ret visus totam rem visam nec figuram et formam eius nisi
 50 esset res visa equalis parti medie superficiei visus per quam
 erit visio, et cum hoc non potest comprehendere res visas mul-
 tas in eodem tempore. Et cum inter visum et rem visam fuerit
 aliquod spatium, poterit comprehendere totam rem visam in
 eodem tempore ex aliqua parte parva, quamvis res visa sit
 55 magna; et potest comprehendere res visas multas simul in eo-
 dem tempore. Et cum res visa fuerit remota a visu erit possi-
 bile lucem oriri super superficiem eius oppositam visui. Prop-
 ter ergo istas duas causas non comprehendit visus ex rebus
 visibilibus nisi sit inter eos aliquod spatium.

60 [8.5] Quare vero non comprehendit visus rem visam que
 est cum eo in eodem aere et in parte opposita illi nisi sit inter

32 applicabitur: applicetur R 33 comprehendet: comprehenderet EP3R
 34 comprehendet: comprehenderet R 35 applicatam *corr. ex oppositam a. m. E/*
opposite: apposite P1; corr. ex applicate a. m. E/ comprehendet (36): comprehenderet R
 38 *post post add. partem EP3R* 39 comprehendet¹: comprehendit Er 40 *post*
partem add. ipsam P3 41 *post rem add. visam EP3R/in¹ om. R/est: sit EP3R*
 42 *quod: ut R/post res add. esset EP3* 44 *vise: visa Er/res: re Er* 45 *super-*
positam: suppositam EP3RS/foramini inter. a. m. E/si corr. ex non S 47 *pars om. P3*
 48 *contactum: tactum R* 51 *et . . . non: nec etiam sic R/res . . . comprehendere (53)*
mg. a. m. S/res . . . multas (52): multas res visas R/res (?) S 52 *ante rem add. inter*
EP3/rem (?) S/visam om. P1 53 *comprehendere . . . visam: rem visam comprehen-*
dere R/visam om. ErS 54 *ante ex add. totam R/aliqua om. EErP3R/parte parva*
transp. P1/parva om. S/res visa sit: sit res visa EP3R 56 *visa fuerit corr. ex fuerit visa*
P3/fuerit: fuit Er 57 *lucem om. Er/lucem oriri transp. EP3R* 58 *ergo istas; istas*
igitur R/ante ex add. quicquam R 59 *eos: ea R/aliquod corr. ex ad P3*
 60 *comprehendit: comprehendat R* 61 *post et scr. et del. tempore P1*

quodlibet punctum eius et aliquod punctum superficiei partis
per quam erit visio ex superficie visus linea recta est quia de-
claratum est quod visio non erit nisi ex formis venientibus a re
65 visa ad visum, et quod forme non comprehenduntur nisi se-
cundum lineas rectas. Et propter hanc causam non compre-
hendit visus rem nisi sit inter ea linea recta. Et si secuerint
densa media corpora omnes lineas que sunt inter ea, latebunt
res vise visum, et si secuerit illud corpus quasdam illarum
70 linearum rectorum, latebit visum quedam pars que est apud
extremitatem linearum resectorum per corpus densum.

[8.6] Quare vero visus non comprehendit rem visam nisi sit
in ea lux est propter duas causas: aut quia forme coloris que
sunt in rebus visis non extenduntur in aere nisi sit lux cum co-
75 lore, aut quia forma coloris extenditur in aere, quamvis non sit
cum ea lux, sed non operatur in visum operatione sensibili nisi
per lucem. Et manifestum est quod forma lucis est fortior for-
ma coloris, et quod lux operatur operatione manifestiori, et
quod forma coloris, quia est debilis, non potest operari in vi-
80 sum sicut operatur lux. Et forma coloris que est in corpore il-
luminato semper est admixta cum forma lucis, et cum perve-
nerit ad visum, operatur in ipsum per suam fortitudinem et
preparationem visus ut patiat ex ea. Et quia admiscetur
cum forma coloris et non distinguitur ab ea, non sentit visus
85 formam lucis nisi admixtam cum forma coloris. Visus ergo non
sentit colorem rei vise nisi ex colore admixto cum forma lucis
veniente ad ipsum ex re visa, et propter hoc alterantur colores
multarum rerum visarum apud visum per alterationem lucis
orientis super ipsas. Quia ergo forma coloris non operatur in
90 visum nisi sit admixta cum lumine, et non sit ex colore forma
nisi sit in ea lux, nichil comprehendit visus ex rebus visibilibus
nisi quando in ea fuerit aliqua lux.

[8.7] Quare vero non comprehendit visus rem visam nisi sit

62 superficiei partis: partis superficiei visus R 63 ex . . . visus om. R 64 erit:
sit R 65 comprehenduntur: comprehendantur R 66 comprehendit (67):
comprehendet S 67 post visus scr. et del. nisi E/post rem add. visam EP1 (scr. et
del E) 68 densa media om. Er/densa . . . corpora: corpora . . . media EP3R/media
inter. a. m. E 70 linearum om. Er 71 resectorum: rectorum ErS 72 com-
prehendit: comprehendat R; comprehendet S 73 coloris . . . rebus (74) om. R
74 visis: vise R 77 est fortior: manifestior est R 79 quod: quia Er/quia
om. EEerP3 81 ante lucis scr. et del. co P1 82 post visum add. semper EP3R
84 non¹ om. S 86 post sentit scr. et del. visus formam Er/cum forma om. P1
88 apud visum om. P1/lucis orientis (89) transp. EP3 89 orientis om. R/post non scr.
et del. a S 90 sit admixta transp. EP3R/lumine: luce Er/sit²: fit ErP1; est R
93 vero om. P1/comprehendit: comprehendat R

corpus eius aliqua quantitate est quia declaratum est quod
 95 forma rei vise non pervenit ad visum nisi ex pyramidibus cuius
 caput est centrum visus et basis superficies rei vise et quod
 ista piramis distinguit ex superficie membri sentientis parvam
 partem in qua ordinabitur forma rei vise. Et si res visa fuerit
 valde parva, erit piramis que est inter ipsam et centrum visus
 100 valde parva. Erit igitur pars distincta ex membro sentiente
 quasi punctum valde parva. Sed sentiens non sentit formam
 nisi quando pars sue superficiei ad quam pervenit forma fuerit
 quantitatis sensibilis respectu totius. Et virtutes sensus etiam
 sunt finite, et cum pars membri sentientis ad quam pervenit
 105 forma non est quantitatis sensibilis apud totum membrum sen-
 tiens, non sentiet passionem que accidit in illa parte propter
 parvitatem ipsius, quare non comprehendit formam. Res ergo
 visa que est possibilis comprehendi a visu est illa in qua erit
 piramis que figuratur inter visum et centrum visus distinguens
 110 ex superficie glacialis partem quantitatis sensibilis respectu
 totius superficiei glacialis. Et iste sensus erit secundum tan-
 tum ad quantum pervenit virtus sensitiva, et non extenditur ad
 infinitum, et diversatur etiam secundum diversitatem virtutis
 oculi. Et cum piramis que figuratur inter rem visam et centrum
 115 visus est distinguens ex superficie glacialis partem quantitatis
 insensibilis respectu totius superficiei glacialis, non potest vi-
 sus comprehendere illam rem. Et propter hoc non comprehen-
 det rem visam visus valde parvam.

[8.8] Quare vero non comprehendit visus rem visam nisi
 120 quando corpus medians inter ipsam et visum fuerit diafonum
 est quia visio non est nisi ex forma venienti ex re visa ad vi-
 sum. Forme autem non extenduntur nisi in corporibus diafo-
 nis, et visio non completur quando res visa fuerit cum visu in

94 *post eius add. in EP1P3R/quod: quia EP3* 95 *pervenit: perveniat R/cuius:*
cuiusmodi EP3; quarum R 97 *distinguit: distinguat R* 98 *ordinabitur:*
ordinatur R 99 *piramis corr. ex pymamis P3/ipsam: ipsum EP1P3* 100 *erit*
igitur transp. Er/igitur: ergo R/post pars scr. et del. parva P3 103 *post sensibilis scr.*
et del. ro Er/ante et add. apud totum membrum EP3R (mg. a. m. E) 104 *post membri*
add. etiam P1S 106 *post que add. illi R/in illa parte om. R* 107 *parvitatem:*
permutationem EP3 108 *est possibilis: potest R/erit om. R* 109 *post visum add.*
et rem visam P1S/distinguens: distinguet R 111 *secundum om. S* 113 *et inter.*
S/etiam om. EP1P3R 114 *cum: si P3 (inter.)* 115 *est: fuerit EErP3/est*
distinguens: distinxit R 117 *illam rem transp. P3/post rem add. visam Er/hoc non*
corr. ex non hoc P3/comprehendet (118): comprehendit Er 118 *rem . . . visus: visus*
rem R 119 *non . . . visus: visus non comprehendat R* 120 *medians: medium*
R/ipsam et: ipsum EP3R 121 *venienti: veniente ErR/corr. ex veniente P1*
 122 *non om. S* 123 *post completur add. nisi EP1 (scr. et del. E)*

eodem aere (et fuerit comprehensio non secundum reflexionem)
 125 nisi quando aer fuerit continuus inter rem visam et visum, et
 non abscederit lineas rectas verticales que sunt inter ea corpus
 densum, quoniam forma non extenditur in aere consimilis dia-
 fonitatis nisi secundum lineas rectas. Et propter hoc non com-
 prehendit visus rem visam que est cum eo in eodem aere et in
 130 parte opposita visui nisi quando aer medius inter eas fuerit
 diafonus consimilis diafonitatis.

[8.9] Quare vero visus non comprehendit rem visam nisi
 quando fuerit in ea densitas aut aliquid densitatis est propter
 duas causas, quarum altera est quia quod est densum est col-
 135 oratum, et ex colore venit forma ad visum ex qua compren-
 dit visus colorem rei vise. Quod autem est in fine diafonitatis
 caret colore, quare non comprehenditur a visu. Et causa se-
 cunda est quoniam visus non comprehendit rem visam nisi sit
 illuminata, et veniat ex luce que est in ea forma secunda ad vi-
 140 sum cum forma coloris. Et non erit forma secunda ex luce ori-
 enti super aliquod corpus nisi figatur lux in illo corpore super
 quod oritur. Cum ergo lux fuerit fixa in illo corpore, erit ex eo
 forma secunda; et quando lux orietur super corpus diafonum
 valde, non figetur in eo, sed extendetur in sua diafonitate.
 145 Cum ergo corpus diafonum fuerit oppositum visui et super ip-
 sum oritur lux ex parte in qua est visus, in eo extendetur et non
 figetur in sua superficie. Et sic non erit in superficie opposita
 visui illius corporis lux ex qua venit forma ad visum. Et si il-
 lud illuminatum cuius lux oritur super illud corpus diafonum
 150 fuerit oppositum visui, pertransibit lux eius in corpus diafo-
 num et perveniet ad visum, et nichil deferet cum eo ad visum
 ex colore corporis diafoni, quoniam corpus diafonum quod est

124 eodem *om.* P1 / *ante non scr. et del.* fuerit comprehensio P1 / non: nisi P3 (*scr. et del.*) /
 reflexionem: refractionem R 125 rem . . visum: visum et rem visam *Er/et visum*
om. EP3R 126 verticales *om.* R 128 nisi . . . diafonitatis (131) *om.* P1 / non . . .
 visus (129): visus non comprehendit R 130 eas: ea R 131 diafonus: diafonis *Er*;
 diafonum S / diafonitatis *corr. ex dyafoniatis* P3 132 comprehendit: comprehendat
 R / visam *inter. a. m. E* 133 fuerit in ea: in ea fuerit R / aut *corr. ex autem S / densitatis*
corr. ex densitas S 134 est^{1,2} *om.* P1 / est² *om.* S / est³ *om.* E / est coloratum (135) *transp.*
 P3 / *post* coloratum (135) *add.* nisi (128) . . . coloratum (134/135) P1 (medius [130] *om.* /
 diafonus [131]: diafonum / est^{1,2} [134]: est in) 135 et *inter.* P1 137 compre-
 henditur: comprehendetur EP3R 139 luce: lumine EP3 / secunda: prima P3
 140 cum: et P1 / orienti (141): oriente R 142 cum *inter. a. m. E / cum ergo transp.*
 EP3R / *post* fuerit *scr. et del.* fi P3 / illo *corr. ex illa S / illo corpore transp.* EP3R / erit *om.* S
 144 extendetur: extenditur *Er* 146 visus *corr. ex lux P3 / extendetur corr. ex exten-*
ditur S 148 illius: istius EP3R / *post* si *add.* fuerit EP3R 149 illuminatum:
 illuminatur *Er / ante* cuius *scr. et del.* lux P1 / lux *om.* P3 150 fuerit *om.* R / fuerit . . .
 diafonum (151) *mg. a. m. S / lux eius (?) S* 151 cum eo: secum R 152 quod . . .
 diafonum (156) *mg. a. m. S*

in fine diafonitatis non habet colorem. Visus ergo comprehendet ex illo loco corpus illuminatum cuius lux oritur super corpus diafonum post corpus diafonum, et non comprehendit corpus diafonum propter hoc quia non comprehendit visum rem visam que est in fine diafonitatis. Et cum diafonitas corporis fuerit similis diafonitati aeris, erit eius dispositio sicut dispositio aeris, et non comprehendetur a visu, sicut nec aer et corpora diafona quorum diafonitas non est spissior diafonitate aeris non comprehendentur a visu, quoniam nulla forma venit ex eis ad visum que potest operari in visum. Et similiter erit si inter visum et rem visam fuerit medium corpus diafonum preter aerem et fuerit diafonitas rei vise non spissior diafonitate corporis medii.

[8.10] Et cum res visa fuerit densa, erit colorata, et cum super ipsam oritur lux, figetur in sua superficie, et erit ex colore eius et ex luce que oritur super ipsam forma que extenditur in aere et in corporibus diafonis. Et cum ista forma pervenerit ad visum, operabitur in eo, et ex ea sentiet visus rem visam. Et cum res visa fuerit diafona, sed minus quam aer, habebit colorem secundum suam spissitudinem, et cum super ipsam oritur lux, figetur in ea aliqua fixione secundum illud quod est in ea de spissitudine, et pertransibit in ea secundum suam diafonitatem. Et erit ex ea forma in aere secundum colorem et lucem que sunt in sua superficie, et cum illa forma pervenerit ad visum, operabitur in visum, et sentiet visus illam rem visam. Et propter istam causam nichil comprehendit visus ex rebus visibilibus nisi quando fuerit densum aut fuerit in eo aliquid densitatis.

[8.11] Iam ergo declarate sunt cause propter quas nichil comprehendit visus nisi quando fuerint aggregate in eo intentiones predictae, et hoc quod declaravimus est illud quod intendimus declarare in isto tractatu.

153 non habet (?) S/comprehendet (154) *corr. ex comprehendit E* 154 loco (?) S
 156 quia: quod EP3 157 corporis (158): corpus Er 158 similis *corr. ex simul P1S/aeris corr. ex aerit S/erit eius dispositio: eius . . . erit P1* 160 est spissior *corr. ex spissior est Er* 161 quoniam *om. Er* 162 potest: possit EP3R 163 erit: accidit R; *om. EErP3* 167 ipsam: ipsum S/lux . . . oritur (168) *mg. a. m. S/figetur: figura Er*
 168 eius (?) S/ipsam: ipsum P1S 170 *post ad add. ipsum EP3R/ea corr. ex eo E*
 172 spissitudinem *corr. ex dispositionem P1* 174 spissitudine *corr. ex spissitudinem S* 175 *ante in scr. et del. e P3* 176 pervenerit: pervenit P3/*post ad scr. et del. istam causam et E* 178 nichil: non R 179 *post quando add. ipsum visibile R/fuerit rep. Er* 181 cause: res P3 182 nisi *om. S/in eo om. R/eo corr. ex eos P3*
 183 quod¹ *inter. S*

[SECUNDUS TRACTATUS]

[CAPITULUM 1]

[1.1] Declaratum est qualiter fiat visio, et est qualitas sensus visus a forma lucis et coloris que sunt in re visa ordinatum ita sicut sunt in superficie rei vise. Visus autem comprehendit ex rebus visibilibus multas intentiones preter lucem et
5 colorem.

[1.2] Et etiam declaratum est in primo tractatu quod visio non erit nisi ex verticationibus linearum radialium, et lineae radiales diversantur in dispositionibus suis, et similiter diversantur dispositiones formarum venientium super ipsas ad
10 visum.

[1.3] Et etiam comprehensio visus a re visa non est in omnibus temporibus et in omnibus visibilibus secundum unum modum. Sed diversatur qualitas sensus visus a rebus visibilibus, et diversatur qualitas sensus visus in una re visa secundum unum situm et secundum eandem distantiam.
15

[1.4] Et nos declarabimus in isto tractatu diversitatem dispositionum linearum radialium et distinguemus proprietates earum et omnes intentiones comprehensas a visu. Et declarabimus qualiter comprehendit visus quamlibet illarum et
20 diversitatem comprehensionis visus ab eis.

[CAPITULUM 2]

[2.1] Iam declaratum est in primo tractatu quod lineae radiales ex quarum verticationibus comprehendit visus visibilia

1 sensus visus (2) *transp.* P3 2 a: et L3 3 ante ita *scr. et del.* et E/sunt om. P1
6 est om. P3/primo *corr. ex principio* S 7 erit: sit R; *corr. ex exit a. m. E/post*
verticationibus *scr. et del.* eorum P3 8 diversantur: diversentur R/dispositionibus
suis *transp.* EL3P3R 9 ante dispositiones *scr. et del.* in dispositionibus suis P1/ipsas
corr. ex istas a. m. E 12 temporibus: corporibus R; *inter. L3/secundum: sed Er/*
secundum . . . modum (13) om. R 14 in: ab C1EErL3P3/visa: visum P3 (*scr. et del.*)
15 unum situm *transp.* P3R 16 declarabimus . . . tractatu: dividemus istum
tractatum in tria capita in primo declarabimus R 18 et¹: in secundo declarabimus
R/declarabimus (19) om. R 19 et: in tertio declarabimus R 20 post eis *scr. et del.*
visus ab eis E

sunt linee recte quarum extremitates concurrunt apud centrum visus. Et iam declaratum est in forma visus quod membrum
 5 sentiens, quod est membrum glaciale, est compositum super extremitatem concavitatis nervi super quem compositus est oculus totus, et quod, quando iste nervus giratur, non giratur nisi a posteriori centri visus, et a posteriori totius oculi, et apud foramen quod est in concavo ossis.

10 [2.2] Et iam declaratum est quod linea recta transiens per omnia centra tunicarum visus extenditur in medio concavi nervi, et pervenit recte ad medium girationi concavi nervi, et transit per centrum foraminis quod est in anteriori uvee. Et iam declaratum est quod situs istius lineae non diversatur res-
 15 pectu totius visus, nec respectu tunicarum superficierum, nec respectu partium visus. Linea ergo recta transiens per omnia centra tunicarum visus semper extenditur recte ad locum girationis concavi nervi super quem componitur oculus in omnibus dispositionibus visus, sive sit visus in motu sive in quiete. Et
 20 quia ista linea transit per centrum visus et per centrum foraminis quod est in anteriori uvee, extenditur in medio pyramidis cuius conus est centrum visus, et continet ipsam circumferentia foraminis quod est in anteriori uvee; apellemus ergo istam lineam axem pyramidis.

25 [2.3] Et declaratum est etiam in ipso tractatu primo quod pyramis figurata inter rem visam et centrum visus distinguit ex superficie glacialis partem continentem totam formam rei vise que est apud basim illius pyramidis. Et erit forma ordinata in
 30 ista parte superficiei glacialis per verticationes linearum radialium extensarum inter rem visam et visum secundum ordinationem partium superficiei rei vise. Cum ergo visus comprehendit aliquam rem visam, et pervenit eius forma in parte superficiei glacialis quam distinguit pyramis predicta, quodlibet

4 visus² corr. ex lucis P1 5 glaciale: glacialis R 6 quem: quam C1ErP1S
 7 oculus totus transp. C1Er/ quod: quia P3/ quando om. EP3R/ post nervus scr. et del. gra
 P1/ giratur om. C1ErEP3R; inter. L3 8 ante centri add. nervo P3/ post visus scr. et del.
 et a posteriori centri visus S 12 et¹ . . . nervi om. R/ post nervi scr. et del. et pervenit
 recte ad medium S 13 centrum: medium EP3R/ ante quod add. et L3 14 situs:
 centrum EP3R; corr. ex centrum L3 15 tunicarum superficierum transp. EP3R/ ante
 nec² add. visus EP3R/ nec²: in S/ post nec² scr. et del. per P1 18 quem: quam ErP1S/
 corr. ex quam a. m. C1 19 visus¹ om. EL3P3R/ ante sit scr. et del. ut L3 21 est om.
 EP3/ post uvee add. et per centrum uveae R/ pyramidis: pyramis L3S 22 conus . . .
 centrum: centrum est R/ ante visus scr. et del. est S/ post continet scr. et del. centrum P3/
 ipsam: ipsum EL3P3/ circumferentia: circumferentiam Er 23 ante uvee scr. et del.
 ve P1 25 post et add. etiam L3/ etiam om. L3/ etiam . . . tractatu om. P1/ ipso om. C1Er
 29 verticationes: verticationem EL3P3R 30 rem . . . visum: visum et rem visam P1
 31 rei vise corr. ex vise rei ErS/ comprehendit (32): comprehenderit R 32 pervenit:
 pervenerit R/ parte: partem R 33 quodlibet: quod licet Er

punctum forme predictae est super lineam radialem extensam
 35 inter illud punctum et punctum oppositum illi in superficie rei
 vise super quam venit forma ad illud punctum in superficie
 glacialis recte. Cum ergo forma rei vise fuerit in medio super-
 ficiei glacialis, erit axis predictus una linearum super quas veni-
 unt forme punctorum que sunt in superficie rei vise, et erit
 40 punctum superficiei rei vise quod est apud extremitatem istius
 axis illud super quod venit forma eius super istum axem.

[2.4] Et declaratum est in primo tractatu quod forme que
 comprehenduntur per visum extenduntur in corpore glacialis et
 in concavo nervi super quem componitur oculus, et perveniunt
 45 ad nervum communem qui est apud medium anterioris cerebri
 —et illic erit comprehensio sentientis ultimo a formis rerum vi-
 sibilium—et quod visio non completur nisi per adventum forme
 ad nervum communem, et quod extensio formarum a superficie
 glacialis intra corpus glacialis erit secundum rectitudinem line-
 50 arum rectarum radialium tantum, quoniam glacialis non recipit
 istas formas nisi secundum verticationes linearum radialium
 tantum.

[2.5] Et ultimum sentiens non comprehendit situs partium
 rei vise nisi secundum suum situm in superficie rei vise. Et
 55 cum situs partium forme adinvicem, scilicet forme pervenientis
 ad superficiem glacialis, sint situs partium superficiei rei vise
 adinvicem, et iste forme extenduntur sicut predictum est, et
 cum omnia ista ita sint, visio ergo non complebitur nisi post
 perventum forme que est in superficie glacialis ad nervum
 60 communem, et situs partium eius secundum suum esse in su-
 perficie glacialis sine aliqua admixtione.

[2.6] Forma autem non pervenit a superficie glacialis ad
 nervum communem nisi per extensionem eius in concavo nervi

34 forme predictae *transp. P3/radialem corr. ex radialem P3* 35 et . . . punctum (36)
mg. a. m. L3/punctum² om. P3/in inter. C1/in superficie: superficiei P1S 36 superficie:
 superficiem R 37 recte *inter. a. m. E/ergo forma transp. P3* 38 predictus: posi-
 tus P3 39 punctorum *corr. ex predictorum L3* 40 istius: illius S 41 quod *om.*
Er/forma rep. P3 44 nervi: termini P3/quem: quam L3S/perveniunt: perve-
 nit C1EErL3P3 45 *post apud scr. et del. md P3/anterioris: interioris ErL3P1RS; corr.*
ex interioris a. m. C1; alter. in interioris EP3 (a. m. E) 46 erit: est R/*ante a add. et C1Er/*
a corr. ex autem L3 47 per adventum: perventum Er; *corr. ex perventum a. m. C1*
 48 quod *om. P1* 49 corpus *corr. ex superficiem a. m. E/erit: est R* 50 rectarum
om. C1Er/quoniam inter. L3 51 formas *inter. a. m. S/verticationes: verticatio-*
nem EP3R 53 *ante situs add. aliquam mg. P3/situs om. P3* 54 superficie:
 superficiei S 55 adinvicem: inter se R 56 sint: sunt P1; sicut P3 57 adinvicem:
 inter se R/extenduntur: extendantur R/predictum: dictum P1 58 ita *om. P3/sint:*
sunt C1Er/ergo: igitur Er/post corr. ex per C1 59 perventum: adventum EP3R
 60 *post eius add. est C1/post esse add. est L3/superficie (61): superficiem R*
 61 admixtione: mixtione C1Er 63 nervi *om. L3*

super quem componitur glacialis. Si ergo forma non perveniret
 65 in concavo istius nervi secundum suum esse in glaciali, nec etiam
 perveniet ad nervum communem secundum suum esse. Forma autem non potest extendi a superficie glacialis ad concavum nervi secundum rectitudinem linearum rectarum et conservare situs partium secundum suum esse, quoniam omnes ille
 70 lineae concurrunt apud centrum visus. Deinde quando fuerint extense secundum rectitudinem post centrum, convertetur situs earum, et quod est dextrum efficietur sinistrum et econverso, et superius inferius et inferius superius. Si ergo forma fuerit extensa secundum rectitudinem linearum radialium, congregabitur
 75 apud centrum visus et efficietur quasi unum punctum; et quia centrum visus est in medio totius oculi et ante locum girationis nervi concavi, si forma fuerit extensa a centro et ipsum unum punctum super unam lineam, perveniet ad locum girationis et ipsum unum punctum. Et sic non perveniet forma tota
 80 ad locum girationis, quia non nisi unum punctum, scilicet quod est in extremitate axis pyramidis. Et si fuerit extensa secundum rectitudinem linearum radialium et pertransierit centrum, erit conversa secundum conversionem linearum se secantium super quas extendebatur. Non potest ergo forma pervenire a
 85 superficie glacialis ad concavum nervi ita quod situs partium sit secundum suum esse. Non potest ergo forma pervenire a superficie glacialis ad concavum nervi nisi secundum lineas reflexas secantes lineas radiales.

[2.7] Et cum ita est, visio ergo non complebitur nisi postquam
 90 reflectitur forma que pervenit a superficie glacialis et extenditur super lineas secantes lineas radiales. Ista ergo reflexio debet esse ante perventum ad centrum, quoniam si fue-

64 post componitur *add.* oculus vel P1; *add.* oculus sive humor EP3R/non om. S/ perveniret: perveniet L3; perveniat R 65 concavo: concavum R 66 perveniet: perveniret P1S/nervum *corr.* ex formam L3/secundum *inter.* L3 68 rectitudinem: consuetudinem Er 69 suum esse *transp.* EP3/illic lineae (70) *transp.* P3 70 deinde: et R 71 secundum om. Er 72 econverso: econtrario R 73 forma . . . extensa (74): fuerit . . . forma P1 76 post medio *scr.* et *del.* oculi P1 77 nervi concavi *transp.* EL3P3R/extensa a centro *corr.* ex a centro extensa P3/post centro *add.* oculi EP3R/et: vel EP3; *corr.* ex vel L3/ipsam: ipsa P1; ipsius R; *corr.* ex ipsa S; *alter.* in ipsa L3 78 unam lineam *transp.* S 79 et¹ *inter.* L3/ipsam: ipsa P1S; ipsius R; *alter.* in ipsa L3/unum *corr.* ex unam S/tota . . . pyramidis (81) *mg.* a. m. L3S/post tota *add.* scilicet C1Er 80 ad . . . girationis om. L3/post non *scr.* et *del.* est E 82 pertransierit: pertransiverit C1Er; pertransiret L3 83 post secundum *scr.* et *del.* consequod P3/conversionem: consequens in termino EP3; *corr.* ex conversiconem L3/ante se *scr.* et *del.* radialium P1/post se *add.* se *inter.* L3/post secantium *scr.* et *del.* superius P1 85 ita . . . nervi (87) *mg.* a. m. E; om. S/quod: ut R 87 post nervi *scr.* et *del.* r P3 88 reflexas: refractas R 89 est: sit R 90 reflectitur: refracta fuerit R 91 post lineas¹ *add.* rectas L3/lineas² om. P1/ergo om. P1/reflexio (92): refractio R

rint reflexe post transitum centri, erunt converse.

[2.8] Et iam declaratum est quod ista forma pertransit in
 95 corpore glacialis secundum rectitudinem linearum radialium, et
 cum non potest pervenire ad concavum nervi nisi postquam
 reflectitur super lineas secantes lineas radiales, forma non re-
 flectitur nisi post pertransitum eius in corpore glacialis. Et iam
 predictum est in forma visus quod corpus glacialis est diverse
 100 diafonitatis et quod pars posterior eius, que dicitur vitreum,
 est diverse diafonitatis a parte anteriori. Et nullum corpus est
 in glaciali diverse forme a forma corporis anterioris preter cor-
 pus vitreum. Et ex proprietate formarum lucis et coloris est ut
 reflectantur quando concurrerint alii corpori diverse diafonia-
 105 tis a corpore primo. Forme ergo non reflectuntur nisi apud
 perventum earum ad humorem vitreum, et istud corpus non
 fuit diverse diafonitatis a corpore anterioris glacialis nisi ut
 reflectantur forme in ipso.

[2.9] Et debet esse superficies istius corporis antedens
 110 centrum ut reflectantur forme apud ipsum antequam pertran-
 seant centrum. Et debet ista superficies esse consimilis ordi-
 nationis, quoniam si non fuerit consimilis ordinationis, appar-
 ebit forma monstruosa post reflexionem. Superficies autem
 consimilis ordinationis aut est plana aut est spherica. Et non
 115 potest esse superficies ista ex spera cuius centrum erit centrum
 visus, quoniam si ita esset, essent lineae radiales semper per-
 pendiculares super ipsam, et sic extenderetur forma secundum
 rectitudinem earum, et non reflecteretur. Nec potest esse ex

93 reflexe: refractae R 94 ista: nulla P3; *alter. in nulla a. m. E*/pertransit: pertran-
 seat R 96 potest: possit R 97 reflectitur: refracta fuerit R/post lineas¹ *add.*
 radiales C1Er; *scr. et del.* radiales E/secantes lineas *om.* P1/secantes . . . radiales *inter.*
 L3/post forma *add.* ergo P1R/reflectitur (98): refringitur R 98 post *om.* EP3R/
 pertransitum: transitum L3P1S; per transitum R/glacialis: glaciali C1Er 100 eius
om. S/que: quod P3/vitreum: humor vitreus R 101 diverse . . . glaciali (102) *mg. a.*
m. S/anteriori: anteriore R 102 preter: inter ipsum et P1S 104 reflectantur:
 refringantur R/post quando *add.* concurrunt P3/concurrerint: occurrerint R/diverse
om. P3 105 ergo non *om.* C1Er/reflectuntur: reflectantur Er; refringuntur R/apud:
 ad primum C1Er 107 anterioris: anteriori L3/anterioris glacialis *transp.* P3/ut
 reflectantur (108): refringerentur R 108 in *inter.* L3 109 esse *om.* R/istius *corr.*
ex ipsius S/antedens: antecedere R 110 reflectantur: refringantur R 111 post
 debet *scr. et del.* esse P1 112 quoniam . . . ordinationis *om.* P3/non *inter.* L3/
 ordinationis *corr. ex* cordinationis C1 113 post reflexionem: propter refractionem R/
 autem: ante S 114 est² *om.* EP3 115 esse . . . ista: ista . . . esse EP3R/superficies
 ista *transp.* C1Er/post ista *scr. et del.* et Er/ex spera *corr. ex* spera ex Er/erit: est EP3R
 116 post radiales *add.* lineae P3 (*alter. ex* linea)/semper: super P3; *inter. a. m. C1; om.* Er
 117 ipsam *corr. ex* ipsum a. m. C1/extenderetur: extendetur C1ErL3/forma *om.* EP3
 118 ante earum *scr. et del.* a Er/reflecteretur: reflectetur C1ErL3; reflectuntur E;
 refringeretur R

spera parva, quoniam si fuerit ex spera parva, quando forma
 120 reflectetur ab ea et elongabitur ab ea, fiet monstruosa. Ista
 ergo superficies aut est plana aut est sperica spere alicuius et
 aliquante bone quantitatis ita quod spericitas eius non opera-
 bitur in ordinatione forme.

[2.10] Superfices ergo humoris glacialis que est differentia
 125 communis inter istud corpus et corpus anterius glacialis est
 superficies consimilis ordinationis antecedens centrum visus.
 Et omnes forme pervenientes in superficiem glacialis extendun-
 tur in corpore glacialis secundum rectitudinem linearum radial-
 ium quousque perveniunt ad istam superficiem, et cum per-
 130 venerint ad istam superficiem, reflectuntur apud ipsam secun-
 dum lineas consimilis ordinationis secantes lineas radiales.
 Linee ergo radiales non iuvant ad ordinationem formarum
 rerum visibilium nisi apud glaciale tantum, quoniam apud
 membrum istud erit principium sensus. Et declaratum est eti-
 135 am in primo tractatu quod impossibile est ut forma rei vise sit
 ordinata in superficie visus cum magnitudine rei vise et parvi-
 tate rei sentientis nisi per istas lineas. Iste ergo linee non sunt
 nisi instrumentum visui per quas completur comprehensio re-
 rum visarum secundum suum esse. Perventus autem formarum
 140 ad ultimum sentiens non indiget extensione secundum rectitu-
 dinem istarum formarum.

[2.11] Et receptio membri sentientis ad formas non est si-
 cut receptio corporum diafonorum ad istas formas. Quoniam
 membrum sentiens recipit istas formas, et sentit eas, et per-

119 spera¹: sperica EL3P3/spera parva¹ trans. P3/quoniam . . . parva inter. L3/ex
 om. P1 120 reflectetur: refringetur R/ea²: eo P1S/fiet: fieret P1S/monstruosa corr. ex
 monstroso P3 121 est² om. EP3R/est sperica transp. C1/post sperica add. ex R/et
 aliquante (122) om. R 122 spericitas: speritas Er; corr. ex speritas a. m. C1/operabitur
 (123): operatur L3 123 post in scr. et del. operatione C1/ordinatione: ordinationem
 L3P1S/ordinatione forme transp. C1 124 est differentia transp. P1 125 corpus
 et om. P1/post corpus¹ add. vitrei R/anterius om. P1S 127 superficiem: super-
 ficie EL3P3 128 glacialis om. Er 129 perveniunt: perveniant R/pervenerint
 (130): perveniunt EL3P3 130 ante ad scr. et del. ad istam S/istam superficiem
 transp. EP3R 132 ergo radiales transp. Er/ordinationem: ordinem L3 134 mem-
 brum istud transp. C1Er/erit: est EL3P3R/erit principium transp. R/etiam (135)
 om. C1EErP3R 135 post tractatu add. etiam EP3R/ut inter. P3 136 magnitudine:
 ymagine EP1P3R; alter. in ymagine L3; corr. ex ymagine S 138 completur com-
 prehensio transp. P3/comprehensio: visio P1S 139 post secundum scr. et del. visum
 Er/suum esse corr. ex esse suum Er 140 extensione: intentione S 141 forma-
 rum: linearum R 142 post et add. etiam C1ErL3; add. est P1S/post receptio add.
 formarum in R/membri sentientis: membro sentiente R/ad formas om. R/est om. P1S/
 post est add. nisi EP3 (scr. et del. E) 143 corporum . . . formas: formarum in corpori-
 bus diaphanis R 144 membrum: membrorum Er/post sentiens scr. et del. non L3/
 pertranseunt (145): per transeunt Er/post per et ante transeunt (145) scr. et del. corpora
 autem diafona non recipiunt istas formas nisi receptione qua recipiunt ad redendum et
 non sentiunt ipsas Er

145 transeunt in eo propter suam diafonitatem, et virtutem sensi-
bilem que est in eo recipit ergo istas formas secundum recep-
tionem sensus. Corpora autem diafona non recipiunt istas
formas nisi receptione qua recipiunt ad redendum, et non
sentiant ipsas. Et cum receptio corporis sentientis ab istis
150 formis non est sicut receptio corporum diafonorum non sen-
tientium, extensio formarum in corpore sentienti non debet
esse secundum verticationes quas corpora diafona exigunt.
Visus ergo non est appropriatus receptioni formarum ex verti-
cationibus linearum radialium tantum nisi quia proprietas for-
155 marum est ut extendantur in corporibus diafonis super omnes
verticationes rectas. Et cum iste forme pervenerint apud mem-
brum sentiens ordinate et comprehendantur a membro sentien-
te ordinate, nichil remanebit post indigens istarum verticatio-
nibus.

160 [2.12] Pars ergo anterioris tantum glacialis est appropriata
receptioni formarum ex verticationibus linearum radialium;
posterior autem pars, que est vitreum, et virtus recipiens que
est in isto corpore non est appropriata cum sensu suo istarum
formarum nisi ad custodiendum ordinationem earum tantum.
165 Et cum ita est, qualitas ergo receptionis vitrei a formis non est
sicut qualitas receptionis corporis anterioris glacialis, et virtus
recipiens que est in vitreo non est virtus recipiens que est in
parte anteriori.

[2.13] Et cum qualitas receptionis vitrei a formis non est
170 qualitas receptionis partis anterioris glacialis, reflexio ergo
formarum apud superficiem vitrei non est nisi propter diver-
sitate qualitatibus receptionis sensus inter ista duo corpora.
Forme ergo reflectuntur apud vitreum duabus de causis qua-
rum altera est diversitas diafonitatis duorum corporum, et
175 altera est diversitas qualitatibus receptionis sensus inter ista duo

145 eo: ea P1S 146 istas formas *transp.* P1 147 *post sensus add.* et L3/istas
formas (148) *transp.* P1 148 qua: quia P1 149 istis: istas Er 150 sentientium
(151): sentium L3 151 formarum *om.* P3/sentienti: sentiente R 153 *post visus*
add. est P3/receptioni *corr.* ex recte P3 154 radialium *corr.* ex radealium Er/
proprietas: proprietates S 156 rectas *corr.* ex recta P3/cum *inter.* S/apud: ad R/
membrum (157) *corr.* ex membro Er 160 ergo *om.* EP3/anterioris: anterior R/
appropriata *corr.* ex propria S 161 verticationibus: virtutibus EP3 162 vit-
reum: humor vitreus R 163 isto: illo EP3/sensu suo *transp.* R 164 ordinationem
earum *transp.* C1EErP3R/earum: eorum R; *alter.* in eorum E 166 *post sicut add.*
receptio corporis sive EP3R (sive: vel P3)/receptionis *om.* R 167 in: cum EErP3/in
... est² *inter.* a. m. L3 (in: cum)/virtus *om.* S 168 anteriori *om.* E; *mg.* ErP3 (a. m. Er)
169 receptionis *corr.* ex recipiens P1/est: sit R 170 receptionis *om.* R/reflexio:
refractio R 171 nisi *om.* P1 173 reflectuntur: reflectantur C1L3; refringuntur R
175 est *om.* EL3P3R/post sensus *scr.* et *del.* sensus L3

corpora.

[2.14] Et si diafonitas duorum corporum esset consimilis, esset forma extensa in corpore vitreo secundum rectitudinem linearum radialium propter consimilitudinem diafonitatis, et
 180 esset reflexa propter diversitatem qualitatis sensus. Et sic esset forma post reflexionem monstruosa, aut due forme essent propter istam dispositionem. Et cum diversitas diafonitatis affirmat reflexionem, scilicet obliquationem, et diversitas qualitatis sensus affirmat illam obliquationem, erit forma post
 185 obliquationem una forma, et propter hoc diversatur diafonitas corporis vitrei et diafonitas corporis anterioris glacialis. Forme ergo perveniunt ad vitreum ordinate secundum ordinationem earum in superficie visi, et recipit ipsas istud corpus, et sentit ipsas. Deinde obliquantur propter diversitatem diafonitatis et
 190 diversitatem sensus istius corporis, et sic pervenit forma secundum dispositionem suam. Deinde extendetur iste sensus, et iste forme, per hoc corpus quousque perveniat iste sensus et iste forme ad ultimum sentiens. Et erit extensio sensus et extensio forme in corpore vitrei et in corpore sentienti extenso in
 195 concavo nervi ad ultimum sentiens sicut extensio sensus tactus et sensus doloris ad ultimum sentiens.

[2.15] Sensus autem tactus et sensus doloris non extenduntur a membris nisi in filis nervorum et in spiritu extenso secundum illa fila. Et forme rerum visibilium quando pervenerint
 200 in corpus humoris vitrei, extendetur sensus ab isto membro in corpus sentiens extensum in concavo nervi continuati inter visum et anterius cerebri. Et secundum extensionem sensus extenduntur forme ordinate secundum suam dispositionem, quoniam corpus sentiens naturaliter conservat ordinationem
 205 istarum formarum. Et ista ordinatio conservatur in corpore sentienti, quoniam ordinatio partium corporis sentientis recipi-

177 *post si add. ista P1S/post diafonitas add. istorum EP3; add. ista R* 179 radialium
corr. ex radialia P3 180 reflexa: refracta R 181 post reflexionem: propter
refractionem R/post reflexionem add. aut C1Er/aut: aud S 183 affirmat reflexionem:
affirmet refractionem R/reflexionem: reflexio Er; corr. ex reflexio a. m. C1/scilicet
obliquationem om. R/obliquationem: obliquatio Er; obliquatione P3; corr. ex obliquatio
a. m. C1 184 affirmat: affirmet R/*ante illam scr. et del. reflexionem S/illam om. P1/*
post illam add. refractionem aut R 186 diafonitas *corr. ex diafonitatis L3/corporis*²
om. P1S 188 visi: nisi Er/istud: illud P1S/*post et*² *add. ordinat ipsas vel EP3*
 189 obliquantur: obliquatur EP3; refringitur forma R 191 extendetur: extenditur
R/iste inter. a. m. L3 194 vitrei: vitreo R; *corr. ex utrei Er/sentienti: sentiente R; corr.*
ex sentiententi S/extenso: extensio P1 196 *ante et scr. et del. u C1* 197 *post autem*
scr. et del. aut Er 199 illa: ista P1RS/forme: corpora P3/pervenerint: perveni-
unt EL3P3 200 isto: illo EP3R 201 continuati *corr. ex coniuncti L3*
 204 conservat: servat EP3R 205 et . . . formarum (207) *mg. a. m. C1; om. Er/*
conservatur . . . ordinatio (206) inter. a. m. S 206 sentienti: sentiente C1R

entium partes formarum, et ordinatio virtutis recipientis que
 est in partibus corporis recipientis, est in corpore vitrei et in
 omni corpore subtili extenso in concavo nervi ordinatio con-
 210 similis. Et cum ita est, quando forma pervenit ad quodlibet
 punctum superficiei vitrei, curret in verticatione continua, et
 non alterabitur eius situs in concavitate nervi in quo extenditur
 corpus sentiens. Et erunt omnes verticationes per quas currunt
 omnia puncta que sunt in forma consimilis ordinationis adin-
 215 vicem, et erunt omnes iste verticationes girantes apud giratio-
 nem nervi, et erunt apud girationem ordinate secundum suam
 ordinationem ante girationem, et post, propter qualitatem sen-
 sus istius corporis. Et sic perveniet forma ad nervum commu-
 nem secundum suam dispositionem, et non est possibile ut sit
 220 extensio formarum visibilium usque ad ultimum sentiens nisi
 secundum hunc modum, quoniam non est possibile ut forme
 perveniant ad nervum communem secundum suum esse nisi sit
 extensio earum secundum hunc modum.

[2.16] Et cum forme extenduntur secundum istam ordinati-
 225 onem, oportet ut forma perveniens in quolibet puncto super-
 ficiei glacialis semper extendatur super eandem verticationem
 ad idem punctum loci nervi communis ad quod pervenit for-
 ma. Sed tamen forma perveniens ad quodlibet punctum su-
 perficiei glacialis pervenit semper ad idem punctum superficiei
 230 vitrei. Et sequitur ex hoc ut omnia duo puncta consimilis situs
 in respectu duorum oculorum ab eis extendantur due forme ad
 idem punctum in nervo communi.

[2.17] Et etiam sequitur ut sit corpus sentiens quod est in
 concavo nervi aliquantulum diafonum ut appareant in eo for-
 235 me lucis et coloris, et sequitur etiam ut sit eius diafonitas simi-
 lis diafonitati humoris vitrei ut non obliquantur forme apud

207 que . . . recipientis (208) *om. P1* 209 omni *om. P3* 210 est: sit R
 211 continua: continuarum P3 212 in²: ex P3 213 post omnes *add. iste C1Er/*
ante per add. iste EL3P3R/per . . . verticationes (215) mg. a. m. E/currunt corr. ex
concurrunt S 214 adinvicem (215): inter se R 215 iste *om. P1S* 216 post
erunt add. omnes P1S 217 ordinationem *corr. ex reflexionem P1/propter mg. L3*
 218 perveniet: pervenit P1 219 sit: si *Er; corr. ex si a. m. C1* 220 nisi *inter. L3*
 224 istam: suam P3 225 in . . . puncto: ad quodlibet punctum *EL3P3*
 226 semper: super P3/extendatur *corr. ex extenditur P1* 227 idem *corr. ex ean-*
dem P3 228 tamen *alter. ex inde in quoniam deinde corr. ex quoniam a. m. C1/*
perveniens: proveniens P1; alter. in proveniens S/punctum om. P3 229 punctum:
 puncti S 230 sequitur: sequetur L3/omnia duo puncta: ex omnibus duobus punc-
 tis R 231 ab eis *om. R* 233 sequitur: sequetur L3/ante ut *add. ex hoc EP3R/sit*
om. EL3P3R 234 post nervi *add. sit R* 235 sequitur: sequetur L3/sequitur etiam
transp. EP3R (post etiam scr. et del. ut P3)/ post ut scr. et del. sit P3/eius diafonitas transp.
C1ErP3/similis (236) corr. ex simul P1 236 vitrei *om. P1/obliquantur: obliquentur*
P3; refringantur R

perventum earum ad ultimam superficiem vitrei vicinam
 concavo nervi, quoniam quando diafonitas duorum corporum
 fuerit consimilis, non obliquabuntur forme. Et non est possi-
 240 bile ut forme obliquantur apud istam superficiem, quoniam
 ista superficies est sperica, et est ex spera. Si autem forme
 obliquarentur ab ista superficie, non elongarentur ab ea nisi
 modicum, et fierent statim monstruose. Obliquatio ergo for-
 marum non potest esse apud istam superficiem.

245 [2.18] Et cum diafonitas corporis sentientis quod est in
 concavo nervi non est diversa a diafonitate humoris vitrei, nec
 faciet contingere ista diversitas aliquam diversitatem in forma.
 Et quamvis forma extendatur cum extensione sensus, diafoni-
 250 tas corporis sentientis quod est in concavo nervi non est diver-
 sa a diafonitate corporis vitrei. Diafonitas autem ista istius
 corporis non est nisi ut extendantur forme in eo secundum ver-
 ticationes quas exigat diafonitas. Et diafonitas eius non est
 nisi ut recipiat formas lucis et coloris et ut appareant in eo
 forme, quoniam corpus non recipit lucem et colorem, nec per-
 255 transeunt in eo forme lucis et coloris nisi sit diafonum aut fue-
 rit in eo aliquid diafonitatis. Et non apparet lux et color in
 corpore diafono nisi sit cum eo in diafonitate aliquid spissitu-
 dinis, et propter hoc non est glacialis in fine diafonitatis nec in
 fine spissitudinis. Corpus ergo sentiens quod est in concavo
 260 nervi est diafonum, et in eo est cum hoc aliquid spissitudinis.
 Forma autem pertransit in isto corpore cum eo quod est in eo
 de diafonitate, et apparent forme in eo virtuti sensitive cum eo
 quod est in eo de spissitudine. Et sentiens ultimum non com-
 prehendit formas lucis et coloris nisi ex formis pervenientibus
 265 ad istud corpus apud perventum eorum ad nervum commu-
 nem, et comprehendit lucem ex illuminatione istius corporis et

237 earum *om.* P1 238 concavo *inter.* L3 239 ante fuerit *inter.* non P3/non¹ *om.*
 P3/obliquabuntur: refringentur R 240 forme obliquantur *transp.* C1Er/obliquantur:
 obliquentur C1P3; refringantur R/istam *corr.* ex formam P3 241 est¹ *om.* L3/sperica
 et *inter.* L3/et . . . spera *om.* R/ex *om.* P3 242 obliquarentur: obliquantur P1;
 refringerentur R 243 obliquatio: refractio R/ergo formarum (244) *transp.* P3
 244 post esse *scr.* et *del.* apud S 246 est: sit R/nec: non C1ErR 249 ante corporis
add. tamen R 251 nisi *om.* C1Er/ut *om.* S 252 exigat: exigit R/ante et *add.* eius
 P1S/diafonitas² . . . nisi (253) *om.* R 253 post ut¹ *scr.* et *del.* extendantur S/recipiat:
 rericipiat Er; *corr.* ex recipia S/post et² *scr.* et *del.* l L3/appareant: apparent L3
 254 forme *om.* C1EErL3P3R/non recipit *corr.* ex recipit non P3 255 post coloris *add.*
 nec pertranseunt P1 256 ante in¹ *scr.* et *del.* diaffo Er 257 cum: in C1EErL3P3R/
 eo in: eius R 259 concavo: concavitate P1 260 est² *inter.* L3/est cum hoc: cum
 hoc est L3/cum hoc: insuper R 261 isto *om.* Er 262 de: ex C1Er/forme in eo:
 in eo forme L3R/in eo *inter.* L3/eo: ea EP3/virtuti: virtutis L3/sensitive *corr.* ex senti P3
 263 est *om.* EP3/de *inter.* L3 264 pervenientibus: venientibus P1S 265 eorum:
 earum R

colorem ex coloratione. Secundum ergo hunc modum erit per-
ventus formarum ad ultimum sentiens et comprehensio ultimi
sentientis quoad illas.

270 [2.19] Et postquam declaratum est quod forme obliquantur
apud superficiem vitrei, dicamus quod axis pyramidis radialis
non potest esse declinans super istam superficiem, nec potest
esse alia linea perpendicularis super ipsam. Quoniam axis si
fuerit declinans super istam superficiem, quando forme per-
275 venirent ad istam superficiem, diversificarentur in ordinatione
et mutarentur sue dispositiones. Forme autem non possunt
pervenire in superficie vitrei secundum suum esse nisi fuerit
axis pyramidis super istam superficiem perpendicularis. Quo-
niam quando visus fuerit oppositus alicui rei vise et pervenerit
280 axis radialis super superficiem illius rei vise, perveniet forma
illius rei vise in superficie glacialis ordinata secundum ordina-
tionem partium superficiei rei vise, et perveniet forma puncti
quod est apud extremitatem axis superficiei rei vise ad punc-
tum quod est super axem in superficie glacialis. Et pervenient
285 forme omnium punctorum superficiei rei vise quorum remotio a
puncto quod est apud extremitatem axis est equalis ad puncta
formarum que sunt in superficie glacialis quorum remotio a
puncto quod est super axem est equalis, quoniam omnia punc-
ta pervenientia ad superficiem glacialis sunt super lineas radi-
290 ales extensas a centro visus ad superficiem visus, et axis radi-
alis est perpendicularis super superficiem glacialis. Omnes er-
go superficies plane exeuntes ab axe et secantes superficiem
glacialis erunt perpendiculares super istam superficiem.

[2.20] Et iam declaratum est quod superficies humoris vit-
295 rei aut est plana aut est sperica, et centrum eius non est cen-
trum visus. Si ergo axis radialis est declinans super istam su-
perficiem et non est perpendicularis super ipsam, non exhibit ab
axe superficies plana perpendicularis super istam superficiem

267 colorem *corr. ex corpore Er*/perventus (268): proventus C1Er 268 ultimi:
illius L3 270 et *om. P3*/obliquantur: obliquantur P3; refringantur R 271 pira-
midis: piramis P1 272 esse *rep. P1*/ante nec *add. vitrei S*; *add. vitrei sed P1*/post nec
add. etiam P1S (*inter. S*)/post potest² *add. non P1S* 273 alia linea *om. P1S*
275 diversificarentur *corr. ex diversicarentur S*/in . . . mutarentur (276) *inter. a. m. S*
276 sue: ipsarum R 277 superficiei: superficiem C1EErP3R 278 pyramidis *corr.*
ex piramis P1/superficiem: piramidem EP3; *corr. ex piramidem a. m. L3* 279 fuerit:
fuit L3/et . . . vise (281) *mg. a. m. S*/pervenerit: pervenit EP3 280 post super *add.*
istam EP3R/illius: istius P3R/illius rei *transp. L3*/illius rei vise: rei vise istius E
281 superficiei: superficiem L3R 282 perveniet: pervenit Er 283 ad: apud EP3
284 super *om. Er*/pervenient: perveniet Er 288 est¹ *om. EP3*/est equalis
transp. EP3R 290 ad . . . visus *om. Er* 293 super *rep. P3* 295 eius *corr. ex*
visus Er 297 et *inter. L3*/ipsam: istam S 298 post axe *inter. super P3*/plana:
planas P3/istam *corr. ex ipsam P1*

nisi una superficies tantum, et omnes superficies residue exe-
 300 untes ab axe erunt declinantes super ipsam, quoniam hec est
 proprietas linearum declinantium super superficies planas et
 spericas. Ymaginemur ergo superficiem exeuntem ab axe et
 perpendicularem super superficiem vitrei extendi ab axe. Se-
 cabit ergo superficiem vitrei et superficiem glacialis, et signabit
 5 in eis duas differentias communes. Et ymaginemur super dif-
 ferentiam communem que est communis huic superficiei et su-
 perficiei glacialis inter istam superficiem et superficiem glaci-
 alis duo puncta, et sint remota a puncto quod est super axem
 equaliter. Et ymaginemur duas lineas exeuntes a centro glaci-
 10 alis usque ad ista duo puncta. Erunt ergo due linee cum axe in
 superficie communi perpendiculari super superficiem vitrei,
 quoniam duo puncta et punctum centri ista tria sunt in ista
 superficie. Et erunt duo anguli qui fient ex istis duabus lineis
 et axe equales, et erunt iste due linee secantes differentiam
 15 communem que est in superficie vitrei super puncta duo. Et
 similiter axis secabit communem differentiam istam et super
 punctum medium inter illa duo puncta. Si ergo superficies
 vitrei est plana, erit differentia communis linea recta. Et si
 axis fuerit declinans super superficiem vitrei, et fuerit super-
 20 ficies que fecit differentiam communem perpendicularis super
 istam superficiem, erit axis declinans super communem differ-
 entiam, scilicet super istam lineam. Et erunt laterum duo an-
 guli inequales, quoniam si axis esset perpendicularis super
 istam differentiam communem, esset perpendicularis super

300 ipsam: ipsum *Er* 1 super *om. Er; inter. a. m. S* 2 ymaginemur: imaginemus
Er/ergo: igitur R/post superficiem add. ABCD R/post axe add. AC R 3 ante super
scr. et del. exeuntem P1/super inter. L3/post vitrei add. FGE R/ab axe om. R 4 post
ergo scr. et del. ab axe P3/superficiem corr. ex superficies a. m. C1 5 in eis *corr. ex in*
ipsas P1/post communes add. in glaciali quidem BD in vitreo vero EF R 6 superficiei
et (7) om. P1 7 inter . . . glacialis (8) *om. R/post inter scr. et del. ppa Er* 8 post
puncta add. BD R/sint: sunt C1Er/post puncto add. A R 9 equaliter *corr. ex equalem*
P3/glacialis (10) om. C1Er 10 ante usque *add. quod est C R/ista duo puncta: duo*
. . . ista L3/post puncta add. BD R/post ergo add. iste C1Er; add. hae R/post axe add. AC R
11 post communi add. ABCD R/post vitrei add. EGF R 12 post puncta *add. BD R/post*
centri add. C R/ista tria om. R/sunt: sint EP3/ista superficie (13) transp. C1ErP1
13 istis duabus transp. L3 14 post et¹ *add. ex P1S/post axe add. scilicet anguli ACB*
ACD R/erunt: sint R/post linee add. CB CD R 15 puncta duo *transp. C1Er; duobus*
punctis E F R 16 secabit: secet *R/communem differentiam transp. L3/communem*
. . . istam: differentiam . . . communem EP3R/post istam add. differentiam C1Er/et om.
R; scilicet C1ErL3P3 17 post punctum *add. G R/medium: interiectum R/post*
puncta add. E F R 18 est plana *om. P1* 19 post axis *add. AC R* 21 post erit
add. etiam R/post axis add. AC R/communem differentiam (22) transp. P1 22 scili-
cet om. P1R; inter. a. m. S/istam om. R/post lineam add. EF R/et erunt: eruntque R/
laterum: latera EP3; om. R 23 ante inequales *add. EGC FGC R/post axis add. AC R*
 24 istam *om. R/post communem add. EF R; scr. et del. esset perpendicularis super istam*
differentiam communem S/esset inter. L3

- 25 superficiem. Et cum duo predicti anguli sint inequales, et duo anguli qui sunt apud centrum glacialis quod est extremitas axis sunt equales, erunt due partes lineae quae est differentia communis inequales. Ergo erunt duo puncta extremitatum diverse distantiae a puncto quod est super axem existenti in ista linea.
- 30 Et ista duo puncta sunt illa ad quae perveniunt forme duorum punctorum superficiei glacialis quae sunt equaliter distantia ab axe, quoniam sunt apud duas extremitates duarum linearum radialium transeuntium per ista duo puncta. Et punctus qui est super axem ex superficie vitrei est ille ad quem pervenit
- 35 forma puncti quod est super axem ex superficie glacialis. Et cum axis fuerit declinans super superficiem vitrei, et superficies vitrei fuerit plana, duo puncta forme pervenientis in superficie glacialis quorum distantia a puncto quod est super axem est equalis quae sunt in superficie perpendiculari super superficiem vitrei, quando pervenerint ad superficiem vitrei, erit distantia eorum a puncto pervenienti super axem distantia inequalis.

- [2.21] Et quando axis fuerit declinans super superficiem vitrei, et fuerit superficies vitrei plana, erit differentia communis quae sit a qualibet superficie exeunti ab axe et secante superficiem vitrei continens cum axe duos angulos inequales, preter unam superficiem tantum, et est illa quae secat superficiem perpendicularem super vitreum, quoniam differentia communis eius continebit cum axe duos angulos rectos. Et erit

25 ante et¹ add. vitrei EP1P3; add. vitrei et duo anguli EGC FGE aequales R/et¹: sed R/post cum add. hi R/predicti anguli transp. EP3/sint: sunt Er 26 post anguli add. ECG FCG R/post glacialis add. C R/post axis add. AC R 27 sunt: sint EP3R/post erunt add. EG et GF R/post due scr. et del. equales P3/post lineae add. EF R 28 ante ergo add. quia enim trianguli CEF latera CE, CF sunt inaequalia (secus axis AC essent perpendicularis ad FE per 4 p. 10 d I, contra hypothesim) esto maius CE: factoque ipsi CE aequali CH, ducatur GH recta, quae per constructionem & 4 p I erit aequalis ipsi GE: ductaque ex G perpendiculari GI super HC: erit per 16 p I angulus GFE obtusus: itaque per 19 p I latus HG, idem est EG, erit maius latere FG R/ergo om. P3/ergo erunt transp. Er/post puncta add. EF R/ante diverse add. ipsius R 29 distantie corr. ex substantie C1/post puncto add. G R/quod est: existente/existenti om. R; exeunti EP3/existenti in: existentum Er/ista: illa EP3R/linea om. L3 30 post illa scr. et del. quae adveniunt S 32 post axe add. AC R 33 transeuntium corr. ex transeuntum S/punctus: punctum C1R/ante qui add. G R/qui: quod C1ErR 34 super: supra C1Er/post axem add. AC R/illem: illa P3; illud R/quem: quod R 35 post puncti add. A R 36 post axis add. AC R 37 post plana add. tunc quando R/post puncta add. quorum R/pervenientis; perveniunt R 38 post glacialis add. et R/post puncto add. A R 39 est om. Er/post equalis add. et R/perpendiculari: perpendicularis P3 40 quando om. R/distantia (41): differentia EP3 41 pervenienti: G veniente R/post distantia add. eorum a puncto L3 44 erit: tunc R 45 sit: fit EP1P3R/a qualibet: equalibus Er/exeunti: exeunte R 46 continens: contingens P1; continebit R/inequales om. EP3 47 unam inter. L3/unam superficiem transp. L3

- 50 axis declinans super differentias communes omnium superfici-
erum residuarum. Et cum duo anguli predicti fuerint inequales,
et fuerint duo anguli respicientes duas partes differentie com-
munis, scilicet anguli qui sunt apud centrum superficiei glaci-
55 alis, equales, erunt due partes differentie communis que est in
superficie vitrei inequales, et erunt duo puncta que sunt extre-
mitates istius differentie communis diverse distantie a puncto
quod est super axem. Due autem partes differentie communis
que sunt in superficie glacialis erunt equales, et erunt duo
60 puncta que sunt in extremitate istius differentie communis
equalis distantie a puncto qui est super axem in superficie
glacialis. Et cum ita est, quando forma pervenerit a superficie
glacialis ad superficiem vitrei, erit ordinatio eius non secun-
dum suum esse in superficie glacialis nec secundum suum esse
in superficie rei vise.
- 65 [2.22] Et similiter etiam declarabitur quando superficies
vitrea fuerit sperica, et fuerit axis declinans super ipsam, quo-
niam puncta que sunt in superficie glacialis quorum distantia
ab axe est equalis quando pervenerint ad superficiem vitrei,
erit distantia eorum a puncto axis inequalis. Quoniam quando
70 axis non fuerit perpendicularis super superficiem vitrei, et su-
perficies vitrei fuerit sperica, non pertransibit axis iste per cen-
trum vitrei, et ipse pertransit per centrum superficiei glacialis.
Linee ergo que exeunt a centro glacialis ad puncta quorum dis-
tancia a puncto axis in superficie glacialis est equalis continent
75 cum axe apud centrum glacialis angulos equales. Et cum ita
est, et centrum glacialis non est centrum vitrei, iste linee distin-
guent ex superficie vitrei arcus inequales. Et nulle linee conti-
nentes cum axe angulos rectos et existentes cum axe in eadem
superficie distinguunt ex superficie vitrei duos arcus equales
80 nisi due linee tantum, et sunt ille que sunt in superficie secante
superficiem perpendicularem super superficiem vitrei. Cum
ergo axis fuerit declinans super superficiem vitrei, forme per-

52 fuerint: fiunt P1/post partes scr. et del. differentie P1 54 est: sunt L3P3; alter. in
sunt a. m. E 55 et om. EP3; inter. L3/erunt corr. ex runt Er 56 distantie corr. ex
substantie S/puncto corr. ex centro E 58 sunt corr. ex est a. m. E 60 distantie corr.
ex distantia P3/qui: quod EErP3RS 61 post cum scr. et del. ista P3/ita est transp. P3/
est: sit R 63 superficie corr. ex superficiei L3 65 similiter corr. ex simiter S/etiam
declarabitur transp. EP3R 66 ante vitrea scr. et del. g P1/quoniam (67): quod P1S
68 quando: cum P1S/pervenerint: pervenerit C1ErL3 69 erit... eorum: distabunt
inaequaliter R/inequalis om. R/quando axis (70) transp. C1Er 71 pertransibit:
pertransit P3 72 ipse om. R/pertransit: pertransibit EL3P3R 75 angulos equales
transp. P3 76 est^{1,2}: sit R/distinguunt (77): distinguunt EP3 77 linee inter. L3
78 et inter. L3/existentes corr. ex exeunt a. m. E 79 distinguunt: distinguunt R/ex:
in P3/duos om. EP3R 81 cum... vitrei (82) om. P1; mg. a. m. S

venientes in superficie vitrei erunt diverse ordinationis, sive sit ista superficies plana sive sperica.

- 85 [2.23] Et cum axis fuerit perpendicularis super superficiem vitrei, erit perpendicularis super omnes differentias communes, et erunt quelibet due lineae exeuntes a centro glacialis, quod est punctus in axe, continentes cum axe angulos rectos et distinguentes ex differentia communi quae est in superficie vitrei duas
90 partes equales. Et erit distantia duorum punctorum quae sunt extremitates duarum partium equalium a puncto qui est super axem in superficie vitrei equalis, sive sit superficies vitrei plana sive sperica. Secundum ergo omnes dispositiones non pervenit forma ad superficiem vitrei et situs partium eius secundum
95 esse suum in superficie visus nisi axis perpendicularis sit super superficiem vitrei. Et sentiens non sentit formam nisi secundum suum esse apud perventum eius ad ipsum, et sentiens comprehendit ordinationem partium rei vise secundum suum esse in superficie rei vise. Non est ergo possibile ut forme perveniant in superficie vitrei nisi sit ordinatio partium
100 earum secundum suum esse. Ergo non est possibile ut axis radialis sit declinans super superficiem vitrei; erit igitur perpendicularis. Omnes ergo lineae radiales residue erunt obliquae super istam superficiem, sive sit plana sive sit sperica, quoniam
105 secant axem super centrum glacialis. Nulla autem linearum istarum transit per centrum superficiei vitrei, si fuerit sperica, nisi axis tantum, quoniam est perpendicularis super ipsam et quia centrum superficiei glacialis non est centrum superficiei vitrei. Et cum declaratum est quod forme pervenientes in superficie glacialis non perveniunt ad concavum nervi
110 nisi postquam fuerint oblique reflexe, et non est reflexio earum nisi apud superficiem vitrei, et axis est perpendicularis super

83 superficie: superficiem EP3R 84 post sive add. sit Er 86 omnes om. S/omnes differentias transp. P1 87 erunt om. R/post glacialis scr. et del. vel E 88 continentes cum axe: continebunt R/distinguentes (89): distinguunt R 89 ex: in P3 90 post sunt add. apud mg. L3 91 equalium om. P1/qui: quod R/super inter. P3 92 post sit add. per P1/superficies: superficiem P1 93 post sive add. sit EP3/omnes dispositiones transp. P1R 94 et: ut Er 95 perpendicularis sit transp. C1Er 97 suum om. P1; scr. et del. S/suum esse transp. EP3/perventum eius transp. EP3R/ ipsum: se R 98 ante partium scr. et del. re S 99 est ergo corr. ex ergo est S 100 superficie: superficiem R 101 earum: suarum R/suum esse transp. L3/ergo non est: non est ergo. EL3P3R 102 igitur: ergo L3R 103 post erunt scr. et del. obb C1 104 istam superficiem transp. P1RS/sit² om. C1Er 105 nulla autem: et nulla C1Er/autem: ergo EP1P3R/linearum istarum (106) transp. R 106 post centrum add. glacialis EP1P3 (scr. et del. glacialis P1) 108 superficiei: superficie Er 109 cum: quoniam R 110 ante in scr. et del. ad centrum P1/superficie: superficiem EP3R 111 reflexe: refractae R/non est om. C1Er/est om. P1/reflexio: refractio R/post earum add. non est C1Er 112 nisi: nec L3/apud: propter P1

istam superficiem, et omnes lineae radiales residuae sunt obli-
 quae super istam superficiem, quando forme perveniunt ad
 115 superficiem vitrei, obliquabuntur omnia puncta quae sunt in ea
 praeter punctum axis, quoniam iste punctus extenditur secun-
 dum rectitudinem axis quousque perveniat ad locum girationis
 concavi nervi. Nulla ergo forma perveniens ad superficiem
 glacialis extenditur ad concavum nervi secundum rectitudinem
 120 nisi punctus tantum axis, et omnia puncta residua perveniunt
 ad concavum nervi secundum lineas obliquatas.

[2.24] Cum ergo visus comprehenderit rem visam, et illa res
 visa fuerit opposita medio visus, et fuerit axis intra pyramidem
 radialem continentem illam rem visam, forma illius rei vise
 125 perveniet ad superficiem glaciale secundum rectitudinem
 linearum radialium. Deinde extenduntur forme ab ista super-
 ficie secundum rectitudinem linearum radialium etiam quous-
 que perveniant ad superficiem vitrei. Deinde punctus axis
 extendetur ab ista superficie secundum rectitudinem axis quo-
 130 usque perveniat ad locum girationis concavi nervi. Et omnia
 puncta residua obliquantur secundum lineas secantes lineas
 radiales et consimilis ordinationis quousque perveniant ad
 locum girationis concavi nervi. Perveniet ergo forma in isto
 loco ordinata secundum suum ordinem in superficie glacialis et
 135 secundum suam ordinationem in superficie rei vise. Sed dis-
 positio formarum obliquatarum non est sicut dispositio forma-
 rum extensarum recte, quoniam obliquatio necessario alterabit
 ipsas aliqua alteratione. Sequitur ergo de ista dispositione ut
 sit punctus perveniens ad locum girationis concavi nervi qui
 140 extendebatur secundum rectitudinem axis magis verificatus
 omnibus punctis formarum.

113 superficiem *corr. ex superficies C1/et . . . superficiem (114) mg. a. m. C1; om. Er/post*
 radiales *scr. et del. lineae P3* 114 pervenient: perveniunt L3; pervenerint R
 115 obliquabuntur: obliquantur L3; refringuntur R 116 secundum (117): super C1
 118 perveniens *corr. ex veniens S* 119 glacialis: glaciale S/nervi: nervum P3
 120 punctus: punctum P1RS/tantum axis *transp. EE P3R/perveniunt: pervenient EP3*
 121 obliquatas: refractas R 122 comprehenderit: comprehendit EP3R
 123 fuerit: sunt Er 125 perveniet: pervenit S/post superficiem *add. super P1S/*
glaciale om. Er; corr. ex glacialis a. m. EP3 126 ab *corr. ex ad E* 127 etiam:
 et S 128 perveniant: perveniat C1Er/punctus: perventus P1; punctum R; *alter. in*
perventus L3; corr. ex perventus a. m. S 131 obliquantur: refringuntur R/secun-
 dum: super R 133 nervi *om. P1/isto: illo EL3P3; illum R* 134 loco: locum R/
 ordinem: ordinationem P3/post et *add. ordinata P3R* 136 obliquatarum *corr. ex*
obliquarum L3/post sicut scr. et del. s S/dispositio corr. ex dispositio P3 137 ne-
 cessario *om. EL3P1P3RS* 138 post alteratione *add. necessario EL3P3R/de inter. L3*
 139 punctus: punctum R/perveniens: veniens L3/qui: quod R 140 extendebatur
corr. ex extendebatur S/post axis add. sit R/verificatus: verificatum R; verticatus S

[2.25] Et etiam obliquatio punctorum pervenientium in
superficie obliquationis propinquiorum puncto axis magis est
minor et remotiorum maior, quoniam obliquatio non est nisi
145 secundum angulos qui fiunt ex lineis super quas forme veniunt
et ex perpendicularibus que sunt super superficiem obliquatio-
nis. Et lineae continentes cum perpendicularibus angulos mi-
niores erit obliquatio earum secundum angulos minores, et lineae
continentes cum perpendicularibus angulos maiores erit obli-
150 quatio earum secundum angulos maiores. Et lineae radiales
propinquiores axi minus declinant super superficiem obliqua-
tionis, et sic continent cum perpendicularibus que sunt super
superficiem obliquationis angulos minores. Et ille que sunt
remotiores ab axe magis declinant super superficiem obliqua-
155 tionis, et sic continent cum perpendicularibus angulos maiores.
Et forme quarum obliquatio est minor magis manifestantur, et
forme quarum obliquatio est maior minus. Punctus ergo qui est
super axem perveniens ad locum girationis concavi nervi est
manifestior omnibus punctis residuis, et quod est propinquius
160 illi est manifestius remotiori ab illo.

[2.26] Et iste forme sunt ille que extenduntur ad nervum
communem, et ex illis comprehendit ultimum sentiens formam
rei vise. Et cum ista forma perveniens ad locum girationis con-
cavi nervi est diverse dispositionis—scilicet quod punctus axis
165 est manifestior omnibus punctis residuis, et quod est propin-

142 obliquatio: refractio R/pervenientium: provenientium L3S 143 superficie
obliquationis: superficiem refractionis R/propinquiorum: propinquorum C1P3S;
propinquarum EL3/magis om. R 144 post minor add. obliquatio EP3/post quoniam
add. tertia EP3/obliquatio: refractio R 145 fiunt: fuerit C1Er/ex om. L3/forme
veniunt transp. C1Er 146 et: etiam P3; om. C1/super om. Er/obliquationis (147):
refractionis R 147 lineae continentes: linearum continentium R 148 obliquatio:
refractio R 149 maiores: minores P1/obliquatio (150): refractio R 150 earum
om. R/radiales om. R 151 obliquationis (152): obliquationes P3; refractionis R
152 et... obliquationis (153) mg. a. m. C1; om. Er/continent cum perpendicularibus (??)
C1/super... sunt (153) mg. L3 153 obliquationis: refractionis R/angulos...
obliquationis (154/155) mg. a. m. S/que: qui S 154 declinant: declinantur P1S/
obliquationis (155): refractionis R 155 continent: continet P1S 156 obliquatio:
refractio R/post minor scr. et del. m Er/manifestantur: manifestatur C1ErS; corr. ex
manifestantur P1/post manifestantur scr. et del. et forme quarum obliquatio est minor
magis manifestantur E/et²: quam C1Er 157 forme om. R/obliquatio: refractio R/
post maior scr. et del. n C1/minus om. C1Er; inter. L3/post minus inter. manifestantur L3/
punctus: punctum R/ergo inter. L3/qui: quod R 158 super... perveniens:
perveniens... axem L3/post super scr. et del. superficiem EP3/concavi nervi
transp. EP3R 159 post omnibus add. aliis EP3R/quod: quid E; alter. ex quid in qui
P3/propinquius: propinquior P3; propinquum R 160 illi: isti EP1P3S; om. L3/
manifestus: manifestior P3/remotiori: remotiore R 161 ille om. EP3R
163 perveniens: perveniat L3 164 est: sit R/punctus: punctum R 165 mani-
festior: manifestus R/post residuis add. forme P1S

quius illi est magis manifestum post—forma perveniens in ner-
vo communi ex qua comprehendit virtus sensitiva formam rei
vise erit diverse dispositionis. Et punctus eius respondens
puncto axis in superficie rei vise est manifestior omnibus
170 punctis residuis forme, et ei propinquius manifestius.

[2.27] Et cum inducantur dispositiones rerum visarum, et
distinguaturs qualitas comprehensionis visus a rebus visis quas
comprehendit visus in simul et qualitas comprehensionis visus
a partibus unius rei vise, invenientur convenientes huic quod
175 determinavimus. Quoniam aspiciens quando in eodem tempo-
re fuerit oppositus multis rebus visibilibus, et visus eius fuerit
quietus, et non moverit ipsum, inveniet rem visam oppositam
medio sui visus manifestiorem illis que sunt a parte laterum
illius medii, et quod est propinquius medio erit manifestius. Et
180 similiter quando inspiciens inspexerit rem visam magnam, et
visus eius fuerit oppositus medio illius rei vise, et fuerit quie-
tus, comprehendet medium illius rei vise manifestius illius rei
extremitatibus. Et hoc manifestabitur bene quando fuerint
multa visibilia sibi propinqua, et aspiciens fuerit oppositus uni
185 illorum quod erit medium inter illa visibilia, visu quieto, quoni-
am tunc comprehendet comprehensione manifesta illud medi-
um; et cum hoc etiam comprehendet illa que sunt in lateribus
illius, sed non manifeste. Et hoc manifestatur magis quando
spatium super quod sunt illa visibilia fuerit longum, quoniam
190 tunc erit inter comprehensionem medii et comprehensionem
extremitatum magna diversitas.

[2.28] Deinde si hec species motus moverit suum visum in
aspiciente et fuerit oppositus alii rei vise preter illam rem vi-
sam que ante erat opposita, comprehendet istam secundam
195 comprehensione manifesta. Primam autem comprehendet
comprehensione debili. Et si fuerit oppositus extremitati et
intueatur ipsam, comprehendet ipsam comprehensione mani-

166 magis . . . post: remotiore manifestius R/post forma add. ergo R 168 punctus:
punctum R 169 est manifestior: erit manifestius R 170 punctis inter. L3/ei: huic
R/post ei inter. punctum L3/post manifestius add. remotiore R 171 cum: si R
172 visis corr. ex visus S 173 comprehendit: comprehenderit R/in om. R
174 post vise scr. et del. et L3/ante huic add. omnino P1S/huic: in hoc R 175 de-
terminavimus: declaravimus P1RS/eodem corr. ex edem S 178 manifestiorem corr.
ex manifestior est a. m. C1 179 illius: ipsius P1S/quod: quae R/propinquius:
propinquior R/manifestius: manifestior R 181 medio corr. ex magno P1/fuerit²:
fuit L3 182 illius²: istius C1EErP3R 184 fuerit: fuit L3 185 visu: visui
EL3P1P3/visu quieto transp. RS 186 comprehensione: comprehensio P3
187 cum om. EP3/cum hoc: simul R/etiam om. EL3P3 192 suum om. R
193 rem om. P3/visam (194) om. P1S 194 post secundam add. rem visam EP3R
196 comprehensione corr. ex comprehensio P3 197 intueatur: intuetur P3/
manifestiori (198): manifestiore R

festiori quam in comprehensione prime dispositionis secundum
eius remotionem ab eo, et cum hoc comprehendet medium
200 comprehensione debili, quamvis sit propinquius. Et erit inter
comprehensionem medii apud oppositionem eius extremitati et
inter comprehensionem medii apud oppositionem eius ipsi
medio illius diversitas sensibili.

[2.30] Manifestabitur ergo ex hac experimentatione quod
205 visio per medium visus et per axem quem distinximus est
manifestior visione per extremitates visus et per lineas conti-
nentes axem. Declaratum est ergo quod visio erit per axem
pyramidis radialis manifestior quam visio per omnes lineas
radiales et quod visio per illud quod propinquius est axi est
210 manifestior quam per illud quod est remotior.

[CAPITULUM 3]

[3.1] Sensus quidem visus nichil comprehendit de rebus
visibilibus nisi in corpore. In corpore autem multe res congre-
gantur et accidunt ei multe res, et visus comprehendit de cor-
poribus multas res que sunt in eis et que accidunt illis. Et color
5 est unum eorum que accidunt corporibus, et similiter lux, et
sensus visus comprehendit utrumque istorum in corporibus. Et
comprehendit etiam alias res preter istas duas, sicut figuram,
et situs, et magnitudinem, et motum, et alia que nos distingue-
mus post. Et comprehendit etiam consimilitudinem colorum et
10 diversitatem eorum, et consimilitudinem lucis et diversitatem
eius. Et similiter etiam comprehendit consimilitudinem figura-

199 cum hoc: simul *R/post* medium *add.* in *L3* 200 propinquius: propinquus *C1S/*
erit . . . comprehensionem (201): inter . . . erit *S* 201 *post* medii *scr. et del.* app *C1/*
apud . . . eius: dum aspiciens opponitur *R/oppositionem*: oppositum *P3/extremitati*
. . . eius (202) *om.* *S* 202 apud . . . ipsi: dum opponitur *R/oppositionem*: opposi-
tum *L3* 203 illius *om.* *R* 204 ergo ex hac: ex hac ergo *L3/post* hac *scr. et del.*
in *C1* 205 quem: que *P1/distinximus*: definivimus *R* 206 *post* manifestior *add.*
quod *P1/visione*: visio *P1S/visus om.* *R* 207 declaratum . . . axem *om.* *P3*
209 illud: istud *P1S/illud* . . . est¹: propinquiores *R* 210 quam *corr. ex* quod *a. m. S/*
illud . . . remotior: remotiores *R/remotior*: remotius *EP3; alter. in* remotius *L3*
1 comprehendit: comprehendet *Er* 2 autem: vero *R/multe res transp.* *EP3R*
3 et¹ . . . res *inter. L3/post* accidunt *add.* etiam *C1Er/ei*: eis *EP3/post* visus *scr. et del.*
prima dies lucem prebet creat altera celum secunda pelago tertia germen humo sub
quarta stellas sub quinto *S* 4 res *om.* *Er* 5 *post* unum *scr. et del.* est *L3*
6 istorum: illorum *Er* 7 comprehendit: comprehendat *S* 8 et² *inter. S/ante* et³
scr. et del. et *S/nos* distinguemus (9) *transp. L3P1S* 9 consimilitudinem: similitudinem
EL3P3R/et² . . . lucis (10) *om.* *Er* 10 consimilitudinem: similitudinem *EL3P3R/*
diversitatem²: diversitatis *L3 (post* diversitatis *inter. esse)* 11 eius *om.* *P3/*
comprehendit: comprehendet *S*

rum, et situum, et motuum.

[3.2] Et comprehensio omnium istorum non est secundum
unum modum, nec comprehensio cuiuslibet istorum est sensu
15 solo. Quoniam visus quando comprehendit duo individua in
eodem tempore, et fuerint consimilia in forma, comprehendet
individua, et comprehendet que sunt similia. Sed consimilitu-
do duarum formarum individuorum duorum non est ipse forme
nec una illarum.

20 [3.3] Et cum visus comprehendit individua ex formis per-
venientibus ad ipsum visum ex duobus individuis, ipse ergo
comprehendit consimilitudinem duorum individuorum ex simi-
litudine duarum formarum pervenientium a forma ad visum.
Et consimilitudo duarum formarum non est ipse forme nec ter-
25 tia forma propria consimilitudini.

[3.4] Et etiam consimilitudo duarum formarum est con-
venientia illarum in aliquo. Non ergo comprehendetur duarum
formarum similitudo nisi ex comparatione unius ad alteram et
ex comprehensione istius in quo sunt consimiles. Et cum visus
30 comprehendit similitudinem, et non est in eo tertia forma ex
qua comprehendit similitudinem, visus ergo non comprehendit
similitudinem duarum formarum nisi ex comparatione unius
ad alteram.

[3.5] Et similiter comprehendit visus diversitatem duarum
35 formarum diversarum ex comparatione unius ad alteram.

[3.7] Et cum ita est, comprehensio ergo sensus visus a simi-
litudine formarum et diversitate illarum non est per solum
sensem sed per comparationem formarum adinvicem.

12 situum: situm P1; corr. ex situm a. m. S / motuum: motum P1; corr. ex motum a. m. S
13 et: sed C1Er 14 unum modum transp. S / sensu solo (15) transp. EP3R
15 visus quando transp. L3 / comprehendit: comprehenderit C1Er / post individua scr. et
del. et comprehendet que sunt similia S / in om. C1Er 17 et . . . individua (20) mg.
a. m. E / que alter. in quoniam a. m. C1 / que sunt om. EL3P3R / consimilitudo (18): simili-
tudo EL3P3 18 duarum corr. ex darum Er / individuorum duorum: in duobus
individuis R; transp. EP3 / est: sunt R 19 ante nec add. ambae R 20 et: sed C1Er /
comprehendit: comprehendunt P1; comprehendet S; corr. ex comprehenditur P3 /
perveniuntibus (21) corr. ex pervenientibus P1 21 ipsum om. C1ErL3 / visum om.
EP3R / ex: in P3 / ergo om. R 22 consimilitudinem corr. ex similitudinem L3
24 consimilitudo: similitudo P3 / est: sunt R / tertia (25) om. P3; inter. a. m. E / tertia forma
(25) transp. C1Er 26 et etiam: sed R 27 in om. S 28 ex inter. a. m. E / unius
corr. ex illius P3 / alteram: alterum C1ErL3P1S 29 comprehensione corr. ex
comprehensio P3 / istius: illius C1Er / consimiles: similes C1Er; corr. ex similia S / cum:
quia R 30 et inter. S / post est scr. et del. et S 31 qua: quo EP1S / visus . . .
similitudinem (32) om. P1 32 ex om. P1 34 et . . . alteram (35) om. R
35 diversarum om. P1 / comparatione corr. ex comparatio C1P3 (a. m. C1) / post unius scr.
et del. v P3 36 est: sit R / visus om. P1 / a corr. ex ad C1 / similitudine (37):
consimilitudine C1EErP1P3R 37 post per scr. et del. illum P3 / solum sensum (38)
transp. P3 38 per om. P1 / adinvicem: inter se R

[3.8] Et etiam quando visus comprehendit duos colores
 40 unius generis, et fuerit unus illorum fortior altero, sicut viride
 mirti et viride fistici, comprehendet que sunt viridia, et com-
 prehendet etiam quod alterum illorum est fortioris viriditatis.
 Et distinguet inter duas viriditates, et comprehendet consimili-
 tudinem eorum in viriditate et diversitatem illorum in fortitu-
 45 dine et debilitate.

[3.9] Sed distinctio inter duas viriditates non est ipse sen-
 sus viriditatis, quoniam sensus viriditatis est ex viridificatione
 visus et ex viridificatione visus ab utraque viriditate, et com-
 prehendet quod sunt unius generis. Comprehensio ergo visus
 50 quod altera viriditas est fortior altera et quod due sunt unius
 generis est distinctio colorationis que est in visu, non ipse sen-
 sus coloris.

[3.10] Et similiter, quando duo colores sunt consimiles in
 fortitudine et fuerint unius generis, quoniam visus comprehen-
 55 dit duos colores, et comprehendit quod unius generis sunt et
 quod sunt consimiles in fortitudine.

[3.11] Et similiter est dispositio lucis apud visum, quoniam
 visus comprehendit lucem et distinguit inter lucem fortem et
 debilem.

[3.12] Comprehensio ergo visus quoad consimilitudinem
 60 colorum et diversitatem eorum, et consimilitudinem lucis et
 diversitatem eius, et consimilitudinem lineationum formarum
 rerum visibilium, et figure et situs earum, et diversitates illarum
 non est nisi ex comparatione illorum adinvicem, non solo
 65 sensu.

[3.13] Et etiam sensus visus comprehendit diafonitatem
 corporum diafonorum et diafonitatem corporum que non sunt

39 comprehendit: comprehenderit C1ErL3 40 fuerit: sit P1S/post unus scr. et del.
 color fortior C1/fortior om. C1/altero om. P3/viride: viridem R 41 mirti: mixti EP3;
 corr. ex mixti a. m. P1/viride fistici: viridem levistici R/que: quod C1EErP3/viridia:
 virides R 42 quod rep. Er/est corr. ex et L3 43 distinguet: distinguetur C1Er;
 distinguent P1 44 eorum: illorum EP3/viriditate: viriditatem P3 46 sed: et L3
 47 viridificatione: viridicatione C1P3; diversificatione P1; alter. ex verificatione in
 diversificatione L3; alter. ex diversificatione in verificatione a. m. S 48 et . . . visus
 om. P1R/ex om. L3/viridificatione: viridicatione C1/post visus² scr. et del. vel E/viriditate:
 viriditatem Er/et² om. C1Er/comprehendet (49): comprehendit C1Er 51 est¹: et Er;
 corr. ex et a. m. C1/est distinctio om. P3 53 sunt: fuerint C1Er; om. R/consimiles:
 similes EP3R 54 et om. R/quoniam om. R; corr. ex quam a. m. E 58 et¹:
 etiam P3 60 consimilitudinem: similitudinem L3 61 colorum . . .
 consimilitudinem (62) mg. a. m. S 62 lineationum corr. ex lineationis P1 63 et²
 inter. L3/illarum: earum EP3R 64 non . . . adinvicem rep. P1/illarum adinvicem:
 illarum inter se R 66 etiam om. EP3/post visus add. non EP3 67 ante et inter. et
 etiam diafonorum L3/et . . . corporum om. L3/que . . . sunt corr. ex que sunt L3/non om.
 EP1P3R/non sunt corr. ex sunt non C1

in fine diafonitatis, sed non comprehendit diafonitatem talem
 ratione nisi per comparisonem. Quoniam lapides diafoni
 70 quorum diafonitas est modica non comprehenduntur a visu
 esse diafoni nisi postquam fuerint oppositi luci, et comprehen-
 detur lux a posteriori eorum, et comprehendetur quod sunt
 diafona. Et similiter diafonitas cuiuslibet corporis diafoni non
 comprehendetur a visu nisi postquam comprehendetur corpus
 75 aut lux que est a posteriori eius, et comprehendetur cum hoc
 per distinctionem quod illud quod appareat a posteriori est
 diversum a corpore diafono.

[3.14] Comprehensio autem eius quod illud quod est a
 posteriori corporis diafoni est diversum ab illo corpore non est
 80 comprehensio solo sensu, sed est comprehensio per rationem.
 Et cum diafonitas non comprehendetur nisi per signationem,
 ergo non comprehendetur nisi distinctione et ratione.

[3.15] Et etiam scriptura non comprehendetur nisi ex dis-
 tinctione formarum litterarum, et compositione illarum, et
 85 comparatione illarum ex sibi similibus que sunt note scriptori
 ante. Et similiter multe res visibiles quando considerabitur
 qualitas comprehensionis illarum, invenietur quod non com-
 prehenduntur solo sensu sed ratione et distinctione.

[3.16] Et cum ita est, non ergo omne quod comprehenditur
 90 a visu comprehenditur solo sensu; sed multe visibiles intenti-
 ones comprehenduntur per rationem et distinctionem cum
 sensu forme vise.

[3.17] Visus autem non habet virtutem distinguendi, sed
 virtus distinctiva distinguit istas res. Sed distinctio virtutis
 95 distinctive in istis rebus visibilibus non est nisi mediante visu.

68 *post talem add. tali P1S; add. alia R* 69 *comparisonem corr. ex verticationem P1*
 70 *post est scr. et del. max P1/comprehenduntur: comprehenditur EErP3; corr. ex*
comprehenditur a. m. C1 71 *postquam corr. ex quando L3/fuerint: fuerit EP1P3/*
oppositi: oppositum EP3/comprehendetur (72): comprehendatur R 72 *compre-*
hendetur: comprehenduntur P1RS 74 *comprehendetur¹: comprehenditur R/*
comprehendetur²: comprehensum fuerit R 75 *comprehendetur cum hoc: compre-*
hendatur insuper R 79 *corporis: corpus S; om. EP3/est² . . . sed (80) mg. a. m. S*
 80 *sensu: sensus P3* 81 *comprehendetur: comprehendatur R/signationem:*
significationem C1EErL3P3 ((??) EP3); alter. in signationem a. m. S 82 *distinctione*
corr. ex distinctio P3/post ratione scr. et del. et P3 83 *etiam inter. L3/comprehendetur:*
comprehenditur R 84 *litterarum: litteratarum L3P1S; alter. in litteratarum EP3/post*
illarum scr. et del. et compositione L3 85 *ex corr. ex et a. m. C1/sibi similibus transp.*
L3/note: noti Er 86 *visibiles corr. ex visibiles P3* 87 *invenietur: inveniatur Er;*
om. R/quod om. R/comprehenduntur (88): comprehenduntur C1Er 88 *post sed add.*
multe P1S 89 *est: sit R/ergo omne transp. C1Er* 90 *a . . . comprehenditur inter.*
L3/ comprehenditur: comprehendetur C1Er/visibiles intentiones (91) transp. EP3R
 91 *comprehenduntur: comprehenduntur EL3P3R* 92 *post forme inter. rei C1L3*
 (a. m. C1) 94 *distinctiva: distinctam Er/sed: attamen R*

[3.18] Et etiam visus comprehendit multas res visas per cognitionem, et cognoscit hominem esse hominem, et equum equum, et Socratem esse Socratem quando viderit ipsum prius. Et cognoscit animalia sibi assueta, et arbores, et plantas, et lapides, quando prius vidit ipsa et sibi consimilia. Et cognoscit omnes intentiones sibi assuetas in rebus visibilibus.

[3.19] Et non comprehendit visus quiditatem alicuius rei vise nisi per cognitionem. Cognitio autem non est comprehensio solo sensu, quoniam visus non cognoscit omne quod videt prius. Et cum visus comprehenderit aliquod individuum, et postea separabitur ab illo longo tempore, et post viderit ipsum, et non fuerit rememorans ipsius, non cognoscit ipsum, quoniam non cognoscit illud quod cognovit nisi quando fuerit rememorans. Si ergo cognitio esset comprehensio solo sensu, oporteret quando visus videret aliquod individuum quod prius vidit quod statim cognosceret ipsum in secunda visione secundum omnes dispositiones, sed non ita est.

[3.20] Et cum cognitio non est nisi per rememorationem, cognitio ergo non est comprehensio solo sensu. Comprehensio autem per cognitionem est comprehensio per aliquem modorum rationis, quoniam cognitio est comprehensio consimilitudinis duarum formarum--scilicet forme quam comprehendit visus apud cognitionem et forme quam comprehendebat illius rei vise, vel sibi similis, in prima vice vel prioribus vicibus. Et propter hoc non erit cognitio nisi per rememorationem, quoniam si prima forma non fuerit presens memorie, non comprehendet visus similitudinem duarum formarum, et sic non cognoscet rem visam.

[3.21] Cognitio autem est forme alicuius rei individue et

97 cognoscit: cognovit L3; cognoscis P1 99 et³⁴ om. L3P1S 100 post lapides scr. et del. prius P1 / vidit: viderit EP3R / sibi om. R / post et² scr. et del. g P3 101 sibi . . . visibilibus: in rebus visibilibus sibi assuetas R 103 post est scr. et del. nisi P1 104 videt: vidit R; alter. in vidit C1 105 comprehenderit: comprehendit P1P3S 106 illo: eo L3 107 fuerit: fuit C1 / rememorans: memor R / cognoscit: cognos- cet C1EErL3P3R 108 quoniam . . . rememorans (109) om. P3 109 rememorans: memor R 110 post quando scr. et del. sensus E / visus videret transp. EP3R 112 ita est transp. C1ErR 113 post nisi scr. et del. per rememorationem S / rememorationem corr. ex remotionem L3 115 post est scr. et del. ali P1 / post comprehensio scr. et del. a Er / aliquem: aliquam EP3 116 rationis: ratiocinationis EP3R / cognitio: ergo P3 / est: et EL3P3 117 ante duarum scr. et del. o P1 118 quam comprehendebat om. R 119 similis: similitudinem EL3P3; similitudinum C1Er / post similis add. quam comprehendebat R / post in scr. et del. potentia P1 / vel² . . . vicibus om. R / vicibus: visi- bus Er 120 post erit add. comprehensio P3 122 similitudinem: consimilitudinem C1Er / cognosceret (123): cognoscit P3R; corr. ex cognoscit E 124 est forme transp. C1Er / forme: forte C1

- 125 forme speciei. Cognitio ergo individui est ex assimilatione
forme individui quam comprehendit visus apud cognitionem
individui alii forme quam prius comprehendebat. Et cognitio
speciei est ex assimilatione forme rei vise ad alias formas sibi
similes in individuis sue speciei que prius comprehendebat.
- 130 [3.22] Et comprehensio similitudinis est comprehensio per
rationem, quoniam non est nisi ex comparatione unius forma-
rum ad alteram. Cognitio ergo non est nisi modus rationis; sed
ista ratio distinguitur ab omnibus rationibus, quoniam cognitio
non erit per inductionem omnium intentionum que sunt in for-
135 ma, sed erit per signa. Cum ergo visus comprehendit aliquam
intentionum que sunt in forma, et fuerit memorans prime for-
me, statim cognoscet formam. Et non est ita omne quod com-
prehenditur per rationem, quoniam plura eorum que compre-
henduntur per rationem non comprehenduntur nisi post induc-
140 tionem omnium intentionum que sunt in eis.
- [3.23] Quoniam scriptor, quando momento aspexerit for-
mam ABCD, statim comprehendet quod est ABCD. Ex com-
prehensione ergo eius quod A est precedens et D est ultimum,
comprehendit quod est ABCD. Et similiter, si viderit DOMI-
145 NUS scriptum, statim comprehendit ipsum per cognitionem et
consuetudinem. Et similiter omnes dictiones sibi assuetas;
quando scriptor viderit ipsas, statim comprehendit sine indi-
gentia distinctionis unius ab altera. Et non est ita si scriptor
inspexerit dictionem extraneam scriptam quam ante non vidit,
150 quoniam scriptor non comprehendit istam dictionem nisi
postquam distinxerit eius litteras, et post comprehendit
dictionem. Omnis ergo forma quam prius non vidit visus nec
similem sibi, quando comprehenditur a visu, non comprehen-
det visus quid est illa forma nisi postquam distinxerit omnes

125 forme *corr. ex forte a. m. C1; alter. in forte L3*/individui *corr. ex individue Er*
127 comprehendebat: comprehendat P3 128 forme *inter. L3*/alias *corr. ex aliquid*
P1/sibi *om. R* 129 in *om. EP3R*/sue *om. L3*/que: qui Er 130 similitudinis:
consimilitudinis P3 131 formarum (132): forme R 132 cognitio ergo *transp.*
C1Er/post *modus add. ratiocinationis vel EP3* 133 post ista *scr. et del. o P3*
134 post erit *add. nisi EP3* 136 fuerit: fuit L3/memorans: memor R 137 com-
prehenditur (138): comprehendit R 138 eorum: illorum C1Er/comprehenduntur
(139) *corr. ex comprehenditur Er* 139 comprehenduntur: comprehenduntur C1ErL3
140 sunt *corr. ex fiunt P3* 141 scriptor quando *transp. C1Er*/quando: quoniam L3
142 ABCD¹: ABC R/ABCD²: ABC ErL3P3R; *corr. ex ABC a. m. C1*/comprehensione
(143): apprehensione EP3R 143 ergo *om. P1*/ergo eius *transp. S*/post quod *add. est*
P1/D: C R 144 ABCD: ABC R/si viderit *om. P1* 146 dictiones: dispositio-
nes R 147 ipsas: ipsam P1S 149 inspexerit: aspexerit P3/scriptam: scripturam
P1S/vidit *alter. in novit a. m. S* 150 quoniam *corr. ex quam Er* 153 sibi: illi R
154 quid: quod R

155 illas intentiones illius forme aut plures illarum.

[3.24] Forma autem consueta comprehenditur a visu statim comprehensione quarumdam intentionum que sunt in illa forma. Illud ergo quod comprehenditur per cognitionem comprehenditur per signum, et non omne quod comprehenditur
160 per rationem comprehenditur per signum. Et plures intentiones visibilium non comprehenduntur nisi per cognitionem, et non comprehenditur quiditas alicuius rei vise nec alicuius rei sensibilis alio sensu nisi per cognitionem. Et virtus cognitionis est coniuncta virtuti sensus, et non completur comprehensio
165 sensibilium nisi per cognitionem.

[3.25] Cognitio autem non est solo sensu. Intentiones ergo que comprehenduntur sensu visu quedam comprehenduntur solo sensu, et quedam per cognitionem, et quedam per rationem et distinctionem.

[3.26] Et etiam plures intentiones visibilium que comprehenduntur per rationem et distinctionem comprehenduntur in tempore valde parvo, et non apparet quod comprehensio earum sit per rationem et distinctionem propter velocitatem rationis per quam comprehenduntur iste intentiones. Quoniam
170 figura, et magnitudo, et diafonitas corporis, et sibi similia ex intentionibus que sunt in rebus visibilibus, comprehenduntur in maiori parte comprehensione valde veloci. Et non comprehenditur tunc quod comprehensio earum sit per rationem. Et cum comprehensio istarum intentionum est per rationem, non est
180 nisi propter manifestationem positionum illarum et per consuetudinem virtutis distinctive ad istas intentiones. Apud ergo istum eventum istius forme, comprehendit omnes intentiones

155 illas *om. C1Er/post illas add. distinctiones vel EP3/intentiones corr. ex distinctiones L3* 156 comprehenditur: comprehenditur P3/a visu *om. P1S* 157 ante comprehensione *add. ex C1Er* 159 comprehenditur: comprehenditur C1Er
160 comprehenditur: comprehenditur EP3R 162 comprehenditur: comprehenditur P3/post comprehenditur *scr. et del. per signum S* 163 et . . . cognitionem (165) *mg. a. m. EC1; om. Er* 164 completur: comprehenditur complete P3 165 sensibilium: visibilium EP3R 166 sensu *corr. ex sensus P3/ergo que (167) corr. ex que ergo S* 167 que: quedam EL3P3/comprehenduntur¹: comprehenditur P3/ante sensu *add. solo EP3 (inter. a. m. E); add. a R/comprehenduntur² om. C1EErL3P3S* 168 et¹ *om. R/post quedam¹ scr. et del. quedam P3/cognitionem: distinctionem P3/et² om. EP3R/per rationem (169) corr. ex rationem per Er* 170 etiam *om. EP3R/post intentiones add. sensibilium EP3 (alter. ex visibilium P3)* 171 per . . . comprehenduntur *inter. L3; om. P3* 172 tempore *corr. ex corpore Er/earum (173): eorum Er* 173 ante propter *scr. et del. comprehenduntur S* 175 figura *corr. ex figugura S/sibi om. R* 177 post et *add. quod C1ErL3/comprehenditur (178) corr. ex comprehenduntur P1* 178 tunc *om. Er; mg. a. m. C1/quod inter. L3/earum: eorum Er/cum inter. a. m. E* 179 ante est¹ *add. que S* 180 propter: per EP3R; *corr. ex per L3/post propter add. secundum Er/et om. S/post et add. est L3P1P3S* 181 ergo . . . eventum (182): istum . . . ergo R 182 istum *om. C1ErL3P3R/eventum: perventum EP3R/istius: illius R*

que sunt in ea, et sic distinguuntur ab eo apud comprehensionem.

185 [3.27] Et similiter argumentatio et omnes rationes quarum propositiones sunt universales et manifeste; non indiget virtus distinctiva aliquanto tempore etiam in comprehendendo suas conclusiones, sed apud intellectum statim propositionis intelligitur conclusio.

190 [3.28] Et causa in hoc est quod virtus distinctiva non arguit per compositionem et ordinationem propositionum, sicut componitur argumentatio per vocabula, quoniam argumentum quod concludit non erit argumentum secundum verbum nec secundum ordinationem propositionum. Argumentum autem
195 virtutis distinctivae non est ita, quoniam virtus distinctiva comprehendit conclusionem sine indigentia in verbis et sine indigentia ordinationis propositionum et ordinationis verborum.

[3.29] Quoniam ordinatio verborum argumenti non est nisi
200 modus qualitatis comprehensionis virtutis distinctivae a conclusionem, sed comprehensio virtutis distinctivae ad conclusionem non indiget modo qualitatis nec ordinatione qualitatis comprehensionis.

[3.30] Intentiones ergo visibiles que comprehenduntur ratione comprehenduntur pluries valde velociter, et non apparet in
205 maiori parte si comprehensio earum sit in ratione. Et etiam intentiones visibiles que comprehenduntur per rationem et distinctionem, quoniam multotiens comprehenduntur per rationem, et intellexerit virtus distinctiva intentiones earum, si post viderit ipsas, comprehendet eas per cognitionem sine indigentia
210 distinctionis omnium intentionum que sunt in secundis, sed per signa tantum. Et distinguet illam conclusionem per cogni-

183 comprehensionem (184): apprehensionem L3P1S 185 argumentatio . . .
rationes: in argumentatione et in omnibus rationibus R/et²: quod Er; corr. ex quod
a. m. C1 187 etiam om. P1R/suas: illarum R 188 statim propositionis transp.
C1ErL3/post propositionis add. statim P3 190 quod: quia P1S; alter. in quia a. m. C1/
distinctiva corr. ex sensitiva P1 191 propositionum: propositionis EL3P3R
192 argumentatio mg. P1/post quoniam scr. et del. ag Er 193 quod inter. S; corr. ex
quoniam Er/concludit: concluderunt P1/post concludit scr. et del. quod S/non om. R/
argumentum om. EP3R/nec: sed Er; et R; corr. ex sed a. m. C1; alter. in sed L3 196 in
corr. ex tamen a. m. E 197 propositionum: propositionis L3 198 post quoniam
scr. et del. odi P3/argumenti om. L3/post nisi add. argumenti L3 201 ordinatione:
ordine EP3R 203 post comprehenduntur add. a R 204 pluries: ut plurimum R
207 quoniam: quando P1S/multotiens om. P1/comprehenduntur corr. ex distingu-
untur P3 208 intellexerit: intelligit P3R; alter. in intelligit a. m. E/post: primo P1S
210 ante distinctionis scr. et del. a L3/distinctionis corr. ex consuetudinis a. m. E/post
sunt scr. et del. in eis vel E/secundis: illis C1Er; alter. in illis L3; alter. in eis a. m. S
211 illam: illa L3P3

tionem sine indigentia argumentationis alicuius iterande, et est exemplum in eo scriptore qui primo videt verbum extraneum.

[3.31] Et similiter omnes intentiones que comprehenduntur
 215 per rationem quando propositiones earum fuerint manifeste et conclusiones fuerint vere; quoniam quando anima intellexerit conclusionem esse veram, deinde multotiens venerit anime, erit conclusio quasi propositio manifesta. Et sic quando anima viderit propositionem, statim intelliget conclusionem sine indigentia argumentationis iterande.
 220

[3.32] Et plures intentiones quas non comprehendit virtus distinctiva quod sint vere nisi per rationem putatur quod sint propositiones prime, et quod non comprehendantur nisi per naturam et intellectum, non per rationem. Verbi gratia, quod
 225 totum sit maius parte, et putatur quod natura intellectus iudicet quod sit verum, et quod comprehensio veritatis ipsius non est per rationem. Sed totum esse maius parte non comprehenditur nisi per rationem, quoniam distinctio non habet viam ad comprehendendum quod totum est maius sua parte nisi postquam intellexerit intentionem totius, et partis, et intentionem maioritatis. Quoniam si non intellexerit intentionem partium, non intelliget intentionem totius. Intentio autem totius non est nisi omnitias, et intentio partis non est nisi aliquiditas, et maioritas est relatio ad alterum, et intentio maioris est illud quod
 230 est equale alii et plus. Et probatio quod omne totum est maius sua parte est quod refertur ei cum quadam equivalentia et addit super ipsam cum residuo. Et ex convenientia intentionis maioris cum intentione totius in augmentatione, apparet quod
 235

214 et mg. P3/post similiter add. sunt R 215 quando: quoniam ErL3; corr. ex quoniam C1 217 veram corr. ex verum P3/anime: in animam R 219 conclusionem corr. ex conusionem a. m. S 220 post iterande scr. et del. et exemplum est P1 222 putatur: putantur EP1P3RS; corr. ex putantur L3 224 verbi gratia inter. a. m. E 225 post maius add. sua EP3R/et: etiam P1S; om. R/iudicet (226): indicet P1S; indigeret P3; corr. ex indiget a. m. E 226 quod om. C1Er 227 esse: omne C1Er; est RS/post maius add. sua R/comprehendetur (228): comprehendet EP3R 228 ante nisi add. prius EP3R/post rationem scr. et del. q S/distinctio: distinctiva P3; corr. ex distinctiva a. m. E/ad inter. L3 229 est: sit R/maius: magis P1S/sua om. C1Er 230 intentionem¹: intentiones EP3R; post intentionem² scr. et del. n C1 231 post maioritatis add. et minoritatis EP1P3R 232 intentionem om. C1Er; mg. L3; inter. a. m. S 233 post nisi¹ add. a C1EP3/omnitias: communitas ErL3P1RS; coniunctis P3; alter. in communitas a. m. C1; alter. ex coniunctis in communitas a. m. E/non est om. EErP1P3RS; mg. a. m. C1 234 post intentio scr. et del. in C1 235 post equale add. ei P3/et plus mg. a. m. C1; inter. a. m. Er 236 post parte add. et L3; est quod: ad quam C1Er/refertur: confertur R/ei om. C1Er/equivalentia: ea Er; corr. ex equidistantia L3; alter. ex ea in continentia a. m. C1/et scr. et del. C1 237 super: supra EL3P3/ipsam: ipsum C1Er/post residuo add. quod est plus EP3R (post plus add. scilicet ER) 238 in: et R/augmentatione: argumentatione EP3R; aummentatione S; corr. ex argumentatione L3

totum sit maius parte. Et cum comprehensio eius quod totum
 240 sit maius parte non est nisi per istam viam, comprehensio ergo
 eius non est nisi per rationem, non per naturam intellectus. Et
 illud quod est in natura intellectus non est nisi comprehensio
 convenientie intentionis totius et intentionis maioris in aug-
 mentatione tantum.

245 [3.33] Et ordinatio istius sillogismi est ita: omne totum
 addit super partem; et omne addens super aliud est maius
 ipso; ergo omne totum est maius sua parte. Et velocitas com-
 prehensionis virtutis distinctivae circa conclusionem non est nisi
 quia propositio universalis est manifesta. Sed comprehensio
 250 virtutis distinctivae quod totum est maius sua parte est per
 rationem, et quia propositio universalis est ei manifesta, com-
 prehendit conclusionem apud eventum propositionis minoris
 particularis, et propositio particularis est additio intentionis
 totius super partem. Et quia veritas conclusionis istius sillo-
 255 gismi est certissima in anima et presens in memoria, quando
 venit propositio ad ipsum, recipit ipsam intellectus sine indi-
 gentia argumentationis iterande, sed per cognitionem tantum.

[3.34] Et omne quod est istius generis vocatur ab homini-
 bus propositio prima. Et putatur quod comprehenditur solo
 260 intellectu et quod non indigeatur in comprehensione veritatis
 circa ipsum nisi solo intellectu. Et causa illius est quod com-
 prehenduntur statim.

[3.35] Sillogismi ergo quorum propositiones sunt univer-
 sales et manifeste comprehenduntur in tempore insensibili.
 265 Deinde quando sillogisatur multotiens, comprehendit ita
 quod veritas conclusionis confitetur vel certificetur in anima;
 tunc efficietur conclusio quasi propositio manifesta. Et secun-
 dum hunc modum erit comprehensio virtutis distinctivae ad

239 sit maius *transp.* C1/post maius *add.* sua EP1P3R/et . . . nisi (240) *om.* P1/eius:
 huius propositionis EP3R 240 post maius *add.* sua EP3R; est: sit R; ergo *om.* S
 242 post natura *add.* quod est Er 243 convenientie: convenientem S/ante maioris
scr. et del. m S/post maioris *add.* et P1R/augmentatione (244): argumentatione P3; *corr.*
ex argumentatione a. m. E 245 post totum *scr. et del.* et L3 246 aliud: alium EP3/
 maius: magis S/post maius *scr. et del.* pon P1 249 propositio *inter.* L3/sed com-
 prehensio: ex comprehensione R; *corr.* ex ex comprehensione a. m. E 250 post
 distinctivae *add.* sed comprehensio R/sua *om.* C1ErL3P3R/est² . . . rationem (251):
 per . . . est L3 253 et . . . particularis *om.* P1 256 propositio *om.* P1/post recipit
scr. et del. iam Er 259 comprehenditur: comprehenduntur C1; comprehendatur
 EP3R/post solo *scr. et del.* intell P3 260 veritatis: virtutis P3 261 ipsum: ipsam
 L3/quod: quia C1Er 263 ergo *om.* P1 264 tempore: corpore P1 265 sil-
 logisatur: sillogizantur EL3P3; sillogismus Er; *alter.* ex sillogismus in sillogizetur a. m.
 C1/multotiens: toties R/post multotiens *add.* et Er/comprehendet: comprehenditur
 C1Er/comprehendet ita *om.* R 266 quod *om.* P1; ut R; *corr.* ex iterum a. m. E/ con-
 fitetur *corr.* ex refertur P3/confitetur vel *om.* R

270 plures intentiones que comprehenduntur ratione in tempore
insensibili sine indigentia argumentationis iterande.

[3.36] Et etiam multotiens non apparet qualitas compre-
hensionis intentionum visibilium que comprehenduntur ratione
et cognitione, quoniam comprehensio earum erit valde velociter
et quia comprehensio qualitatis comprehensionis non erit nisi
275 per secundum argumentum post primum argumentum per
quod fuit visio. Virtus autem distinctiva non utitur isto argu-
mento secundo in tempore in quo comprehendit aliquam inten-
tionem visibilem, nec distinguit qualiter comprehendit illam
intentionem, nec potest propter velocitatem comprehensionis
280 eius ad intentiones comprehensas per cognitionem et per argu-
mentum cuius propositiones sunt manifeste et certe in anima.
Et propter hoc non sentitur qualitas comprehensionis veritatis
plurium propositionum verarum que comprehenduntur per
cognitionem, et radix affirmationis veritatis earum est per rati-
285 onem apud earum eventum. Quoniam quando iste propositio-
nes evenerint virtuti distinctivae, statim iudicat quod sint vere
per cognitionem, sed apud cognitionem non inquit qualiter
affirmata fuerit prius veritas, nec inquit qualiter comprehen-
dit quod sunt vere apud eventum earum.

290 [3.37] Et etiam secundum argumentum per quod compre-
hendit virtus distinctiva qualitatem comprehensionis eius ad
illud quod comprehendit non est argumentum in fine velocita-
tis, sed indiget consideratione. Quoniam comprehensiones
diversantur; et quedam sunt per naturam intellectus, et que-
295 dam per cognitionem, et quedam per considerationem et dis-
tinctionem. Comprehensio ergo qualitatis comprehensionis et
que comprehensio eiusmodi comprehensionis est non est nisi
per argumentum et distinctionem non velocem. Et propter hoc
non apparet multotiens qualitas comprehensionis rerum visibi-
300 lium que comprehenduntur ratione apud comprehensionem.

269 tempore *corr. ex temporum a. m. C1* 272 comprehenduntur: comprehenduntur
C1EErP3R 273 post comprehensio *scr. et del. est L3/post earum add. non*
C1EErL3P1P3RS/erit: sit R/erit valde: est EL3P3 274 erit: est R 275 per
secundum *mg. a. m. C1/per² om. EP3* 276 fuit *corr. ex fit EP3 (a. m. E)/argumento*
secundo (277) *transp. EP3R* 280 eius *om. EP3* 283 plurium: plurimum S
286 evenerint: eveniunt EP3R; *corr. ex evenerunt L3/sint: sunt C1Er* 287 sed . . .
cognitionem *inter. L3* 288 affirmata *corr. ex affirmativa C1/comprehendit . . . vere*
(289): sunt vere quod comprehendit P1S (sunt: sit P1) 289 quod *rep. Er/sunt: sint*
EP3R/sunt vere *transp. EL3P3R/earum om. P1* 290 secundum: pari modo R
291 ad . . . comprehendit (292): quod comprehendit ad illud S (quod comprehendit
alter. ex comprehendit quod) 294 naturam: verum P3 296 qualitatis:
qualitas S 297 eiusmodi *corr. ex eiusdem a. m. S* 298 argumentum *corr. ex*
distractionem *a. m. E/post et¹ add. per Er* 300 que *inter. L3*

[3.38] Et etiam est homo natus ad distinguendum et ad arguendum sine difficultate et labore, et non percipit quod ipse arguit nisi quando arguit cum difficultate. Quando vero non utitur difficultate et cognitione, non percipit quod arguit. Argumenta ergo assueta quorum propositiones sunt manifeste et non indigent difficultate sunt in homine naturaliter, et propter hoc non percipit quando comprehendit conclusiones earum quod comprehendit ipsas per argumentum. Et significatio quod homo natus est ad arguendum, et quod ipse arguit et non percipit quod arguit, est quod apparet in pueris in primo cremento. Quoniam ipse comprehendit plures res sicut homo perfectus distinguens, et utitur multis operationibus per distinctionem. Verbi gratia quia puer, quando ei demonstrantur duo ex eodem genere, sicut duo poma, et fuerit unum pulcrius alio, accipiet pulcrius et dimittet alterum. Sed electio rei pulcrioris non est nisi per comparisonem alterius ad alterum. Et comprehensio pulcri quod sit pulcrum, et fedi quod sit fedum—et similiter, quando elegerit pulcrius alio pulcro minoris pulcritudinis—significat quod non elegit ipsum nisi post comparisonem unius ad alterum, et comprehensionem forme cuiuslibet illorum, et comprehensionem argumenti pulcritudinis pulcrioris super minus pulcrum. Et electio pulcrioris non est nisi per propositionem universalem dicentem quod est pulcrius est melius, et quod est melius est dignius ad eligendum. Ipse ergo utitur hac propositione, et non percipit quod utitur ea.

[3.39] Et cum ita est, puer ergo arguit et distinguit. Et non est dubium quod puer nescit quid sit argumentum, nec percipit, quando arguit, utrum arguat aut non. Et si quis etiam intenderet ipsum instruere quid esset arguere, non intelligeret.

1 natus: situs EP1P3; corr. ex situs a. m. C1Er; alter. ex situs in ordinatus L3S/et² . . . difficultate (2): sine . . . et ad arguendum EL3P3R/ad om. R 2 et¹: sine EL3P3R/ipse om. EL3P3R 3 vero: ratio EP3 4 cognitione corr. ex cognitionem P3 7 quando: quod C1Er/quando comprehendit om. P3/comprehendit . . . quod (8) scr. et del. C1/earum: eorum EP3R 8 comprehendit: comprehendat EP3R 9 ante quod¹ add. est EP3R (mg. a. m. E)/et¹ om. R 10 percipit: precipit S/est om. R/post primo scr. et del. in P1/cremento (11): incremento R 11 ipse comprehendit: ipsi comprehendunt EP3R 12 post perfectus add. et R/utitur: utuntur EP3R/post utitur scr. et del. mult P3 13 quia om. EP3R 14 ex rep. P3 15 accipiet: accipit C1Er/dimittet: dimittit C1Er 16 ad: ab Er 17 elegerit: eligerit Er; elegit P3 18 significat: scilicet C1EErL3P3/non om. Er/elegit: eligerit L3/nisi corr. ex natum L3/comparationem (20): comparisonum Er 21 illorum: eorum EL3P3R 22 pulcrioris: pulcriorioris S/per inter. L3 23 est pulcrius est melius (24): pulcrius est melius est C1EErL3P3R 24 est¹ om. L3/est melius transp. C1Er/est dignius transp. C1ErR/ipse ergo transp. EL3P3R 25 utitur²: utatur R 26 est: sit R/puer ergo transp. P1 27 quid: quod C1R/sit: est R 28 arguat: arguit L3/etiam corr. ex autem S 29 esset: sit argumentum vel EP3R

- 30 Et cum puer arguit et nescit quid est argumentum, anima ergo
humana est nata ad arguendum sine difficultate et labore, et
non percipit homo apud comprehensionem rei quod sit huius-
modi quod sit per argumentum. Sed intentiones que compre-
henduntur ratione non sunt nisi intentiones manifeste quarum
35 propositiones sunt valde manifeste; intentiones vero quarum
propositiones non sunt valde manifeste et quarum argumenta
indigent difficultate, quando comprehenduntur ab homine,
forte percipit quod comprehendit ipsas per rationem quando
fuerint ille vere distinctionis.
- 40 [3.40] Iam ergo declaratum est ex omni quod diximus quod
quedam intentiones que comprehenduntur per visum compre-
henduntur solo sensu, et quedam per cognitionem, et quedam
per distinctionem, et argumentum, et rationem, et positionem,
et quod qualitas comprehensionis intentionum particularium
45 per visum non apparet in maiori parte propter velocitatem
istius quod comprehenditur per cognitionem et propter veloci-
tatem argumenti per quod comprehenduntur intentiones visi-
biles, et quia virtus distinctiva est nata ad arguendum sine
labore et difficultate, sed natura et consuetudine.
- 50 [3.41] Et non indiget argumentatione iteranda illa virtus in
comprehensione alicuius intentionum particularium que multo-
tiens fuerint vise.
- [3.42] Et comprehenduntur etiam intentiones que multoti-
ens fuerint vise ratione et distinctione que sunt in anima ita
55 quod homo non percipit quietem illarum; nec quies illarum
habet principium sensibile, quoniam habet ex pueritia quod
comprehendit visibilia, et ex pueritia est in eo quedam distinc-
tio, et precipue distinctio per quam comprehenduntur distinc-
tiones sensibiles. Ipse ergo comprehendit intentiones sensibiles

30 cum: quia R/est: sit L3P3RS/anima: non Er; corr. ex non a. m. C1 31 est nata
transp. EP3R 32 post homo add. quantum EP3 (quantum alter. ex quoniam P3)/
apud: ad EP3/post sit scr. et del. huma P1 34 quarum . . . manifeste (35) om. P1P3
35 valde manifeste transp. C1/intentiones vero om. P3 36 valde manifeste transp.
S/argumenta corr. ex argumentam S 38 quod corr. ex et a. m. C1 40 ergo:
vero L3 41 comprehenduntur om. P1 42 sensu corr. ex visu C1/et¹ . . .
distinctionem (43): et quedam per distinctionem et quedam per cognitionem EP3R
46 istius: illius C1Er; ipsius S 49 labore et difficultate: difficultate et labore L3
50 non om. P1 52 vise: in se Er 53 et . . . vise (54) mg. a. m. E/comprehenduntur
om. C1Er/etiam om. C1/etiam intentiones transp. Er/intentiones . . . vise (54) mg.
a. m. C1 54 fuerint: fiunt L3/vise: in se Er/post vise add. et comprehenduntur Er;
add. comprehenduntur C1 55 illarum²: earum L3 56 sensibile corr. ex visibile
P3/post quoniam add. homo C1Er/habet² om. Er; mg. a. m. C1/ex pueritia: experientia
R/quod om. Er; inter. a. m. C1 57 comprehendit: comprehendat sensibilia EP3/post
visibilia scr. et del. et alia E/ex pueritia: experientia R/est: inest EP3 58 distinctiones
(59): intentiones EP3R 59 sensibiles¹ om. P3

- 60 ratione et distinctione, et acquirit cognitionem intentionum
sensibilium, et multotiens reduntur ipse intentiones sensibiles
illi successive quousque quiescant in eius anima ita etiam quod
non percipit quietem earum. Et sic, quando venerit ipsa inten-
tio particularis que quievit in anima eius, comprehendet etiam
65 apud eius eventum per cognitionem. Et cum hoc non percipit
qualitatem comprehensionis, nec qualitatem cognitionis, nec
qualiter quieverit cognitio ipsius intentionis in anima eius. Om-
nes ergo intentiones particulares que comprehenduntur ratione
et distinctione et multotiens reduntur iam comprehensa sunt
70 ab homine in preterito tempore, et quieverunt in anima, et fac-
ta est forma universalis quiescens ex qualibet intentione par-
ticularium. Comprehenduntur ergo iste intentiones sine aliqua
argumentatione iteranda quam primo fecit, et sine ratione per
quam comprehensa fuit veritas illius intentionis, et sine com-
prehensione qualitatis comprehensionis ipsius apud compre-
hensionem, et sine comprehensione qualitatis cognitionis apud
75 comprehensionem. Et nichil remanet indigens argumentatione
iteranda nisi intentiones particulares que sunt in individuis
particularibus, sicut figura in re individua (scilicet in re visa
80 signata), aut situs rei vise individue, aut magnitudo rei vise
individue, aut comparatio coloris alicuius rei vise individue
cum colore alterius rei vise, et sibi similis. Et secundum istos
modos erit comprehensio omnium intentionum particularium
que sunt in rebus visibilibus.
- 85 [3.43] Et cum declarata sint omnia ista, incipiemus modo
ad declarandum qualitates comprehensionis cuiuslibet intenti-
onum particularium que comprehenduntur per visum et quali-

60 cognitionem: intentionem *P1*; intentiones *R*/cognitionem intentionum *corr. ex*
intentionem sensibilem *a. m. S*/intentionum *om. P1R* 61 reduntur: reducuntur *P3*;
corr. ex reducuntur *a. m. E* 62 post etiam *add. et EL3P3*/quod: ut *R* 63 percipit:
percipiat *R*/ipsa intentio (64) *transp. C1Er* 64 quievit: quieverit *R*/etiam: eam *R*
65 eius eventum *transp. L3*; *corr. ex* eventum eius *P3*/et cum hoc: nec tamen *R*/non
om. EP3R 66 nec . . . cognitionis *om. P1S* 67 qualiter *inter. L3*/post qualiter *add.*
vel donec *a. m. S*; *add. donec EP1 (scr. et del. E)*/cognitio . . . eius: in anima eius cognitio
ipsius intentionis *EP3R* 69 et² *inter. L3*/reduntur: reducuntur *P3*; *corr. ex* reducuntur
a. m. E 70 quieverunt: quieverit *L3*/facta . . . forma (71): faciunt formam *P1S*
71 quiescens: quiescere *P1S* 72 iste intentiones *transp. EL3P3R*/aliqua *om. EL3P3R*
73 argumentatione *corr. ex* intentione *S*/primo fecit *transp. C1Er* 74 fuit: est *R*/
intentionis *corr. ex* intentiones *L3* 76 cognitionis *corr. ex* comprehensionis *Er*
77 indigens . . . iteranda (78): argumentatione . . . indigens *EP3R* 78 post nisi *add.*
considerare *EP3R*/post in *add. ipsis EP3R* 79 sicut *corr. ex* si *a. m. E*/scilicet *om.*
C1P1; *inter. ErL3 (a. m. Er)*/visa *rep. P1* 81 post aut *scr. et del. compara P3*/comparatio
corr. ex comparationis *S*/coloris alicuius *transp. C1Er*/individue . . . vise (82) *om. S*
82 sibi: illi *R* 83 comprehensio: corpore hensio *Er* 85 et: at *EP3*/sint *om. P3*/
modo *om. P1*

tates argumentationum per que acquirit virtus distinctiva intentiones comprehensas sensu visus.

- 90 [3.44] Intentiones particulares que comprehenduntur visu sunt multe, sed generaliter dividuntur in 22, et sunt: lux, color, remotio, situs, corporeitas, figura, magnitudo, continuatio, discretio vel separatio, numerus, motus, quies, asperitas, lenitas, diafonitas; item, spissitudo, umbra, obscuritas, pulcritudo, 95 turpitudine, et consimilitudo et diversitas in omnibus intentionibus particularibus et in omnibus formis compositis ex intentionibus particularibus. Ista sunt ergo omnia que comprehenduntur per sensum visus. Et si aliqua intentio visibilis est preter istas, collocabitur sub aliqua istarum: sicut ordinatio, que 100 collocabitur sub situ; et scriptura et pictura, que collocantur sub figura et ordinatione; et sicut rectitudo, et curvitas, et concavitas, et convexio, que collocantur sub figura; et multitudo et paucitas, que collocantur in numero; et sicut equalitas et augmentum, que collocantur sub similitudine et diversitate; et 105 alacritas, et risus, et tristitia, que comprehenduntur ex figura forme faciei (collocantur ergo sub figura); et sicut fletus, qui comprehenditur ex figura faciei cum motu lacrimarum (collocatur ergo sub figura et motu); et sicut humiditas et siccitas que collocantur sub motu et quiete, quoniam humiditas comprehenditur sensu visu, sed non sensu visu comprehenditur 110 nisi ex liquiditate corporis humidi et ex motu unius partis illius ante aliam, et siccitas comprehenditur visu, sed non comprehenditur visu nisi ex retentione partium corporis sicci et ex privatione motus liquiditatis. Et similiter quelibet intentio 115 particularis comprehensa a visu collocatur sub partibus quas prediximus, et omnes intentiones visibiles sunt sicut superius

88 argumentationum: argumentorum R 89 visus: visu C1ErL3S 90 ante visu add. sensu EP3R 91 post lux add. et C1Er 92 continuatio: continuum EP3R 93 vel: et R/numerus corr. ex numerum C1/post motus add. et EP3/post asperitas add. et EP3 94 item om. C1ErR/obscuritas corr. ex obscura L3/post pulcritudo scr. et del. pul Er 95 et¹ om. R/intentionibus (96) corr. ex intentione a. m. S 96 particularibus: partibus S/compositis: positus Er; corr. ex positus a. m. C1/post ex add. omnibus EP3R 97 sunt ergo transp. EL3P3R 98 visibilis est transp. C1Er 100 que om. L3/collocantur: collocabuntur EL3P3R 101 ordinatione: ordine EP3R/rectitudo corr. ex reti a. m. P3/rectitudo et om. L3 102 convexio: convexitas R/post figura rep. et¹ (101) . . . figura (102) Er; scr. et del. sicut (101) . . . figura (102) C1 103 collocantur: collocatur ErP1; colligitur L3/in: sub EP3R 104 collocantur: collocatur P1/similitudine: consimilitudine C1EP3; alter. in consimilitudine Er/post diversitate scr. et del. eius P3 106 sicut corr. ex situs P1 107 comprehenditur: continetur EP3/ex: sub P3R/faciei corr. ex forme S 110 visu^{1,2}: visus P1 112 post comprehenditur add. sensu EL3P3R (inter. L3)/visu: visus EL3P3R 113 visu om. EL3P3R/retentione: intentione P1 114 intentio corr. ex intentione L3 115 sub partibus rep. P1 116 prediximus: diximus prius EP3R/sunt mg. a. m. C1; inter. a. m. Er

diximus.

[3.45] Et cum ita est, distinctio et argumentatio virtutis
distinctive, et cognitio formarum et signorum eorum, non erunt
120 nisi ex distinctione virtutis distinctive ex formis pervenientibus
intra concavum nervi communis apud comprehensiones ultimi
sentientis illas et ex cognitione signorum formarum istarum.

[3.46] Et etiam corpus sentiens extensum a superficie
membri sentientis usque ad concavum nervi communis—scilicet
125 spiritus visibilis—est sentiens per totum, quoniam virtus sensi-
tiva est per totum istius corporis. Cum ergo extenditur forma
a superficie membri sentientis usque ad concavum nervi com-
munis, quolibet pars corporis sentientis sentiet formam. Et
cum pervenerit forma in concavum nervi communis, compre-
130 hendetur ab ultimo sentiente, et tunc erit distinctio et argu-
mentatio. Virtus ergo sensitiva sentit formam rei vise ex toto
corpore sentiente extensa a superficie membri sentientis usque
ad concavum nervi communis, et virtus distinctiva distinguit
intentiones que sunt in forma apud comprehensionem ultimi
135 sentientis circa formam. Secundum ergo hunc modum erit
comprehensio formarum rerum visibilium a virtute sensitiva, et
ab ultimo sentiente, et a virtute distinctiva. Et declarabitur ex
ista dispositione quod virtus sensitiva sentit locum membri
sentientis in quo pervenit forma, quoniam non sentit formam
140 nisi ex loco in quo pervenit forma.

[3.47] Et etiam declaratum est in capitulo precedenti quod
a quolibet puncto superficie glacialis extenditur forma secun-
dum unam verticationem continuam cum eo quod est in ea de
obliquatione et incurvatione quousque perveniat ad unum
145 punctum loci in quod pervenit forma in concavo nervi commu-
nis. Et cum ita est, forma ergo perveniens in parte superficie
glacialis extenditur ab illa parte ad aliam partem concavi nervi
communis. Et vise res diverse que comprehenduntur simul in

118 est: sit R; inter. a. m. S 120 post ex¹ add. cognitio vel EP3R 121 com-
prehensiones: comprehensionem R 122 formarum istarum transp. C1Er
123 etiam: ita R 124 scilicet . . . communis (127/128) mg. a. m. E/post scilicet scr. et
del. pus C1 126 extenditur forma transp. R 127 usque corr. ex sed a. m. S
128 ante quolibet scr. et del. et E/post pars scr. et del. s P1 130 ab corr. ex ad Er
131 ergo: autem EL3P3R/sentit corr. ex senti P3/formam: forma S 132 extensa:
extensam PIRS 133 nervi communis transp. C1Er 135 erit: est C1/erit
comprehensio (136) rep. P1 137 a om. P1 139 quoniam . . . forma (140) mg.
a. m. E; inter. L3 140 quo: quem R 141 etiam om. EL3P3/etiam . . . est: declara-
tum est etiam R/in . . . precedenti om. R 143 est om. ES/ea: eadem ER; eodem P3/
de inter. a. m. E 145 quod: quo L3; quem R 146 est: sit R/parte: partem R
148 post et add. forme cuiuslibet R/vise res diverse: visarum rerum diversarum R

150 eodem tempore extenditur forma cuiuslibet illarum ad locum
 certum concavi nervi communis, et perveniunt forme omnium
 illarum rerum visarum ad concavum nervi communis, et erit
 ordinatio formarum illarum adinvicem in concavo nervi com-
 155 munis sicut ordinatio ipsarum rerum visarum adinvicem. Cum
 ergo fuerit visus oppositus alicui rei vise, forma lucis et coloris
 illius rei vise pervenit in superficie visus et in superficie glacia-
 lis, et extenditur super verticationes determinatas quas dixi-
 mus secundum suam ordinationem, et figuram, et formam
 quousque perveniat ad concavum nervi communis. Et compre-
 160 hendetur a virtute sensitiva apud proventum eius in corpore
 glacialis et apud proventum eius in toto corpore sentiente.
 Deinde apud proventum eius in concavo nervi communis com-
 prehenditur ab ultimo sentiente, et virtus distinctiva distinguit
 omnes intentiones que sunt in ea. Et forma coloris et forma
 lucis non perveniunt ad concavum nervi nisi quia corpus senti-
 165 ens extensum in concavo nervi coloratur a forma lucis et col-
 oris, et illuminatur a forma lucis. Et pervenit forma ad con-
 cavum nervi communis, et erit pars corporis sentientis quod
 est in concavo nervi communis ad quem pervenit forma rei vise
 colorata colore illius rei vise et illuminata luce que est in illa re
 170 visa. Et si res visa habuerit unum colorem, erit illa pars cor-
 poris sentientis unius coloris, et si partes rei vise fuerint diversi
 coloris, erunt partes illius partis corporis sentientis quod est in
 concavo nervi communis diversi coloris. Et ultimum sentiens
 comprehendit colorem rei vise ex coloratione quam invenit in
 175 illa parte, et comprehendit lucem rei vise ex illuminatione
 quam invenit in illa parte. Et virtus distinctiva comprehendit

149 forma . . . illarum *om. R*/illarum: earum *EP3* 150 certum *om. S*/concavi: in con-
 cavo *R* 152 adinvicem: inter se *R* 153 rerum visarum *om. P1*/rerum . . . adin-
 vicem: adinvicem . . . visarum *P3*/visarum adinvicem *transp. ER*/adinvicem: inter se *R*
 154 *post* ergo *scr. et del.* rerum *P1*/fuerit visus *transp. R*/et . . . illius (155) *rep. P1*
 155 illius: istius *EP3R*/pervenit: perveniunt *C1EErL3P3RS*/in¹: ad *R*/superficie¹:
 superficiem *EP3R*/post et *add.* perveniunt *EL3P3R* (*alter. ex* pervenerint *a. m. E*)/super-
 156 ficie²: superficiem *R* 156 extenditur: extenduntur *P1RS*/super: secundum *R*
 158 perveniat: perveniant *P1RS*/comprehendetur (159): comprehenduntur *R*
 159 a *om. S*/post sensitiva *scr. et del. i Er*/proventum: perventum *EL3P3R*; *corr. ex*
 perventum *S*/eius: earum *R* 160 proventum: perventum *P3R*/eius: earum *R*/toto
om. S/toto corpore *transp. P1* 161 deinde . . . proventum *om. Er*; deinde . . . sentiente
 (162) *om. R*/proventum: perventum *P3*/in . . . comprehenditur (162): comprehenditur
 in concavo nervi communis *EL3P3S*/comprehenditur (162): comprehenditur *C1EErL3P3*
 163 ea: eis *R*/forma . . . lucis (164): forma lucis et forma coloris *R*/forma² *om. P1S*
 165 coloratur *inter. L3* 166 forma² *om. P1S* 167 pars *mg. a. m. Er* 168 quem:
 quam *RS* 169 *post* illuminata *add. a L3* 170 habuerit *corr. ex* fuerit *S*/post
 habuerit *scr. et del. rem P3*/unum colorem *transp. P3* 171 sentientis *om. P1*
 172 illius *corr. ex* istius *P3*/partis *om. P1S*/partis corporis *transp. EP3R* 173 et *corr.*
ex ad S 174 comprehendit: sentit *EP3R* 175 et . . . parte (176) *mg. a. m. S*

plures intentiones particulares que sunt in re visa ex distincti-
one intentionum que sunt in illa forma ab ea—scilicet ex ordi-
natione partium forme, et ex figuratione illius quod continet
180 formam, et ex figuratione partium eius, et diversitate colorum,
et situum, et ordinationum que sunt in partibus illius forme, et
ex consimilitudine et diversitate earum.

[3.48] Et etiam lux veniens a re visa colorata ad visum non
venit per se sine colore, et forma coloris veniens a re visa col-
185 orata ad visum non venit sine luce sola, et non venit forma
lucis et coloris que sunt in re visa nisi admixte, nec
comprehendit eas ultimum sentiens nisi admixtas. Tamen cum
hoc sentiens comprehendit rem visam illuminatam, et
comprehendit quod lux apparens in re vise est diversa a
190 colore, et ista comprehensio est distinctio. Distinctio autem
non est nisi virtutis distinctive, non sensitive. Tamen cum
comprehensione istius intentionis a virtute distinctiva, ista
intentio quiescit in anima, et non indiget argumentatione
iteranda apud eventum cuiuslibet forme, sed quiescit in anima.
195 Sed quod lux que est in ea est diversa a colore qui est in ea et
comprehensio virtutis distinctive quod lux accidentalis que est
in re visa colorata est diversa a colore qui est in ea est quia
super unam rem visam diversatur lux, et aliquando
augmentatur, et aliquando diminuitur. Et cum hoc est,
200 remanet color eius idem; quamvis diversetur scintillatio coloris
secundum diversitatem lucis, tamen genus coloris non
diversatur. Et etiam lux accidentalis forte pervenit ad rem
visam ex foramine, et cum fuerit opilatum illud foramen,
obscurabitur illa res visa. Ex comprehensione ergo virtutis
205 distinctive circa diversitatem lucis super res visas, et ex
comprehensione eius circa illuminationem rei vise aliquando et
privationem lucis ab ea aliquando comprehendit quod colores
qui sunt in rebus visis sunt diversi a luce que accidit in eis.
Forma ergo quam comprehendit sentiens ex re visa colorata est

177 visa corr. ex vise P3 178 ex: ab EP3 179 ex om. L3/illius...figuratione (180)
om. P1S 180 ex om. Er/diversitate corr. ex distinctione EP3 (a. m. E) 181 illius
forme inter. L3/forme om. P1 182 post ex scr. et del. dis P1/consimilitudine corr. ex
consuetudine P3 183 non...visum (185) mg. a. m. S 185 sine luce sola: sola
sine luce C1Er 187 eas...comprehendit (188) mg. a. m. S/cum hoc (188): etiam R
191 post non² scr. et del. sentisi P3/cum inter. S 192 intentionis: intentione Er; corr.
ex distinctionis E 194 sed...anima om. R 195 post lux scr. et del. acciden-
talis S 197 ante re add. ea P1S/a inter. a. m. C1 199 augmentatur corr. ex
argumentatur S 200 post quamvis scr. et del. enim C1Er/scintillatio corr. ex sintil-
latio S 202 forte: forme Er 203 opilatum: obstructum R 205 super:
supra EP3 206 eius inter. L3/et: etiam R 207 post ab scr. et del. a Er/aliquando
om. R/ante quod add. visus R 208 in² om. P1S

210 forma admixta ex forma lucis et coloris que sunt in re visa, et
virtus distinctiva comprehendit quod color qui est in eo est
diversus a luce que est in ea. Et ista comprehensio est
comprehensio secundum cognitionem apud eventum forme in
sentienti, quoniam iam quiescunt in anima quod lux cuiuslibet
215 forme admixte ex luce et colore est diversa a colore qui est in
ea.

[3.49] Et primum quod comprehendit virtus distinctiva ex
intentionibus que appropriantur forme est quiditas coloris.
Quiditas autem coloris non comprehendetur a virtute distinc-
220 tiva nisi per cognitionem quando color rei vise fuerit ex coloribus
assuetis, et comprehensio quiditatis coloris a virtute distinctiva
secundum cognitionem non est nisi ex comparatione forme coloris
ad formas quas comprehendebat ante, ex formis scilicet similibus
illi colori. Quoniam visus, quando comprehendit colorem rubeum,
225 et comprehendit quod sit rubeus, non comprehendet quod sit rubeus
nisi quia cognoscit ipsum, et ista cognitio non est nisi ex assimilatione
eius ad res quas comprehendebat prius. Si autem visus nunquam
comprehendisset rubeum colorem nisi modo, nesciret apud comprehen-
230 sionem rubei quod sit rubeus. Cum ergo color fuerit ex coloribus
assuetis, cognoscetur a visu secundum cognitionem, et si fuerit
ex coloribus extraneis ita quod visus nunquam comprehenderit
talem ante, non comprehendetur a visu ut cognoscat ipsum;
sed assimilabit ipsum coloribus propinquis illis, scilicet quos
235 cognoscebat. Radix ergo comprehensionis coloris est solo sensu;
deinde quando multotiens redierit super visum, comprehendetur
per cognitionem, scilicet cuiusmodi fuerit coloris.

[3.50] Et quiditas lucis etiam non comprehendetur a visu
nisi per cognitionem, quoniam visus cognoscit lumen solis et

210 *post et*¹ *add. forma C1ErL3P3R/visa inter. a. m. C1* 212 est comprehensio (213)
om. P1 213 comprehensio *om. C1Er/post forme add. que est EP3R* 214 qui-
escunt: quiescit *R* 219 comprehendetur: comprehenditur *P1; corr. ex*
comprehenditur *P3* 221 a . . . distinctiva (222) *mg. a. m. S* 224 visus quando
transp. R/quando corr. ex non P3/comprehenderit (225): comprehendit P1R
225 comprehendit: comprehendet *EL3P3; comprehenderit C1Er* 226 comprehendet:
comprehendit *P1RS* 227 non *om. P3/ante eius add. forme C1ErL3P3R/post ad add.*
illas P1S 229 rubeum colorem *transp. P1S* 230 *post rubei scr. et del. et Er/sit:*
esset R/color fuerit corr. ex fuerit color Er 231 *post secundum scr. et del. n C1*
233 talem: tale *P1S/non inter. L3* 234 ipsum: propter *Er/illis om. EP3R/scilicet*
quos transp. C1Er 235 *post est add. a EL3P3R/solo sensu (236) transp. EP3R*
236 *post quando add. super visum EP3R (mg. a. m. E)/super visum om. EP3R/*
comprehendetur per cognitionem (237): per . . . comprehendetur EP3R 237 scilicet
cuiusmodi *transp. L3* 239 *post cognitionem scr. et del. o C1/post cognoscit add.*
lumen ignis et *EP3R; add. lumen visus ignis et L3*

240 distinguit inter ipsum et lucem lune et ignis, et sic cognoscit
lucem lune et lucem ignis. Comprehensio ergo quiditatis cuius-
libet istarum lucium a visu non est nisi per cognitionem.

[3.52] Deinde omne quod comprehenditur per sensum vi-
sus post lucem et colorem non comprehenditur solo sensu, sed
245 comprehenditur per distinctionem et argumentationem cum
sensu. Quoniam omne quod comprehenditur per distinctionem
et argumentationem non comprehenditur nisi ex distinctione
intentionum que sunt in forma sensibili, et similiter omne quod
comprehenditur per cognitionem non comprehenditur nisi ex
250 comprehensione signorum que sunt in forma sensibili. Et in-
tentiones que comprehenduntur per distinctionem, et argumen-
tationem, et cognitionem non comprehenduntur nisi cum sensu
forme. Lux autem que est in corpore illuminato per se compre-
henditur a visu secundum suum esse, et per se, et ex ipso sen-
255 su; et lux et color que sunt in corpore colorato illuminato lumi-
ne accidentali comprehenduntur a visu in simul et admixta, et
solo sensu. Lux ergo essentialis comprehenditur a sentiente ex
illuminatione corporis sentientis, et color comprehenditur a
sentiente ex alteratione corporis sentientis et eius coloratione.
260 Et cum huiusmodi comprehensione lucis a corpore sentienti per
lumen accidentale admixtum cum illo colore sentiens ergo com-
prehendit ex corpore apud perventum forme coloris ad ipsum
lucem coloratam, et comprehendit ex eo apud perventum for-
me lucis essentialis in eo lucem solam. Ista ergo duo tantum
265 comprehenduntur a visu solo sensu.

[3.53] Et etiam dicemus quod comprehensio coloris in eo
quod est color est ante comprehensionem quiditatis coloris:
scilicet quod visus comprehendit colorem et sentit quod est
color antequam sentiat cuiusmodi sit coloris. Quoniam apud

240 et¹ om. EP3R/lucem: lumen C1ErP3R/lucem lune corr. ex lumen lucerne a. m. E/
lune: lucerne P3/post et² add. lumen C1Er 241 lucem² om. P1S/post quiditatis scr.
et del. i P3/cuiuslibet (242) om. EP3R 244 comprehenditur: comprehenditur R
245 comprehenditur: comprehenditur R 247 argumentationem corr. ex
argumentationi S/comprehenditur: comprehenditur C1ErR 248 et . . . sensibili
(250) om. R 249 comprehenditur^{1,2}: comprehenditur L3/ante non scr. et del. quod
Er/non comprehenditur transp. Er/ante nisi add. quidem P1S 251 argumentationem
corr. ex argutionem (252) a. m. S 256 comprehenduntur: comprehenduntur C1Er/
in om. R 258 post et scr. et del. eius S/comprehenditur: comprehenditur L3/post a
scr. et del. sentie P3 259 post alteratione add. forme EL3P1P3R (mg. a. m. E)/post
corporis add. forme C1Er (scr. et del. C1) 260 sentienti: sentiente R 261 colore:
corpore EP3 262 ipsum: ipsam C1EErP3; se R 263 post et add. sic P1/ex:
cum P3 264 in eo om. R/solam corr. ex sole P3/ista corr. ex ita S 266 etiam:
iterum R 267 coloris om. P3 268 comprehendit om. P3/post comprehendit add.
quiditatem EP3/colorem: coloris EP3 269 cuiusmodi: cuius L3/post sit add. cor-
poris vel EP3

270 perventum forme in visu coloratur visus, et cum coloratur visus, sentit quod sit coloratus, et sic sentit colorem. Deinde ex distinctione coloris et comparatione ipsius ad colores notos visui comprehendit quiditatem coloris. Comprehensio ergo coloris in eo quod est color erit ante comprehensionem quiditatis coloris, et erit comprehensio quiditatis coloris per cognitionem. Et significatio quod visus comprehendit colorem in eo quod est color antequam comprehendat cuiusmodi sit ratio coloris est quia visibilia quorum colores sunt fortes, sicut viriditas profunda, et fuscitas, et sibi similia, quando fuerint in
280 loco obscuro non valde, non comprehenduntur a visu in illo loco nisi quasi color tantum. Tamen sentit quod sint colores, et non distinguit cuiusmodi sint colores in principio comprehensionis. Et quando locus non fuerit valde obscurus, et fuerit visus multum intuens, comprehendet cuiusmodi sint coloris,
285 aut si lux augmentetur et intendatur in illo loco. Declarabitur ergo ex ista experimentatione quod visus comprehendit colorem in eo quod est color antequam comprehendat cuiusmodi sit coloris.

[3.54] Et illud quod comprehendit visus ex colore in principio sui proventus ad visum est coloratio, et coloratio est quasi
290 obscuritas aut umbra quando color fuerit subtilis. Et si res visa fuerit diversorum colorum, comprehendet visus in principio ex forma illius rei vise obscuritatem partium diverse qualitatis secundum fortitudinem et debilitatem, aut quasi umbras diversas in fortitudine et debilitate. Primum ergo quod comprehendit visus ex forma coloris est mutatio membri sentientis et coloratio eius que est obscuritas, aut similitudo obscuritati. Deinde sentiens distinguet illam colorationem. Et si res visa fue-

270 perventum: proventum *P1S*/visus¹ *om.* *P1*/et . . . visus (271) *mg.* *L3*/coloratur visus (271) *transp.* *EP3R* (visus *inter. a. m. E*) 271 sentit¹ *corr. ex* sentiens *L3*
273 comprehensio . . . coloris¹ (275) *mg.* *L3* 274 erit: est *EP3R* 275 et . . . coloris *om.* *C1*; *inter. a. m. S*/ante per *inter.* que est *a. m. C1* 276 ante et *scr. et del.* si ergo *P3*/colorem: colore *Er* 277 comprehendat *alter. in* comprehendit *P1*/post comprehendat *scr. et del.* co *P1*/post sit *scr. et del.* id *C1*/ratio: id *EERL3P3*; *om.* *C1* 278 quorum *corr. ex* cuiusmodi *EP3* (*a. m. E*) 279 sibi *om.* *R*/similia: similes *R*; *corr. ex* consimilia *P1*
280 loco obscuro *transp.* *P1R*/post loco *add.* valde *R*/post obscuro *scr. et del.* non *P1*/non valde *om.* *R*/post illo *scr. et del.* co *C1* 281 color: colores *R*/post color *add.* obscurus *C1Er*; *add.* colorata *P3*/tantum *om.* *P3*/sint *corr. ex* sentit *L3* 282 post non *scr. et del.* di *L3*/colores *mg.* *a. m. E* 283 fuerit² *om.* *R* 284 multum *corr. ex* tantum *a. m. E*/intuens: intueatur *R*/comprehendet: comprehendit *EL3P3RS*/post comprehendet *add.* visus *EP3R*/sint: sunt *P1S*/coloris: colores *L3*; *corr. ex* colores *EP3* 285 aut: ante *S*/intendatur *corr. ex* intendetur *P1* 286 comprehendit: comprehendet *C1Er*
287 est *om.* *EP3*/comprehendat: comprehendit *S* 290 proventus: perventus *R*
291 fuerit *om.* *P1* 295 debilitate: debilitatem *P1* 297 obscuritati: obscuritatis *EP3R*

rit illuminata, distinguetur ille color a visu et comprehendetur
 300 eius quiditas quando fuerit ex coloribus quos multotiens com-
 prehendebat. Et si fuerit ex coloribus quos fere semper com-
 prehendebat, comprehendetur in minimo tempore, et in instan-
 ti secundo inter quod et primum in quo comprehendit colorem
 in quantum est color non est sensibile tempus. Si autem fuerit
 5 ex coloribus non manifestis quos visus non comprehendit ante
 nisi raro, aut fuerit in loco obscuro debilis lucis, non compre-
 hendetur a visu quiditas eius nisi in tempore sensibili. Et si res
 visa fuerit obscura, et non fuerit in ea nisi modica lux, sicut
 illud quod comprehenditur nocte et in locis valde obscuris, non
 10 distinguetur a sentiente ex ea nisi obscuritas tantum. Declara-
 tum est ergo ex comprehensione colorum in locis obscuris quod
 comprehensio coloris in eo quod est color est ante comprehen-
 sionem quiditatis eius.

[3.55] Et significatio etiam quod visus comprehendit color-
 15 em in eo quod est color antequam comprehendat cuiusmodi sit
 coloris est quia visus, cum comprehenderit colorem extraneum
 quem nunquam vidit ante, comprehendet quod est color, et
 cum hoc nesciet cuiusmodi sit coloris. Et cum fuerit multum
 circa ipsum, assimilabit ipsum propinquiore colori simili ipsi.

20 [3.56] Ex istis ergo experimentationibus declaratur declar-
 atione manifesta quod comprehensio coloris in eo quod est
 color erit ante comprehensionem quiditatis coloris. Et declar-
 atum est etiam ex istis experimentationibus quod comprehen-
 sio quiditatis coloris non erit nisi per distinctionem. Illud ergo
 25 quod comprehendit visus solo sensu non est nisi color in eo
 quod est color, et lux in eo quod lux, et preter ista non com-
 prehendit solo sensu nisi per distinctionem, et argumentatio-
 nem, et cognitionem.

1 ante et add. prius EP3R/post quos scr. et del. multotiens Er/post semper add. ante EP3R
 2 minimo: minori P3; minore R; corr. ex minori a. m. E 3 post inter scr. et del. et P1/
 post primum scr. et del. aut L3 4 in quantum: quatenus R/tempus corr. ex tem-
 poris S 5 non² inter. L3/comprehendit: comprehendidit Er 6 post obscuro add.
 et R 8 non om. R 9 post quod add. sicut P3/ante nocte scr. et del. quia E/nocte
 corr. ex recte P1/nocte et inter. a. m. E/valde obscuris transp. P3 10 distinguetur a
 sentiente: sentietur a distinguente EP3/ex ea inter. a. m. E; om. R/declaratum (11):
 determinatum EP3 14 significatio etiam transp. R/etiam om. Er/comprehendit
 corr. ex comprehenditur L3 15 ante in scr. et del. extraneum S 16 comprehenderit:
 comprehendit P1RS 17 vidit: viderit EP3/comprehendet: comprehendit RS
 18 cum hoc nesciet: tamen nescit R/nesciet: nesciret P1S; corr. ex nescit a. m. E
 19 post ipsum² add. et Er/ipsi: sibi EP3; illi R 20 declaratur: determinatur EP3
 21 comprehensio corr. ex comprehensione P3 22 erit: erat Er 23 etiam om. P1S
 25 eo inter. a. m. Er 26 est om. L3S/post et¹ scr. et del. in S/post quod² add. est C1ErR/
 non: nihil R 27 nisi: sed R 28 et cognitionem om. Er

[3.57] Et etiam dicamus quod comprehensio quiditatis
 30 coloris non est nisi in tempore, quoniam comprehensio quidi-
 tatis coloris non est nisi per distinctionem et assimilationem.
 Sed distinctio non est nisi in tempore; ergo comprehensio
 quiditatis coloris non est nisi in tempore. Significatio autem
 manifesta quod comprehensio quiditatis coloris non est nisi in
 35 tempore est illud quod apparet in troco apud motum eius,
 quoniam quando in troco fuerint tincture diverse, et ille tinc-
 ture fuerint lineae extense ex medio superficiei eius manifeste et
 ex parte colli eius usque ad finem sue circumferentie, quoniam
 quando trocus fuerit circumgiratus motu forti, et aspexerit
 40 ipsum quis, comprehendet omnes eius colores quasi unum
 diversum ab omnibus coloribus qui sunt in eo, quasi esset color
 compositus ex omnibus coloribus illarum linearum. Et non
 comprehendet lineationem nec diversitatem colorum. Et cum
 hoc comprehendet ipsum quasi quietum quando motus eius
 45 fuerit valde fortis, quoniam quodlibet punctum non figitur in
 eodem loco tempore sensibili, sed in quam minimo tempore
 girat circumferentiam totam super quam revolvitur. Pervenit
 ergo forma puncti in visu super circumferentiam circuli in visu,
 et visus non comprehendit colorem illius puncti in minimo tem-
 50 pore nisi ex tota circumferentia circuli pervenientis in visu.
 Comprehendit ergo colorem illius puncti in minimo tempore
 circumgiratum. Et similiter omnia puncta que sunt in super-
 ficie troci; scilicet quod visus comprehendit colorem cuiuslibet
 illorum super totam circumferentiam circuli super quam move-
 55 tur ille punctus in minimo tempore, et omnia puncta quorum
 remotio a centro est equalis moventur apud circumgirationem
 troci super eandem circuli unius circumferentiam. Et accidit
 ergo ex hoc ut appareat color cuiuslibet puncti illorum punc-

29 etiam *inter. S/post* comprehensio *scr. et del.* quid *Er* 30 nisi *inter. a. m. P1/post*
 quoniam *add. enim R* 31 coloris *om. P1S* 33 coloris *om. L3/post* tempore *scr. et*
del. est illud *S/significatio: significationem R* 34 manifesta: manifestam *R*
 35 est: praebet *R/troco corr. ex toto P3* 36 quando *inter. L3/post* troco *add. quan-*
do L3 37 lineae: sine *Er; corr. ex sine a. m. C1* 38 sue circumferentie *transp. P1/*
quoniam om. R 39 quando: et *R* 40 ipsum quis *transp. C1Er/eius colores transp.*
EP3R/post eius scr. et del. prord S 41 post omnibus *scr. et del. eius C1/post* coloribus
add. eius EP3R 42 ex: ab *C1Er/coloribus: colorum Er; corr. ex colorum L3*
 43 post comprehendet *add. illam P1S/cum hoc (44): simul R* 44 hoc *om. P3*
 46 quam: quantum *EP3R* 47 circumferentiam totam *transp. C1Er* 48 visu':
 visum *R* 49 puncti *corr. ex visi E* 50 visu: visum *EP3R* 51 comprehendit:
 comprehendet *Er/in inter. L3/post in scr. et del. mino P3* 53 scilicet: significant *R*
 54 quam: quem *C1Er* 55 ille: illius *L3P3; illud R; corr. ex illius a. m. E/punctus:*
 punctum *R/omnia: omni et C1* 56 centro: puncto *EP3/moventur: movetur P1*
 57 troci *mg. a. m. C1/post* circuli *scr. et del. super eandem P1/et om. R* 58 illorum
corr. ex eorum Er

60 torum quorum remotio a centro est equalis super circumferen-
tiam eiusdem circuli in minimo tempore quod erit tempus revo-
lutionis, quare apparebunt colores omnium punctorum in tota
circumferentia illius circuli admixti. Et propter hoc compre-
henditur color superficiei troci quasi unus color admixtus ex
omnibus coloribus qui sunt in sua superficie.

65 [3.58] Si ergo visus comprehendisset quiditatem coloris in
uno instanti, et non indiguisset ad comprehendendum quidi-
tatem eius tempore, comprehendisset in uno instanti et in quo-
libet instantium temporis in quo movetur trocus quiditates
omnium colorum qui sunt in troco distincti apud motum.
70 Quoniam si non indiguerit tempore ad comprehendendum
quiditates eorum, comprehendet illos in parte temporis revolu-
tionis et in quolibet instantium temporis revolutionis apud
motum eorum sicut comprehendet quiditatem eorum apud
eorum quietem, quoniam quiditas omnium colorum visibilium
75 assuetorum in quiete et in motu sunt uniusmodi non mutate. In
quolibet ergo instantium in quibus movetur res visa non muta-
tur color eius. Et cum visus non comprehendit quiditates
colorum qui sunt in superficie troci quando trocus movebitur
motu veloci, et comprehendit ipsos quando trocus fuerit
80 quiescens vel in motu tardo, et cum ita est, visus ergo non
comprehendit quiditatem coloris nisi sit color fixus in eodem
loco tempore sensibili, vel fuerit in motu tempore sensibili in
spatio cuius quantitas non operatur in situ illius coloris a visu
operatione extranea.

85 [3.59] Declarabitur ergo ex ista dispositione quod compre-
hensio quiditatis coloris non erit nisi in tempore, et declarabi-
tur ex ista dispositione quod comprehensio quiditatis omnium
visibilium non erit nisi in tempore. Quoniam quando visus non

59 super circumferentiam (60) *om. Er* 60 tempus revolutionis (61) *transp. L3*
61 *post* omnium *add. illorum C1Er/* tota circumferentia (62) *transp. P3* 63 troci *om.*
64 *P1/ unus: unius L3/ unus color transp. EL3P3R* 65 visus comprehendisset *transp. P1*
66 *et . . . instanti (67) mg. L3/* comprehendendum *corr. ex comprehensionem P1*
67 *post* comprehendisset *add. quiditatem eius EP3* 68 instantium: instanti *P1RS/*
69 *temporis corr. ex corporis S* 69 distincti: districtim *C1EP3; distinctim ErL3; distinctae*
70 *essent R* 70 si non: quando *ErP3R; corr. ex quando a. m. C1; alter. in quando a. m. E*
71 *eorum om. P3* 72 instantium: instanti *P1RS* 74 *eorum om. C1Er/* quiditas:
75 *quiditates C1ErP1R* 75 assuetorum *corr. ex assuetum P3/* *post* mutate *scr. et del. in*
76 *quolibet ergo instantium in quibus motu sunt uniusmodi non unitate S* 76 ergo:
77 *igitur EL3/* instantium: instanti *R/* quibus: quo *EP3R* 77 cum: quia *R/* quiditates:
78 *quiditatem EL3P3R* 79 ipsos: ipsam *R/* fuerit quiescens (80): quieverit *R* 80 *post*
81 *vel add. fuerit R/ et . . . est om. R/ ita corr. ex prima S/ ergo om. P1* 81 *post* comprehendit
82 *scr. et del. atem P3/* quiditatem *mg. P3* 82 loco tempore *corr. ex tempore loco L3*
83 *illius: istius R/ illius coloris transp. EP3R* 86 *et . . . tempore (88) inter. a. m. E; mg.*
87 *a. m. S* 88 erit: est *R/ non² scr. et del. S*

comprehendit quiditatem coloris qui comprehenditur solo sensu nisi in tempore, maxime indiget comprehensione in tempore in intentionibus visibilibus que comprehenduntur per distinctionem et argumentationem. Comprehensio ergo quiditatis visibilium, et comprehensio per cognitionem, et comprehensio per distinctionem et argumentationem non erit nisi in tempore, sed multotiens erit in minimo tempore.

[3.60] Et etiam dicemus quod color in eo quod est color et lux in eo quod est lux non comprehendetur visu nisi in tempore, scilicet quod instans apud quod erit comprehensio coloris in eo quod est color et comprehensio lucis in eo quod est lux est diversum ab instanti quod est primum instans in quo contingit superficiem visus aer deferens formam. Quoniam color in eo quod est color et lux in eo quod est lux non comprehenduntur a sentiente nisi post proventum forme in corpore sensibili, et non comprehenduntur ab ultimo sentiente nisi post proventum forme ad concavum nervi communis. Sed proventus forme ad concavum nervi communis non est nisi sicut proventus lucis a foraminibus per que intrat lux ad corpora opposita illis foraminibus, et proventus lucis a foramine ad corpus oppositum foramini non erit nisi in tempore, quamvis lateat sensum. Quoniam proventus lucis a foramine ad corpus oppositum foramini non potest evadere ab altero duorum modorum, scilicet quod: aut lux perveniet in parte aeris vicinantis foramini antequam perveniat in partem aliam sequentem, deinde perveniet ad illam partem, deinde ad aliam quousque perveniat ad corpus oppositum foramini; aut lux perveniet in toto aere medio inter foramen et corpus oppositum foramini et in ipso corpore opposito foramini

89 qui: non S 90 indiget: igitur indiget tempore in R/comprehensione: comprehensionem P3/post comprehensione scr. et del. in in tempore Er/in²... visibilibus (91): intentionum visibilium R 91 in om. P3 92 comprehensio... argumentationem (94) om. Er/quiditatis: quiditatum P1S 96 etiam om. EP3R 97 comprehendetur: comprehenditur C1Er/ante visu add. a C1ErR/visu om. L3/in² om. L3 98 post apud scr. et del. stans P3 100 est¹ corr. ex et a. m. C1 101 superficiem: superficies P1 103 post mg. a. m. C1/proventum: perventum R 104 sentienti: sentiente EL3P3R 105 proventum: perventum R/post proventum scr. et del. in corpore sensibili S/sed: et R 106 non om. R/sicut om. P1S 107 proventus: perventus R 108 illis: illius Er/et proventus: perventus igitur R 109 non... foramini (111) mg. a. m. C1; om. Er 110 proventus: enim perventus R 111 non: nec P1/duorum om. P3 112 perveniet: veniet EL3P3R/parte: partem R 113 perveniat: veniat EL3P3 114 perveniet: pervenit S/illam: aliam C1EL3P3R/partem scr. et del. P1/deinde ad aliam om. P1 115 post aut add. quod R 116 toto aere medio: totum aerem medium R/post medio add. quod est EP3; add. qui est R 117 ipso... opposito: ipsum corpus oppositum R

simul. Si ergo aer recipit lucem successive, non pervenit lux ad
 corpus oppositum foramini nisi per motum, sed motus non erit
 120 nisi in tempore. Si autem totus aer recipit lucem simul,
 proventus lucis etiam in aere postquam non erat in eo non erit
 nisi in tempore, quamvis lateat sensum. Quoniam quando
 foramen per quod intrat lux fuerit opilatum, et deinde fuerit
 ablatum opilans, instans in quo fuerit ablatum opilans a prima
 125 parte foraminis et in quo fuerit discoopertus aer qui est in
 foramine ad partem lucis est diversum ab instanti apud quod
 pervenit lux in aere contingenti illam partem que est intra
 foramen et in aere continuato cum illo aere secundum omnes
 dispositiones. Quoniam lux non pervenit in aliqua parte aeris
 130 que est intra foramen quod est coopertum circa lucem nisi
 postquam fuerit discooperta aliqua pars foraminis circa lucem,
 et nulla pars foraminis discooperitur in minori uno instanti,
 sed instans non dividitur. Nichil ergo ex luce pervenit in
 interius foraminis in illo instanti in quo fuerit discooperta illa
 135 pars foraminis, quoniam illud quod est discoopertum ex
 foramine in uno instanti non discooperitur successive, nec illud
 quod discooperitur ex foramine in uno instanti est pars
 alicuius quantitatis. Quoniam non discooperitur in uno
 instanti nisi punctus carens quantitate aut linea carens
 140 latitudine, quoniam non auferetur cooperiens ab habenti
 longitudinem et latitudinem nisi successive—igitur per motum.
 Sed motus non erit nisi in tempore, et illud quod discooperitur
 ex foramine in uno instanti caret latitudine.

[3.61] Est ergo punctus aut linea, sed punctus carens
 145 quantitate et linea carens latitudine non est pars aeris. Punc-
 tus ergo carens quantitate et linea carens latitudine quod est
 punctum quod discooperitur ex foramine in instanti non est

118 recipit: reciperet R/pervenit: perveniret R 119 motus non erit: non erit motus
 EL3P3R/erit: est R 120 recipit: reperit EL3P3 121 proventus: perventus R/aere:
 aerem R/post erat inter. prius a. m. S 123 post fuerit¹ scr. et del. o Er/opilatum:
 obturatum R 124 opilans^{1,2}: obturans R/post opilans¹ add. et S 125 qui:
 quod P1S 126 ad corr. ex a E/apud: in R/quod: quo R 127 aere contingenti:
 aerem contingentem R/post est add. in aere EP3; scr. et del. ita E/intra: inter C1L3; apud
 EP3/intra foramen (128) corr. ex foramen inter Er 128 continuato: continuatum R/
 post illo add. in P1 129 aliqua parte: aliquam partem R 130 que: qui R/circa:
 contra C1EErL3P3R 131 circa: contra C1EErP3R; corr. ex contra L3 133 ex luce
 pervenit: pervenit ex luce C1Er/in om. L3 134 illo: isto C1/in quo om. P1/illa: ista
 P1; om. EP3R 135 est: fuit C1Er/ex foramine (136) corr. ex foramine ex Er
 137 in om. L3/post instanti scr. et del. nisi punctus carens quantitate S 139 nisi corr.
 ex nec L3/punctus: punctum R 140 habenti: habente R 142 discooperitur corr.
 ex cooperitur a. m. E 143 ex: a EP3R 144 punctus^{1,2}: punctum R 145 punctus
 (146): punctum R/punctus . . . aeris (149) mg. L3 146 ergo om. L3 147 punctum
 alter. in primum a. m. C1

nisi finis alicuius partium aeris qui est intra foramen, non pars
aeris. Et punctus carens quantitate non recipit lucem nec linea
150 carens latitudine, quoniam non recipit lucem nisi corpus. Et
cum ita est, nichil pervenit ex luce in aerem qui est intra fora-
men in instanti in quo discooperitur primum quod discooperi-
tur ex foramine. Instans ergo quod est punctum instans apud
quod pervenit lux in aere qui est intra foramen aut in parte
155 eius est diversum ab instanti in quo discooperitur primum
quod discooperitur ex foramine. Sed inter quolibet duo instan-
tia est tempus. Lux ergo non pervenit ex aere qui est extra
foramen ad aerem qui est intra foramen nisi in tempore, sed
istud tempus valde latet sensum propter velocitatem recep-
160 tionis formarum lucis ab aere.

[3.62] Et similiter visus quando fuerit oppositus rei vise
postquam non erat ita, et fuerit aer deferens formam rei vise
contingens superficiem visus postquam nichil fuerit ex aere
contingens ipsum, non perveniet forma ex aere deferente for-
165 mam ad interius concavi nervi communis nisi in tempore. Sed
sensus caret via comprehensionis istius temporis propter
parvitatem eius, et errorem eius, et debilitatem eius ad com-
prehendendum id quod est in fine parvitatatis. Istud ergo tem-
pus respectu sensus est sicut instans in respectu.

170 [3.63] Et etiam membrum sentiens non sentit formas veni-
entes ad ipsum nisi postquam patitur ab illis. Non sentit ergo
colorem in eo quod est color nec lucem in eo quod est lux nisi
postquam patitur a forma lucis et coloris. Sed passio membri
sentientis a forma coloris et forma lucis est aliquantula alter-
175 atio, sed nulla alteratio est nisi in tempore. Visus ergo non
comprehendit colorem in eo quod est color nec lucem in eo
quod est lux nisi in tempore. Et in tempore in quo extenditur

148 nisi *om. P1/post partium add. eius L3* 149 punctus: punctum *R/post quantitate*
scr. et del. et linea carens quantitate S 151 qui: quod *P1S* 152 primum . . .
discooperitur (153) om. ErP1 153 quod . . . instans *om. P1S/post punctum add. vel*
primum EP3R; inter. et a. m. C1; inter. scilicet L3/apud quod (154): in quo R 154 lux
inter. L3/aere: aerem R/qui: quod C1ES/parte: partibus P3; partem R 156 *post inter*
scr. et del. quod L3 157 qui: quid *C1Er; quod P1S* 158 ad . . . foramen *inter. L3*
159 istud: illud *C1EErP3; id R* 161 visus: accidit in visu *R/visus quando*
transp. C1ErP3 162 fuerit *om. R/formam corr. ex foramina a. m. C1* 163 con-
tingens: contingerit *R/nichil . . . contingens (164): non contingebat R/fuerit: fuit P1*
164 contingens . . . aere *om. P1/post ipsum add. prius R/perveniet: pervenit EErL3P3R*
166 temporis *rep. P1* 167 eius² *om. P1/post ad add. quod C1Er* 168 ante id *scr.*
et del. ist P3/id: idem L3 169 in respectu *om. P3R* 172 *post est¹ add. quod EP3/*
est² om. P3 173 postquam . . . nisi (177) *mg. a. m. E/a: ex L3/lucis et coloris: coloris*
et lucis C1Er 174 ante a *add. aut P3/est om. P1/aliquantula: aliqua P3R; corr. ex*
aliqua E; corr. ex aliquantulatio S 175 in *inter. L3* 176 est *om. C1/post est scr. et*
del. lux L3 177 est lux *transp. C1Er/et in tempore mg. a. m. S*

forma a superficie membri sentientis ad concavum nervi communis erit comprehensio coloris in eo quod est color et lucis in
 180 eo quod est lux a virtute sentiente que est in toto corpore sentiente, et apud proventum forme in concavum nervi communis erit comprehensio coloris in eo quod est color et lucis in eo quod est lux ab ultimo sentiente. Comprehensio ergo coloris in eo quod est color et lucis in eo quod est lux est in tempore
 185 sequenti tempus in quo pervenit forma a superficie membri sentientis ad concavum nervi communis.

[3.64] Et etiam est instans quod est primum apud quod pervenerit forma in superficie visus diversum ab instanti quod est primum instans in quo aer deferens formam contingit primum punctum superficiei visus quando visus fuerit oppositus
 190 rei vise postquam non fuerit ita et postquam oculus apperuerit palpebras postquam fuerint clause. Quoniam quando ita fuerit, primum quod contingit superficiem visus ex aere deferente formam illius rei vise est unus punctus aut linea carens latitudine; deinde pars post aliam quousque fiat aer deferens formam contingens partem superficiei visus in quam pervenit forma. Et apud contactum illius puncti carentis quantitate aut lineae carentis latitudine superficiei visus ad punctum carens quantitate aut ad lineam carentem quantitate superficiei aeris
 195 deferentis formam nichil pervenit ex forma lucis et coloris in superficie visus, quoniam minimum ex superficie in quod pervenit lux aut forma coloris non erit nisi superficies. In instanti ergo in quo contingit punctus superficiei visus primum punctum aeris deferentis formam nichil pervenit ex forma in superficie visus. Instans ergo quod est primum instans apud quod
 200
 205

178 superficie *corr. ex superficiei P1* 179 est *om. EP3* 180 est¹ *om. P1/sentiente corr. ex sensitiva P1* 181 et *om. Er; inter. a. m. C1/proventum: perventum R/nervi communis transp. C1Er* 183 *post ab scr. et del. est in tempore sequenti C1* 184 est² *om. P1* 185 sequenti: sequente *R/post sequenti add. et est L3S; add. et P1/pervenit forma transp. C1Er* 187 est¹ *om. EP3R/apud quod: in quo R/quod² rep. P3* 188 pervenerit: pervenit *EP3R/superficie: superficiem R/post visus add. est C1Er/post diversum add. est EL3P3R (inter. L3)* 191 fuerit: fuit *P1P3; fuerat R* 192 fuerint: fuerunt *ER; fiunt P1/post quando scr. et del. ista P3/ita corr. ex prima S/ita fuerit (193) corr. ex fuerit ita P3* 193 *post primum add. quidem L3/quod om. P1; inter. L3/deferente: differente L3* 194 vise *om. P3/unus punctus: unum punctum R* 195 *post om. P1/deferens: differens L3* 196 contingens: contingat *R/in . . . visus (198) mg. a. m. S* 197 *post carentis scr. et del. in P1* 198 lineae *corr. ex linea a. m. Er/post lineae scr. et del. in P1* 199 quantitate¹ *corr. ex quantitates P3/ad om. S/carentem corr. ex carentuem S/quantitate²: latitudine L3* 200 deferentis: differentis *L3/nichil: nisi ErL3; corr. ex nisi a. m. C1* 201 superficie¹: superficiem *EP3R/ex: in P3* 203 punctus: punctum *C1R/punctum (204) corr. ex punctus S* 204 deferentis: differentis *L3; deferens S/ex forma om. EL3P3R/superficie (205): superficiem EP3R* 205 apud quod: in quo *R*

pervenit forma in superficie visus est diversum ab instanti quod est primum instans apud quod contingit aer deferens formam superficiei visus quando visus fuerit oppositus rei vise et apperuerit palpebras eius postquam fuerint clause.

210 [3.65] Et cum ita est, non pervenit forma lucis aut coloris in aliqua parte membri sentientis nec in superficie visus nisi in tempore. Non comprehendit ergo sentiens colorem in eo quod est color nec lucem in eo quod est lux nisi in tempore; scilicet quod instans apud quod cadit sensus coloris in eo quod est
215 color et lucis in eo quod est lux est diversum ab instanti quod est primum instans apud quod contingit aer deferens formam superficiem visus.

[3.66] Iam ergo declaratum est ex omnibus que diximus quomodo comprehendit visus lucem in eo quod est lux, et quomodo comprehendit colorem in eo quod est color, et quomodo comprehendit quiditatem coloris et lucis, et quomodo comprehendit qualitatem lucis.

[3.67] Sed remotio rei vise a visu non comprehendetur a visu solo sensu, nec comprehensio remotionis rei vise est
225 comprehensio loci rei vise, nec comprehensio rei vise in suo loco est ex comprehensione remotionis eius tantum, nec comprehensio loci rei vise est ex comprehensione remotionis eius tantum. Quoniam locus rei vise sit ex tribus intentionibus, scilicet ex remotione, et ex parte, et ex quantitate remotionis.

230 [3.68] Quantitas ergo remotionis est diversa ab intentione remotionis in eo quod est remotio, quoniam intentio remotionis inter duo corpora est privatio contactus, et privatio contactus est esse aliquod spatium inter illa duo corpora. Et quantitas remotionis est quantitas illius spatii. Intentio ergo remotionis

206 *post forma scr. et del. visus P1/superficie: superficiem EP3R* 207 *apud quod: in quo R* 208 *superficiei: superficiem C1ErR; superficie P3S/post quando scr. et del. super S/visus fuerit transp. EP3R/oppositus: compositus P1* 209 *fuerint: fuerunt R; corr. ex fuerunt E* 210 *est: sit R/post est scr. et del. et C1/non: et Er* 211 *aliqua parte: aliquam partem R/superficie: superficiem R* 213 *nec: et P1S* 214 *quod¹ alter. in quia a. m. C1/apud quod: in quo R* 215 *est¹ om. Er* 216 *primum instans transp. EL3P3R/apud quod: in quo R/contingit corr. ex tingit S* 219 *comprehendit: comprehendat R/post lux scr. et del. et quomodo comprehendit quiditatem coloris et lucis S* 220 *comprehendit: comprehendet L3; comprehendat R/est om. E* 221 *comprehendit: comprehendet L3; comprehendat R/coloris et lucis: lucis et coloris EP3R/et lucis inter. a. m. E/quomodo: qualiter P3; corr. ex qualiter a. m. E* 222 *comprehendit: comprehendet L3; comprehendat R/qualitatem lucis corr. ex quantitatem visus a. m. L3* 223 *sed om. C1EErP3/comprehendetur: comprehenditur EP3R* 225 *suo loco (226) transp. EP3R* 226 *nec . . . tantum (228) om. EP1R; mg. a. m. S* 227 *est om. Er; mg. a. m. C1* 228 *locus: lucis Er/vise om. L3* 229 *post parte add. universi R* 232 *et . . . contactus om. Er; inter. L3* 233 *esse om. C1Er*

235 in eo quod est remotio est ex situ; non est ergo quantitas remotionis. Comprehensio ergo intentionis remotionis, que est privatio contactus, est diversa a comprehensione quantitatis spatii, que est mensura remotionis.

[3.69] Et comprehensio quantitatis remotionis est ex comprehensione magnitudinis, et comprehensio remotionis rei vise
240 et comprehensio partis eius ambo sunt ex comprehensione situs loci. Et qualitas comprehensionis utriusque istorum est diversa a qualitate comprehensionis alterius, quoniam privatio contactus est diversa a parte. Comprehensio ergo loci rei vise
245 non est comprehensio remotionis rei vise.

[3.70] Et comprehensio rei vise in suo loco consistit in comprehensione quinque rerum: scilicet ex comprehensione lucis que est in ea, et comprehensione coloris eius, et comprehensione remotionis eius, et comprehensione partis eius, et
250 comprehensione quantitatis remotionis eius. Et nullum istorum comprehenditur per se solum, nec comprehenditur unum post aliud; sed omnia comprehenduntur simul, quoniam comprehenduntur per cognitionem, non per argumentationem iterandam.

[3.71] Et ex comprehensione rei vise in suo loco opinati sunt ponentes radios quod visio erit per radios exeuntes a visu et pervenientes ad rem visam, et quod visio erit per extremitatem radii. Et ratiocinati sunt contra naturales dicentes, cum visio fuerit per formam venientem a re visa ad visum, et illa
260 forma pervenit ad interius visus, quare comprehenditur res visa in suo loco qui est extra visum, et forma eius iam pervenit ad interius visus? Et non sciverunt isti quod visio non completur solo sensu tantum, et quod visio non completur nisi per distinctionem et cognitionem antecedentem, et si cognitio et

235 in . . . est¹ *rep. E/post est¹ scr. et del.* in eo quod est P3/ergo *inter. E/* quantitas: qualitas P1S 236 est *inter. a. m. E* 237 quantitatis . . . comprehensione (239/240) *om. Er* 239 ex *om. P3* 240 *ante* magnitudinis *scr. et del.* in L3/remotionis *om. L3/rei vise om. P1* 241 ambo *om. R* 242 *ante* utriusque *scr. et del.* vir P3/utriusque: cuiuslibet L3/istorum: eorum P1S 243 *post* comprehensionis *add. remotionis EP3R (alter. ex remotionis comprehensionis in comprehensionis remotionis P3)/post alterius add. illorum EP3R* 244 *post* diversa *rep. a (243) . . . diversa (244) P1/ergo om. S* 247 comprehensione¹ *corr. ex* comprehensio P3/ex: in R 248 coloris: colore S/eius *om. P3* 250 comprehensione *corr. ex* comprehensionis S/eius *om. L3* 252 *ante* simul *add. in EL3P3/quoniam: quando EL3P3R* 256 erit: esset R 257 visio erit *corr. ex* erit visio L3/erit: esset R 258 contra: circa *Er/naturales: physicos R* 262 non sciverunt: nesciverunt C1Er 263 solo . . . completur *om. P3* 264 distinctionem et cognitionem: cognitionem et distinctionem EP3R/antecedentem: antecedentis P1/cognitio et *om. Er/cognitio et distinctio (265): distinctio et cognitio C1*

265 distinctio antecedens non esset, non compleretur in visu visio,
et non comprehendet visus quid est res visa apud visionem.
Quoniam quid est res visa non comprehenditur solo sensu nisi
per distinctionem aut cognitionem aut argumentationem iter-
andam apud visionem. Si ergo visio esset solo sensu tantum,
270 et omnia que comprehenduntur ex intentionibus que sunt in
rebus visibilibus non comprehenduntur nisi solo sensu, non
comprehenditur res visa in suo loco nisi postquam pervenisset
aliquid ad ipsum quod contingeret et sentiret eam. Cum autem
visio non completur solo sensu, sed per distinctionem, et argu-
275 mentationem, et cognitionem, non indiget in comprehensione
rei in suo loco sentiente extenso ad ipsam.

[3.72] Redeamus ergo ad narrandum qualitatem compre-
hensionis visionis, et dicamus quod remotio rei vise non com-
prehenditur per se nisi per distinctionem. Et cum hoc ista
280 intentio est ex intentionibus que quiescunt in anima secundum
tempora pertransita, ita quod non est percepta ab anima
propter nimiam frequentationem et iterationem eius super
virtutem distinctivam, quare non indiget in comprehensione
eius argumentatione iteranda apud comprehensionem cuius-
285 libet rei vise. Nec querit etiam virtus distinctiva etiam apud
comprehensionem cuiuslibet rei vise quomodo quievit intentio
remotionis rei vise in ea, quoniam non distinguit qualitatem
comprehensionis apud comprehensionem cuiuslibet rei vise. Et
non comprehendit remotionem nisi cum aliis intentionibus que
290 sunt in re visa, et comprehendit illam apud comprehensionem
rei vise per cognitionem antecedentem.

[3.73] Quomodo virtus distinctiva comprehendit remotio-

265 compleretur: completur *ErL3* 266 et non: nec *C1Er*/comprehendet:
comprehenderet *C1Er*; comprehendit *R/post* visus *scr. et del.* visio *S/apud* . . . visa (267)
om. Er; inter. L3 271 non¹ *om. R/comprehenduntur: comprehenduntur C1Er; corr.*
ex comprehenduntur P1/nisi om. R/post sensu scr. et del. non . . . sensu *S* 272 com-
prehenditur: comprehenderetur *R/pervenisset corr. ex pervenissent P1* 273 quod:
et *EL3P3*; que *P1S*/contingeret: contingerit *P1/eam om. P3* 274 argumentationem
et cognitionem (275): cognitionem et argumentationem *P3* 275 indiget: indi-
get *R* 276 ad *rep. P1/ipsam: ipsum P3/post ipsam add. et contingente ipsam*
C1EErL3P3R (mg. a. m. E) 277 comprehensionis (278) *corr. ex comprehensio P3*
278 quod *om. P3R; inter. a. m. E* 279 cum hoc *om. R* 280 post est *add. quod Er*
281 post quod *add. non C1/ante non add. recidit C1EErL3P3/non est om. C1EErL3P3R/*
post percepta add. non recedit R 282 iterationem *corr. ex iterantionem P3/eius*
om. EP3 283 indiget: opus est *R* 285 etiam²: et *EP3; om. R* 287 remotionis
om. EP3R/post remotionis add. eius L3/rei vise om. C1Er 288 post et *scr. et del. co S*
289 non *om. Er/comprehendit: comprehendet L3* 291 post antecedentem *add.*
quomodo virtus distinctiva comprehendit illam apud comprehensionem rei vise per
cognitionem antecedentem *P1* 292 post quomodo *add. autem R/comprehendit:*
comprehendat *R/remotionem (293) corr. ex renem L3*

nem per distinctionem est secundum quod narrabo. Quando
 est visus oppositus rei vise postquam non fuit oppositus,
 295 comprehendit rem visam, et quando auferetur ab oppositione,
 destruetur comprehensio. Et similiter, quando visus apperu-
 erit palpebras postquam fuerint clause, et fuerit oppositus
 alicui rei vise, comprehendet illam rem visam, et cum clauserit
 palpebras, destruetur comprehensio. Et in natura intellectus
 300 est quod illud quod accidit in visu apud aliquem situm et
 destruetur apud eius ablationem non est fixum intra visum,
 nec operans ipsum est intra visum. Et in natura intellectus est
 etiam quod illud quod apparet apud apertionem palpebrarum
 et destruitur apud clausionem earum non est fixum intra vi-
 5 sum, nec faciens ipsum accidere est intra visum. Et cum virtus
 distinctiva comprehenderit quod illud quod accidit in visu ex
 quo visus comprehendit rem visam nec est res fixa intra visum,
 nec operans ipsum est intra visum, statim comprehendit quod
 illud quod accidit in visu est veniens ex extrinseco, et operans
 10 ipsum est extra visum. Et cum visio destruitur apud clausio-
 nem palpebrarum et apud ablationem ab oppositione, et sic
 apud apertionem palpebrarum et apud oppositionem, virtus
 distinctiva comprehendit quod illud quod videtur in visu non
 est applicatum ad visum. Et cum virtus distinctiva compre-
 15 hendit quod illud quod videtur non est intra visum nec est
 applicatum cum visu, statim comprehendit quod inter ipsum
 et visum est remotio. Quoniam in natura intellectus est, aut in
 fine manifestationis distinctionis, quod omne quod non est in
 corpore nec est applicatum cum ipso quod sit inter ea remotio,
 20 et hec est qualitas comprehensionis remotionis rei vise in eo
 quod est remotio.

[3.74] Sed virtus distinctiva non indiget in comprehensione

294 est visus: visus fuerit *EErL3P3R*/fuit: fuerit *C1EErL3P3R* 295 comprehendit:
 comprehendet *P3*; *alter. in* comprehendet *E*/auferetur: aufertur *C1ErR* 296 destru-
 etur: destruitur *C1ErR* 297 *post* palpebras *scr. et del. q L3*/fuerint: fiunt *P1*; fue-
 runt *R* 298 comprehendit: comprehendit *C1ErS*/rem *om. P1* 299 destruetur:
 distinguetur *P3* 1 destruetur: destruitur *C1ErR* 2 operans: faciens *R*; *corr. ex*
faciens EP3 (a. m. E)/post ipsum add. accidere EP3R 3 etiam *om. P1S*/illud: id *R*/
 quod² *inter. C1*/apparet: accidit *C1Er*/apertionem: operationem *Er*; *corr. ex* operatio-
 nem *C1* 4 fixum: visum *EP3* 5 *post nec add. etiam C1Er* 6 comprehenderit:
 comprehendit *C1ErR*; *mg. a. m. E*/illud: id *R* 7 nec: non *C1Er*/fixa: fixum *ErL3*; visa
S; *corr. ex* fixum *a. m. C1* 9 illud: id *R*/est veniens: advenit *R*/ex *om. C1ErL3R*; *inter.*
S/extrinseco: intrinseco *P3*; extrinsecus *R* 11 ablationem: oblationem *ErP3*/sic:
 fit *R* 13 illud: id *R*/in visu *om. P3* 14 ad: in *EL3P3*; cum *R*/visum: visu *EL3P3R*
 16 *ante* applicatum *scr. et del. est P1*/comprehendit: comprehendet *L3* 19 quod *om.*
R/inter ea remotio: remotum ab eo *R* 21 est *om. P1S*/est remotio *transp. L3*
 22 distinctiva *corr. ex* distina *P3*

remotionis rei vise ad dividendum ea que divisimus, quoniam
 non fecimus hoc nisi gratia declarandi. Et virtus distinctiva
 25 comprehendit conclusionem istius distinctionis apud visionem
 sine indigentia illius divisionis. Ex comprehensione ergo rei
 vise apud oppositionem et apertionem palpebrarum, et ex
 destructione eius apud ablationem oppositionis et apud clau-
 sionem palpebrarum, comprehendit virtus distinctiva quod res
 30 visa est extra visum et quod non est applicata cum visu. Et
 secundum istum modum comprehendit virtus distinctiva quod
 inter visum et rem visam sit remotio. Deinde propter frequen-
 tationem istius intentionis et iterationem eius quievit in anima,
 ita quod non percipit quietem eius nec qualitatem quietis eius,
 35 scilicet quod omnia visibilia sunt extra visum et quod inter
 quamlibet rem visam et visum est remotio. Remotio ergo rei
 vise a visu non comprehenditur nisi per modicam distinctio-
 nem, scilicet quod virtus distinctiva comprehendit quod visio
 est propter intentionem extrinsecam a visu. Et cum hoc, quan-
 40 do fuerit quiescens in anima, intelliget virtus distinctiva quod
 quolibet res visa comprehensa a visu est extra visum, et inter
 ipsum et visum est remotio.

[3.75] Et cum hoc, sicut diximus superius, non comprehen-
 ditur remotio nisi cum aliis. Et apud nostrum sermonem de
 45 qualitate comprehensionis situs declarabitur quomodo com-
 prehendetur remotio cum situ, et quomodo comprehendetur res
 visa in suo loco.

[3.76] Comprehensio vero quantitatis remotionis a visu
 diversatur, quoniam quedam comprehenduntur per sensum
 50 visus et certificatur earum quantitas, et quedam comprehen-
 duntur quorum quantitas non certificatur. Remotio rei vise a
 visu comprehenditur in qualibet re visa, et certificatur in qua-
 libet re visa. Quantitas autem remotionis non certificatur
 a visu in qualibet re visa, quoniam inter quedam visibilia et

23 rei vise om. C1Er 25 istius: illius C1Er/visionem: divisionem P1S 27 vise
 om. EP3R/et apertionem om. Er/palpebrarum corr. ex palpebrarum P3 28 eius
 inter. L3/ablationem: oblationem Er 29 quod . . . distinctiva (31) om. Er; mg. a. m. C1
 (quod . . . visum (30) (??) C1) 30 cum visu et (??) C1 31 distinctiva (??) C1
 32 sit: est C1Er/frequentationem (33): sequestrationem P1S 33 iterationem:
 certificationem P1 39 quando (40) om. P1S 42 ipsum: ipsam EL3P3R
 43 cum hoc: etiam R 44 et om. Er; mg. a. m. C1 45 comprehendetur (46):
 comprehendatur R 46 comprehendetur: comprehenditur C1EErL3P3;
 comprehendatur R 47 suo loco transp. EP3R 948 vero: ergo P1S; alter. in ergo
 a. m. E 50 earum: eorum EP3R; alter. in eorum a. m. C1/quantitas: qualitas Er/corr.
 ex qualitas a. m. C1 51 post certificatur scr. et del. earum quantitas S/a visu (52)
 om. P3 52 post certificatur add. visui P1 54 a visu: visui EL3P3R; om. P1S

- 55 visum sunt corpora ordinata continuata, et inter quedam vero
et visum non sunt corpora ordinata continuata, nec remotio
eorum respicit corpora ordinata continuata. Illa ergo quorum
remotio respicit corpora ordinata continuata, quando visus
comprehenderit corpora ordinata que respiciunt remotionem
60 eorum, scilicet visibilia, comprehendet quantitates illorum
corporum. Et cum comprehenderit mensuras illorum corporum,
comprehendet quantitates spatiorum que sunt inter extremitates
eorum. Et spatium quod est inter duas extremitates
corporis visi quod respicit remotionem que est inter visum et
65 rem visam quarum altera est in parte rei vise et altera in parte
aspicientis est remotio rei vise a visu, quoniam respicit spatium
quod est inter visum et rem visam. Cum ergo visus comprehenderit
mensuram istius spatii, comprehendet mensuram remotionis rei vise.
Visus ergo comprehendit quantitatem
70 remotionum rerum visibilium quarum remotio respicit corpora
ordinata continuata ex comprehensione mensurarum corporum
ordinatorum respicientium remotiones earum.

- [3.77] Et remotio quarumdam rerum istarum visibilium est
mediocris, et remotio quarumdam est extra mediocritatem.
75 Remotio ergo visibilium quorum remotio est mediocris comprehenditur
a visu vera comprehensione certificata, quoniam visibilia
quorum remotio est mediocris, et inter ipsa et visum sunt
corpora ordinata continuata, comprehenduntur a visu vera
comprehensione. Et cum visus comprehendit ista visibilia vera
80 comprehensione, comprehendet corpora ordinata interiacentia
ipsum et ipsa visibilia vera comprehensione. Et cum comprehendit
ista corpora vera comprehensione, comprehendet spa-

55 *post continuata scr. et del. nec remotio eorum C1/et om. R/et . . . continuata (56) mg. a. m. E/vero: non C1Er (scr. et del. C1); corr. ex non EL3* 56 visum: visa EP3/*post visum add. et C1Er (scr. et del. C1)/continuata om. L3* 57 respicit: respicit Er/illa . . . continuata (58) mg. a. m. E/illa ergo *transp. EL3P3/post ergo add. quoque L3*
58 respicit: recipit Er 59 comprehenderit: comprehendit L3/respiciunt: recipiunt L3 60 scilicet *om. R/post visibilia add. quando EP3R; add. qua L3P1S (alter. in quando a. m. S)/post comprehendet add. scilicet EP3R/quantitates: quantitas L3*
62 spatiorum que sunt *corr. ex que sunt spatiorum E/inter alter. ex super in intra L3*
63 illorum: eorum P1S 64 corporis *corr. ex corpus S/visi: nisi Er/respicit: respicit Er* 66 a visu *om. P1; inter. a. m. S/quoniam corr. ex quando L3/post quoniam inter. replet et a. m. S* 67 comprehenderit (68): comprehendet EP3R 68 istius: illius P1/comprehendet: comprehenderet Er 69 comprehendit: comprehendet P1
72 respicientium *corr. ex respiciens a. m. C1/earum om. P1* 73 istarum *corr. ex visarum C1* 74 mediocritatem: medietatem P3; *corr. ex medietatem a. m. E*
75 *post est scr. et del. visibilis P3* 76 vera comprehensione *transp. EP3R* 77 et: etiam P3/ipsa: quae R/*post ipsa scr. et del. i S* 79 ante et *scr. et del. comprehendit S*
80 comprehendet: comprehendit EL3P3 81 ante ipsum *add. inter EP3R/comprehendit (82): comprehenderit C1* 82 ista *corr. ex ipsa Er/comprehendet: comprehendit R*

tia interiacentia extremitates eorum vera comprehensione. Et
 cum comprehenderit spatia vera comprehensione, comprehen-
 85 det mensuras remotionum visibilium respicientium ista spatia
 vera comprehensione certificata. Visibilia ergo quorum remotio
 est respiciens corpora ordinata continuata et quorum remotio
 a visu est mediocris, visus comprehendit mensuras remotio-
 num eorum vera comprehensione et certa—et est dicere certa in
 90 ultimitate in qua poterit sensus comprehendere.

[3.78] Mensure vero remotionum visibilium quorum remotio
 est extra mediocritatem et quorum remotio respicit corpora
 ordinata continuata, et cum hoc sunt comprehensa a visu, non
 comprehenduntur a visu vera comprehensione certificata, quo-
 95 niam visibilia quorum remotio est extra mediocritatem non
 comprehenduntur a visu vera comprehensione. Et cum inter
 visum et ista visibilia fuerint corpora ordinata continuata, non
 comprehenduntur a visu omnia ista visibilia vera comprehen-
 sione propter extraneitatem remotionum extremitatum suarum
 100 et exitus eorum a mediocritate per quam visus certificat visi-
 bilia. Et cum visus non comprehendet ista corpora vera com-
 prehensione, non comprehendet spatia interiacentia extremita-
 tes vera comprehensione. Non comprehendet ergo remotiones
 que sunt interiacentes ipsum et visibilia que sunt apud extre-
 105 mitates istorum corporum vera comprehensione. Quantitates
 ergo remotionum visibilium quorum remotio est extra mediocri-
 tatem, et inter ipsam et visum sunt corpora ordinata continu-
 ata, non comprehenduntur a visu vera comprehensione.

[3.79] Remotiones autem visibilium quorum remotio non
 110 respicit corpora ordinata continuata non comprehenduntur
 quidem a visu vera comprehensione, quare visus, quando

83 *post interiacentia add. inter R* 84 *spatia om. P3* 86 *post comprehensione add. et R* 87 *est respiciens: respicit R/respiciens corr. ex repiciens L3* 88 *visus . . . remotionum (89): mensuras remotionum visus comprehendit R/comprehendit: comprehendet P1* 89 *eorum om. R; corr. ex erum S/et¹ om. C1EErL3P3/certa² om. P3* 91 *vero: ergo P1* 93 *ordinata corr. ex coordinatur C1; inter. a. m. E/et om. P1S/et . . . comprehensa: si comprehenduntur R* 94 *comprehenduntur: comprehenduntur C1EErP3R/a visu om. R/post comprehensione add. et R* 95 *mediocritatem: medietatem L3* 96 *cum corr. ex quamvis a. m. S* 97 *fuerint: fiunt L3* 98 *comprehenduntur: comprehenduntur C1ErP1P3/ista om. P3* 99 *extraneitatem: extremitatem P3/remotionum corr. ex remotionis P1/suarum om. P1; inter. a. m. S* 100 *visus om. P3* 101 *comprehendet: comprehendat R* 102 *non . . . comprehensione (103) mg. a. m. S/post interiacentia add. inter R* 103 *comprehensione corr. ex comprehensioi P3* 104 *post interiacentes add. inter R* 107 *ipsam: ipsa C1Er; quam R* 109 *ante remotiones add. similiter R/autem om. R* 110 *respicit corr. ex recipit Er* 111 *quidem om. C1ErR/vera corr. ex illa L3/vera comprehensione om. Er; inter. a. m. C1/post vera add. vel illa EP3/quando: non P3*

comprehenderit nubes in plano et in locis carentibus montibus,
 existimabit quod sint magne remotiois in respectu corporum
 celestium. Et cum nubes fuerint inter montes et fuerint con-
 115 tinuate, forte cooperientur cacumina montium a nubibus, et
 cum nubes fuerint distantes, forte apparebunt cacumina mon-
 tium superiora nubibus, et forte comprehendet visus partes
 nubium applicatas cum ventre montium, et forte erit hoc in
 montibus non valde altis. Ex ista ergo experimentatione vide-
 120 tur quod remotio nubium non est extranea, et quod plures illa-
 rum sunt propinquiores terre cacuminibus montium, et quod
 illud quod existimatur de extraneitate remotiois illarum est
 error. Et declarabitur inde quod visus non comprehendit men-
 suram remotiois nubium in plano, et quod mensura remotio-
 125 nis nubium comprehendetur a visu quando fuerint inter mon-
 tes, et apparuerint cacumina montium superius.

[3.80] Et hoc invenitur etiam in pluribus visibilibus que
 sunt super faciem terre, scilicet quod mesure remotiois non
 respicientes corpora ordinata continuata non comprehendun-
 130 tur a visu. Ex illis ergo ex quibus manifestatur hoc, scilicet
 quod visus non comprehendit quantitatem remotiois rei vise
 nisi quando remotio eius fuerit respiciens corpora ordinata
 continuata, et comprehenderit visus illa corpora, et certifica-
 verit mensuras eorum, est ut paret experimentator domum in
 135 qua non intret ante horam experimentationis. Et sit in quibus-
 dam parietibus illius domus strictum foramen, et sit post illud
 foramen vacuitas quam ante illam horam non vidit. Et sint in
 illa vacuitate duo parietes quorum unus sit propinquior fora-

112 comprehenderit: comprehendit L3 113 remotiois: remotiones P3 115 co-
 operientur: cooperiantur S 116 fuerint distantes: distiterint R/post distantes add.
 una ab altera EP3R/post apparebunt scr. et del. mo Er 118 nubium: montium P1;
 corr. ex montium a. m. S/applicatas corr. ex applicantes a. m. C1/ventre: vertice EL3P3R;
 alter. in vertice a. m. C1S/montium: nubium ErP1; corr. ex nubium a. m. C1S
 119 montibus: nubibus P1; corr. ex nubibus a. m. S/videtur (120): apparet R
 122 extraneitate: extremitate P1S; corr. ex extremitate L3/est error (123) transp. EL3P3R
 124 mensura om. P3/mensura remotiois (125) transp. P1 126 apparuerint:
 apparuerunt L3P3/superius: superiora R 127 et om. P1/pluribus: puribus L3/
 visibilibus: visibus P1 128 mesure corr. ex mensura P1 129 respicientes:
 aspicientes L3/comprehenduntur (130): comprehenduntur C1EErP3R 130 ex¹:
 et P1S 131 comprehendit: comprehendat R/quantitatem: quiditatem P1S
 132 fuerit respiciens: respexerit R/respiciens om. L3 133 comprehenderit:
 comprehendit L3/post corpora add. interposita EP3R/post et² add. comprehenderit vel
 EP3 (comprehenderit alter. ex comprehenderi P3) 134 est: esto Er; corr. ex esto C1/
 ut . . . experimentator: experimentatio sequens sit R/paret: apparet P3; corr. ex apparet
 L3; alter. in apparet a. m. E/domum: domus P3R (alter. ex domu P3) 135 qua: quam
 C1ErR/post qua add. experimentator R/intret: intraverit R; corr. ex erat a. m. S/sit corr.
 ex sint P3/quibusdam parietibus (136): quodam pariete R 138 post illa scr. et del.
 experimentatione P1/sit om. C1Er

mini alio, et sit inter illos duos parietes distantia alicuius
 140 quantitatis. Et sit paries propinquior cooperiens quandam
 partem parietis remotioris, et sit quedam pars parietis remo-
 tioris apparens. Et sit foramen elevatum a terra ita quod,
 quando aspiciens aspexerit per ipsum, non videat faciem terre
 que est post parietem in quo foramen est. Experimentator
 145 quidem, quando intraverit istum locum et inspexerit istud
 foramen, videbit duos parietes in simul, et non comprehendet
 remotionem que est inter ipsos. Si vero remotio primi parietis
 fuerit magna remotio extranea a foramine, comprehendet duos
 parietes quasi se contingentes, et forte existimabit quod sint
 150 unus continuus quando color eorum fuerit unus. Et si paries
 primus fuerit remotus a foramine mediocriter, et percipiatur
 quod sint duo parietes, existimabitur quod sunt duo propinqui
 sibi aut se contingentes, et non certificabitur remotio que est
 inter ipsos. Et cum comprehenderit primum parietem visus,
 155 quando remotio eius fuerit mediocris, quasi esset propinquus,
 et non certificabit remotionem eius etiam. Et non certificabitur
 remotio que est inter ista duo corpora huiusmodi per sensum
 visus quando ante illam horam non vidit illum locum nec illos
 duos parietes. Et forte comprehendit visus illa duo corpora
 160 quasi se contingentia, quamvis ante sciverit distantiam que est
 inter ea.

[3.81] Et cum visus non comprehendit remotionem que est
 inter duo corpora huiusmodi, non comprehendet quantitatem
 remotionis ultimi corporis, et cum hoc comprehendit formam
 165 eius. Et cum non comprehendit quantitatem remotionis istius
 corporis, quamvis comprehendat istud corpus, non compre-
 hendet corpora continuata respicientia remotionem eius, et non

139 ante alio add. altero EL3P3; add. quam alius R/illos: alios P1 140 sit paries
 transp. S/paries corr. ex parietes S 141 parietis¹ om. P1/et... pars inter. L3/post pars
 inter. remotioris L3/parietis remotioris (142) transp. P1S/remotioris (142) om. L3
 142 elevatum inter. L3/elevatum a terra: a terra elevatum L3/quod: ut R 143 terre
 om. P1 144 foramen est transp. C1Er 145 quidem: igitur R/intraverit: accesserit
 ad R/ante istud add. per EP3R 146 in om. R 147 remotio om. S/remotio...
 parietis: primi... remotio P1 149 sint: sit P3R 150 quando... unus mg. a. m.
 E/eorum om. P3/fuerit unus corr. ex unus fuerit P3 151 mediocriter: mediocris S
 152 sunt: sint C1ErL3P3R/duo² om. C1EErP3R/propinqui sibi (153) transp. Er
 156 et¹: alteri EP3R/etiam et transp. L3/non² inter. L3 157 inter ista duo corr. ex ista
 duo inter Er/ista: illa L3 158 quando: quoniam P3R; corr. ex quoniam a. m. E/illam
 om. P1S/vidit: viderit EP3; viderat R/illum: istum R 159 comprehendit:
 comprehendet R; corr. ex comprehendet Er 162 comprehendit: comprehendat R
 163 comprehendet: comprehendit EP3R 164 cum hoc: tamen R/formam om. P1
 165 post eius add. corporis R/cum inter. L3/comprehendit: comprehendat R/istius cor-
 poris (166) om. P1 166 istud: illud EL3P3R/non: nisi C1EL3P3 167 et om. C1Er;
 inter. a. m. E

comprehendet visus quantitatem remotionis rei vise certe ex
comprehensione forme rei vise. Et non comprehendit visus
170 quantitatem remotionis rei vise nisi per argumentationem.
Visus autem non arguit super aliquam mensuram nisi per com-
parationem illius mesure ad aliam mensuram iam comprehen-
sam a visu vel ad mensuram tunc comprehensam cum ea; et
nichil est per quod visus potest mensurare remotionem rei vise
175 et comparare ad ipsum ita quod comprehendat mensuram eius
vere nisi corpora ordinata respicientia remotionem rei vise. Si
autem mensuraverit visus remotionem per alia quam per ista
corpora, erit mensuratio qualiscumque, non certa. Non igitur
comprehenditur quantitas remotionis rei vise a sensu visu nisi
180 sit remotio eius respiciens corpora ordinata continuata, et com-
prehendit visus illa corpora et mensuras illorum.

[3.82] Et ista experimentatio quam diximus habet multa
similia ex visibilibus, sicut ex duabus arboribus erectis secun-
dum modum quem diximus in parietibus, aut ligno ex trans-
verso posito foramini secundum modum quem diximus de
185 pariete primo.

[3.85] Remotiones autem visibilium distantium adinvicem
comprehenduntur a visu ex comprehensione divisionis que est
inter visibilia. Dispositiones autem quantitatis remotionum
190 visibilium adinvicem sunt apud visum sicut dispositiones re-
motionum visibilium a visu. Quoniam due res vise atque dis-
tincte, si inter eas fuerint corpora continuata et ordinata, et
comprehenderit visus illa corpora et mensuras eorum, com-
prehendet quantitatem remotionis que est inter illas res duas
195 visas; si autem non, non comprehendet quantitatem distantie
que est inter illas vere. Et similiter, si inter illas duas res visas

168 comprehendet: comprehendit *P1/remotionis mg. a. m. E/ex mg. a. m. C1*
169 forme rei vise: rei vise forme *S* 171 post per *add. argumentum comparisonis*
sive per *EP3R* 173 tunc comprehensam *transp. C1Er/cum alter. in ab a. m. E*
174 potest: post *Er* 175 comparare *corr. ex parare a. m. E/ipsam: ipsam R/quod:*
ut *R* 176 remotionem: remotionum *Er* 177 per² *om. Er* 179 visu:
visus *EP3* 180 sit *om. R/respiciens: respexerit R; corr. ex respicientia P1/et om. R*
181 comprehendit: comprehendat *C1Er*; comprehenderit *P1S/ante visus add. enim R*
182 experimentatio *corr. ex experimentatione L3* 183 ex¹: in *R/visibilibus: simili-*
bus *P1* 184 quem: quam *P1S/parietibus: patientibus P3/post aut add. in R/ex om.*
R/transverso (185): transversim R 185 foramini: super foramen *R/quem: quod P3*
186 pariete: pariente *E* 187 distantium: distinctorum *P1; corr. ex distinctorum*
a. m. S 189 remotionum: remotionis *EP3R/remotionum visibilium (190)*
transp. C1Er 190 adinvicem: inter se *R* 191 post quoniam *add. quando P1S/due*
. . . eas (192): si inter duas res visas distinctas R/atque om. C1Er 192 si *om. P1S/*
continuata et ordinata: ordinata et continuata EP3R/et¹ om. R 193 eorum: illorum
C1P1 194 illas *om. R/duas om. R/duas visas (195) transp. EP3* 195 non¹ *inter.*
a. m. S/non² inter. a. m. ES/comprehendet: comprehendat E; comprehendit P1; corr. ex
comprehenderit *S* 196 si *om. S/illas²: istas EP3R*

fuerint corpora ordinata continuata, et fuerint valde extranee
remotionis ita quod visus non poterit certificare mensuras
illorum corporum, non certificabitur mensura que est inter illa
200 duo corpora.

[3.86] Remotiones ergo visibilium a visu non comprehen-
duntur nisi ex comprehensione virtutis distinctivae, quoniam
illud quod accidit in visu apud visionem non accidit nisi per
aliquid extrinsecum. Et nulla quantitas remotionis visibilium
205 comprehenditur per sensum visum vera comprehensione nisi
remotiones visibilium quorum remotio respicit corpora ordi-
nata et continuata et quorum remotio cum hoc est mediocris, et
visus cum hoc etiam comprehendit corpora ordinata respicien-
tia remotiones eorum et certificat mensuras illorum corporum,
210 ut se sequuntur. Mensura autem remotionum preter huiusmodi
non certificantur a visu. Visibilia autem quorum mensura re-
motionum earum non certificantur a visu quedam remotiones
eorum sunt respicientes corpora ordinata continuata, et visus
cum hoc comprehendit illa corpora, et sunt illa quorum ex-
215 trematum remotio est extranea. Et quedam remotiones eo-
rum sunt respicientes corpora ordinata continuata, sed visus
non comprehendit illa corpora, sive sint remotiones eorum
extranee sive mediocres. Et quedam remotiones eorum non
respiciunt corpora ordinata continuata, et sunt illa visibilia
220 que sunt valde elevata a terra que sunt extranee remotionis et
que non habent prope ipsam remotionem nec parietem respici-
entem remotionem eorum. Et omnia visibilia dividuntur in
istas partes.

[3.87] Et quando visus comprehendit visibilia quorum

197 *post ordinata add. et C1Er/continuata om. P3* 198 *quod: ut R/poterit: possit R*
199 *certificabitur mensura: certificabit mensuram C1Er/illa . . . corpora (200): illas*
duas res visas R 202 *post ex scr. et del. corpore S/comprehensione corr. ex*
comprehensionis S/virtutis: virtus S 203 *post quod scr. et del. n S/in: a L3*
204 *aliquid: aliud L3/remotionis: remotionum Er* 207 *et² om. EL3P3R/cum hoc:*
simul R/est om. Er 208 *cum hoc: una R* 210 *ut om. C1Er/se om. C1ErP1P3/*
sequuntur: consequenter C1Er; consequuntur R; alter. in sequitur deinde in consequuntur
L3; alter. ex sequitur in consequitur vel consequenter a. m. S/post sequuntur add. vel
consequuntur E; add. vel sequuntur P3 211 *autem: ergo EP3* 212 *earum:*
mensurae R 213 *eorum . . . respicientes: respiciunt R* 214 *cum scr. et del. Er/*
cum . . . corpora: comprehendit illa corpora cum hoc EP3R/post hoc inter. non a. m. Er/
post illa² add. corpora EP3R 215 *est extranea transp. L3* 216 *sunt respicientes:*
respiciunt R/visus om. P1 217 *post corpora scr. et del. et sunt illa quorum extremitatum*
re P1 218 *post sive add. sint EP3R/post remotiones scr. et del. sunt P3/post eorum*
inter. que L3; add. sunt E 219 *respiciunt: respicientes EP3/et om. EL3P3/sunt corr.*
ex super a. m. E 221 *prope corr. ex proprie C1L3/ipsam inter. L3/respicientem (222):*
respicientes P3 222 *remotionem: remotiones C1ErP3/post omnia scr. et del.*
visus P1 223 *post partes scr. et del. n C1* 224 *post comprehendit add. illa L3*

225 remotionum quantitates non certificantur a visu, distinctiva
 virtus statim cognoscit mensuras remotionis eorum secundum
 estimationem, non secundum rectitudinem. Et comparat
 remotionem earum ad remotionem sibi similium ex visibilibus
 230 comprehensis a visu ante, et sustentat se in argumentatione
 super formam rei vise, et comparat formam rei vise ad formam
 visibilium similium quas visus comprehendit ante et quorum
 quantitates remotionum iam certificantur a virtute distinctiva.
 Et sic comparat remotionem rei vise cuius quantitatem remoti-
 235 onis non certificat ad remotionem visibilium sibi similium quas
 comprehendit visus ante et quorum remotionum mesure cer-
 tificantur iam a virtute distinctiva. Cum ergo virtus distinctiva
 non certificaverit lineationes forme rei vise, comparabit quanti-
 tatem totius forme eius ad mensuras formarum visibilium
 equalium illis formis in mensura quarum quantitates remotio-
 240 num iam certificate sunt, et assimilabit remotionem rei vise
 cuius quantitas remotionis non certificatur ab eo ad remotio-
 nem visibilium equalium vise in mensura quorum remotiones
 iam sunt certificate.

[3.88] Et hoc est maximum super quod potest virtus
 245 distinctiva in comprehendendo mensuras remotionum visi-
 bilium. Forte ergo inveniet per istam argumentationem cer-
 titudinem in comprehendendo remotionem illius quod est
 huiusmodi, et forte errabit. Et in illis in quibus invenit certitu-
 dinem non certificatur utrum invenit certitudinem an non. Et
 250 ista argumentatio erit argumentatio in fine velocitatis propter
 assuetudinem virtutis distinctivae in comprehendendo remotio-
 nem visibilium per argumentationem et certificationem.

[3.89] Et forte existimabit virtus distinctiva mensuram re-
 motionis rei vise, si fuerit remotio eius respiciens corpora ordi-

225 remotionum *corr. ex remotionem L3* / distinctiva *corr. ex distincta a. m. E* / distinctiva
 virtus (226) *transp. R* 226 *post remotionis scr. et del. eciti S* 227 estimatio-
 nem *corr. ex estimationibus P1* 228 earum: eorum *EP3R* / visibilibus *corr. ex visibi-*
 lium *P1* 231 quorum: in quibus *R* 232 quantitates: quantitas *P1S* / certificantur:
 certificatur *P1S* 234 *ante non scr. et del. et L3* / remotionem: remotiones *C1Er* / quas:
 quae *R* 235 *post quorum scr. et del. in Er* / certificantur iam (236) *transp. EP3R*
 236 ergo: autem *L3* 238 mensuras *corr. ex mensuram P1* 239 *post* quarum
scr. et del. extremitatem P1 / quantitates remotionum (240) *transp. EP3* 240 *post*
 sunt *add. in virtute distinctiva EP3R* 241 certificatur: certificabitur *R* / ad *inter.*
a. m. E / remotionem (242): remotiones *C1Er* 242 equalium *om. EL3P3R* / vise
om. C1EErL3P3R 244 hoc *inter. a. m. E* / hoc est *transp. EP3R* 248 huiusmodi *corr.*
ex huius S / forte *corr. ex forma L3* / invenit: inveniet *EP3R* 250 *post* erit *scr. et del.*
er P1 251 *ante virtutis add. vel assiduitatem EP3* / ante in *scr. et del. et L3* 252 *post*
et add. per C1Er 253 mensuram: mensuras *R* 254 fuerit *om. R* / respiciens: res-
 pexerit *R*

255 nata, et fuerit ex remotionibus mediocribus, propter assuetu-
 dinem virtutis distinctivae in existimando vel arguendo remoti-
 ones visibilium et propter velocitatem cum sue estimationis
 argumentatione. Et cum remotio rei vise fuerit mediocris, non
 erit inter estimationem remotionum et inter veram remotionem
 260 magna diversitas.

[3.90] Cum ergo visus comprehenderit aliquam rem visam,
 statim virtus distinctiva comprehendet remotionem eius et
 mensuram remotionis eius secundum quod poterit comprehen-
 dere—scilicet aut per certitudinem aut estimationem—et sta-
 265 tim remotio eius habebit in anima mensuram ymaginatam.
 Mensura ergo remotionis rei vise comprehensa a visu cuius for-
 ma est ymaginata in anima, quando illa remotio fuerit respiciens
 corpora ordinata continuata, et cum hoc fuerit illa remotio
 mediocris, et cum hoc comprehenderit visus illa corpora ordi-
 270 nata respicientia eius remotionem, et cum hoc iam virtus distinc-
 tiva cognoverit ipsa et certificaverit mensuras eorum, tunc men-
 sura certificata est.

[3.91] Si autem eius remotio non fuerit respiciens corpora
 ordinata continuata, aut fuerit respiciens corpora ordinata
 275 continuata, et comprehenderit visus illa corpora, et fuerit cum
 hoc remotio extranea ita quod visus non potest certificare
 mensuras illorum corporum, aut fuerit visus respiciens corpora
 continuata ordinata, et non comprehenderit visus illa corpora
 nec certificaverit mensuras eorum, aut poterit comprehendere
 280 illa corpora, sed non aspexerit illa tunc nec mensuraverit
 quantitates eorum, sive sint remotiones illorum visibilium

255 *post ex scr. et del. m P3/propter mg. Er/assuetudinem* (256): *assiduitatem C1Er/*
assuetudine P3 256 *in: et Er* 257 *sue estimationis mg. a. m. E/estimationis corr.*
ex estimatione P3 258 *cum om. L3* 259 *remotionum: remotionis ErR/post*
remotionem scr. et del. in P1 262 *et . . . eius* (263) *inter. a. m. E* 263 *eius om. P1S/*
post quod scr. et del. id S/comprehendere (264): *comprehenderit Er* 264 *aut²: autem*
S/post aut² add. per EP3R 265 *in anima inter. a. m. E/ymaginatam: conceptam R*
 266 *est ymaginata* (267) *transp. C1Er* 267 *ymaginata: concepta R/quando corr. ex*
quoniam a. m. E/post quando scr. et del. illa remotio fuerit S/fuerit respiciens: respex-
erit R 268 *cum hoc: simul R/hoc om. P1P3S/illa remotio om. R* 269 *cum hoc*
om. R 270 *cum hoc: etiam R* 271 *ipsa: ipsam C1P3R; corr. ex ipsam E/eorum*
. . . mensura: corporum ordinatorum R/tunc om. P3/tunc . . . est (272): *est tunc . . .*
certificata C1EErP3 272 *certificata corr. ex ordinata EP3 (a. m. E)* 273 *non: tunc*
EP3/fuerit respiciens: respexerit R 274 *aut . . . continuata* (275) *inter. a. m. S/fuerit*
respiciens: respexerit R 275 *et¹ inter. a. m. E/fuerit cum hoc* (276): *cum hoc fuerit*
C1EErP3R/cum hoc (276): *simul R* 276 *quod: ut R/potest: possit R/post certificare*
add. illas L3 277 *fuerit . . . respiciens: respexerit R* 278 *continuata ordinata*
transp. L3P3R/comprehenderit: comprehendit Er; corr. ex comprehenditur P1
 279 *eorum inter. L3/poterit: possit R* 280 *non om. EP3/post illa² scr. et del. sepe P1/*
mensuraverit: mensuravit C1ErL3P3 281 *illorum: istorum L3*

extranee sive mediocres, erit tunc mensura eius que est ymaginata in anima non certificata nec verificata.

[3.92] Et remotiones que sunt inter visibilia distincta non
 285 comprehenduntur nisi ex comprehensione divisionis que est
 inter visibilia, et quedam quantitates remotionum que sunt inter
 visibilia divisa comprehenduntur vera comprehensione, et
 quedam comprehenduntur per estimationem. Mensura ergo
 remotionis que est inter duo visibilia inter que sunt corpora
 290 ordinata continuata, et visus comprehenderit illa corpora et
 certificaverit mensuras eorum, est mensura certificata. Mensura
 autem remotionis que est inter duo visibilia inter que non
 sunt corpora continuata ordinata, aut inter que sunt corpora
 continuata ordinata, sed visus non certificat mensuras illorum
 295 corporum aut non comprehendet illa corpora, est mensura non
 certificata. Secundum ergo istos modos erit comprehensio remotionum
 visibilium per sensum visus.

[3.93] Et etiam corpora respicientia remotiones visibilium
 assuetorum que sunt in remotionibus assuetis que assuete
 300 comprehenduntur a visu comprehenduntur a visu, et certificantur
 mesure eorum propter frequentationem eorum a visu ita quod visus
 propter hoc comprehendit mensuras remotionum eorum per cognitionem.
 Quoniam visus, quando comprehenderit aliquod visibile assuetum,
 et fuerit in remotione assueta, cognoscet ipsum, et cognoscet eius
 5 remotionem, et existimabit quantitatem remotionis eius. Quando ergo
 existimaverit quantitatem remotionis huiusmodi visibilium, erit
 estimatio eorum prope verum, et non erit inter estimationem eius et inter

282 mediocres: mediocris *Er/post* eius *add.* remotionis *R/que corr. ex quod L3/ymaginata* (283): concepta *R* 283 non: nec *R/post* non *add.* mensurata nec *EP3/certificata corr. ex* certificabitur *P1/nec verificata mg. L3* 285 comprehensione divisionis *transp. L3/que est om. P1S* 286 post inter *add.* illa *R/sunt inter. L3*
 287 divisa: distincta *EP3R* 289 inter² *inter. a. m. E* 290 et!: quae *R/comprehenderit: comprehendit C1R/illa . . . et: et quorum R* 291 certificaverit: certificat *C1EErP3R/eorum om. R* 293 continuata ordinata *transp. EEerP3R/post ordinata inter. est a. m. Er/aut . . . ordinata* (294) *inter. L3* 294 continuata ordinata *transp. EP3R/illorum: eorum L3P1S* 295 corporum *om. P1S/aut corr. ex autem S/comprehendet: comprehendit R/corpora om. R/mensura: mensurata P1*
 296 remotionum (297) *corr. ex remotionem S* 298 remotiones: remotionis *P1*
 299 remotionibus: remotiones *Er; corr. ex remotionis a. m. C1* 300 comprehenduntur² a visu *scr. et del. Er; om. L3P3* 1 mesure eorum *transp. L3/eorum¹ om. P1; inter. a. m. S/propter: per P1S/eorum² scr. et del. S/a visu om. R* 2 quod: ut *R/comprehendit: comprehendat R; comprehendet S* 3 visus quando *transp. S/comprehenderit (4): comprehendit EP3R* 4 aliquod: aliquid *E* 6 quando *corr. ex quoniam S/estimaverit: estimabit EP3R* 7 remotionis *om. P1/post remotionis scr. et del. eius L3/estimatio corr. ex estimandum P1* 8 verum: vera *R/inter² om. EP3R*

veritatem magna diversitas. Quantitates ergo remotionum
 10 visibilium assuetorum que sunt in remotionibus assuetis com-
 prehenduntur a visu per cognitionem et estimationem quanti-
 tatum eorum. Et plures remotiones visibilium comprehendun-
 tur secundum modum huiusmodi.

[3.94] Situs vero quem visus comprehendit ex visibilibus
 15 dividitur in tres modos quorum unus est situs totius rei vise
 apud visum aut situs cuiusdam partium rei vise apud visum.
 Et iste modus est oppositio. Secundus est situs superficierum rei
 vise opposite visui apud visum, et situs superficierum rei vise
 oppositarum visui apud visum quando res visa fuerit multa-
 20 rum superficierum, et fuerit illud quod apparet ex eis visui
 multe superficies, et situs terminorum superficierum visibilium
 apud visum, et situs linearum et spatia que sunt inter quelibet
 duo puncta aut inter quelibet duo visibilia que simul compre-
 henduntur a visu apud visum. Modus tertius est situs partium
 25 rei vise adinvicem, et situs terminorum rei vise superficierum ad-
 invicem, et situs partium terminorum rei vise superficierum ad-
 invicem. Et iste modus est ordinatio. Et similiter situs visibili-
 um diversorum adinvicem collocatur sub hoc modo. Omnes
 ergo situs qui comprehenduntur a visu dividuntur in istos tres
 30 modos.

[3.95] Et situs cuiuslibet habentis situm apud alium com-
 ponitur ex remotione illius habentis situm ab illo alio et ex situ
 illius habentis situm respectu illius alterius. Oppositio ergo rei
 vise visui componitur ex remotione rei vise a visu et ex parte in
 35 qua est res visa respectu visus. Comprehensio autem remotio-
 nis rei vise iam declaratum est quod est intentio quiescens in

9 diversitas *corr. ex* diversas *a. m.* E/quantitates: quantitas EP3R 11 et: ex EErP3R;
 per P1; *corr. ex* ex *a. m.* C1/estimationem: estimatione EErP3R/post estimationem *add.*
 estimatione L3/quantitatum (12) quantitatem Er; *corr. ex* quantitatem P1 12 eorum
inter. L3 13 modum *om.* ErL3/modum huiusmodi *transp.* EP3R 14 vero: ergo
 C1Er/post visus *scr. et del.* vere C1 16 cuiusdam *inter. a. m.* E/partium: partis R
 17 post secundus *add.* modus L3/superficiei rei *transp.* EP3 18 vise¹ *inter. L3/*
et . . . visum (19) *mg. L3* 20 ex eis *mg. a. m.* E/ex eis visui: visui ex eis EP3R/visui
corr. ex visus S 21 superficierum visibilium *transp.* EP3 22 spatia: spatio-
 rum R 24 apud visum *om.* R/est situs *transp.* L3 25 adinvicem: inter se R/et
 . . . adinvicem (26/27) *mg. a. m.* S/post situs *add.* partium L3; rei vise superficierum: superficierum
 rei vise EL3P1P3R; *corr. ex* superficierum rei vise C1/vise² (??) S/adinvicem (26): inter se R
 26 terminorum . . . superficierum: superficierum terminorum rei vise L3/rei vise superficierum:
 superficierum rei vise EP3R/adinvicem (27): inter se R 27 ante et¹ *add.* et situs partium
 superficierum terminorum rei vise adinvicem C1EErP1RS (*inter. a. m.* S/superficiei:
 superficierum E/terminorum *scr. et del.* C1/adinvicem: inter se R)/similiter: consimi-
 liter EP3R 28 adinvicem: inter se R 29 post comprehenduntur *scr. et del.* qui
 comprehenduntur E/in: inter P3 31 alium: aliud R/componitur (32): compo-
 sitio P3 34 visui: ad visum R/visu: visui Er

anima. Verus autem locus rei vise comprehenditur ex situ rei vise apud visionem, quoniam visus non comprehendit rem visam nisi ex oppositione. Et loca que comprehenduntur a
 40 sensu comprehenduntur a distinctione, et sensus et distinctio distinguit inter loca, quamvis in eis nichil sit ex visibilibus. Et distinguit distinctio inter locum obiectum visui et locum propinquum ei, et virtus distinctiva comprehendit omnia loca per ymaginationem. Cum ergo visus fuerit oppositus alicui loco et
 45 comprehendit aliquod visibile, et visus postea fuerit ablatum ab illo loco et fuerit oppositus alii loco, destruetur visio illius rei vise. Et cum revertetur iterum ad oppositionem illius loci, revertetur illius rei vise visio.

[3.96] Et cum visus comprehenderit rem visam apud oppositionem illius in loco in quo est res visa, et comprehenderit
 50 virtus distinctiva locum oppositum visui apud comprehensionem illius rei vise, et quando visus est ablatum ab oppositione illius loci destruetur visio illius rei vise, tunc ergo virtus distinctiva comprehendet quod res visa non est nisi in parte op-
 55 posita visui apud visionem illius rei vise.

[3.97] Et etiam declaratum est quod visus recipit formas proprie ex verticationibus linearum radialium et quod ipse non patitur a formis nisi ex verticationibus istarum linearum tantum. Et etiam est declaratum quod forma extenditur in
 60 corpore visus secundum rectitudinem linearum radialium. Cum ergo forma rei vise pervenerit in visum, statim sentiens sentiet formam, et sentiet partem visus in quam pervenit forma, et sentiet verticationem per quam extendetur forma in corpore membri sentientis. Cum ergo comprehenderit visus
 65 locum forme in visu et comprehenderit verticationem per quam extendebatur forma, statim virtus distinctiva comprehendet

37 *post anima add.* verus autem est locus S/verus: ubi L3P1/*post autem add.* est P1S/
 comprehenditur *corr.* ex comprehenduntur P1/*post situ add.* visus C1Er (*scr. et del.* C1)
 41 distinguit: distinguunt EL3R; distinguuntur P3/in eis *om.* Er; *mg. a. m.* C1
 42 distinctio: distinctionem P3 45 comprehendit: comprehenderit EP3R
 46 oppositus *om.* P3/alii loco *corr.* ex illi loco S/visio: viso Er 47 revertetur:
 reverteretur P3 48 *ante illius add.* iterum EP3R/illius . . . visio: visio illius rei vise
 EP3R/vise *om.* EL3P3 49 visam *om.* C1 50 illius: ipsius C1Er/comprehenderit:
 comprehendit C1EP3 52 et . . . vise (53) *mg. a. m.* E/quando: cum R/est: fuerit R
 53 destruetur: destruitur EP3R 54 comprehendet: comprehendit P1S/visa *corr.* ex
 via P3 55 *post illius scr. et del.* s S 56 etiam *om.* P1S/recipit *alter.* ex respicit in
 resipit Er 57 ipse *corr.* ex ipsa P1 59 est declaratum: declaratur C1Er;
transp. EP3R 63 per quam: postquam C1Er/extendetur: extenditur EP3R/in . . .
 forma (66) *mg. a. m.* S 64 comprehenderit: comprehenderet Er 65 comprehenderit:
 comprehendet EP3; comprehenderet L3 66 *post extendebatur add.* illa R/forma
 . . . illa (67) *mg. a. m.* E/comprehendet: comprehendit P1S

locum in quem ex quo per quem extendebatur illa verticatio.
 Locus autem per quem ex quo extenditur illa verticatio est
 locus in quo est illa res visa. Ex comprehensione ergo partis
 70 visus in qua pervenit forma rei vise, et ex comprehensione
 verticationis per quam extendebatur forma et ex qua patitur
 visus a forma comprehendit virtus distinctiva verticationem
 per quam extendebatur forma rei vise secundum veritatem. Et
 secundum hunc modum distinguuntur loca visibilium, quoniam
 75 visibilia distincta non distinguuntur a visu nisi ex distinctione
 locorum in superficie distinctorum membri sentientis ad que
 perveniunt forme visibilium distinctorum.

[3.98] Et comprehensio loci rei vise secundum hunc modum
 habet simile in auditu, quoniam sentiens comprehendit vocem
 80 per sensum auditus, et comprehendit locum a quo venit vox, et
 distinguit inter vocem venientem a dextra et vocem venientem
 a sinistra, et ab ante et retro. Immo distinguit etiam inter loca
 vorum distinctione subtiliori ista, et distinguit inter locum vo-
 cis venientis a loco sibi opposito faciliter et locum vocis veni-
 85 entis a loco obliquo a verticatione oppositionis. Et non distin-
 guuntur a sentienti loca ex quibus veniunt voces respectu audi-
 tus nisi per verticationes super quas veniunt voces ad audi-
 tum. Sensus ergo auditus comprehendit voces, et comprehen-
 dit verticationes ex quibus veniunt voces, et ex comprehensio-
 90 ne verticationum super quas veniunt voces ad auditum et su-
 per quarum rectitudinem percutit vox auditum comprehendit
 virtus distinctiva locum a quo venit vox. Sicut ergo loca vo-
 cum comprehenduntur a sensu auditus, deinde a virtute dis-
 tinctiva mediante auditu, ita loca visibilium comprehenduntur
 95 a virtute distinctiva per sensum visus.

[3.99] Et ex illis ex quibus declaratur quod sentiens com-
 prehendit verticationem secundum quam patitur visus a forma
 rei vise est illud quod comprehenditur in speculis secundum
 reflexionem, quoniam res visa quam quidem comprehendit

67 *post quo add. et R* 68 *locus corr. ex locum C1/per quem scr. et del. C1/post quem*
add. et R/ex quo inter. a. m. E/extenditur: extendetur EP3R 70 *visus corr. ex visis S/*
qua: quam R/ex om. P3 73 *secundum veritatem inter. L3/veritatem: verticatem S;*
corr. ex verticationem 1 76 *in . . . distinctorum: distinctorum in superficie EP3R*
 80 *venit: per-venit P1S* 82 *ab om. R/post et² add. a C1Er/retro: recto P1* 84 *faci-*
liter: facialiter ER; corr. ex facialiter P3 85 *oppositionis: oppositis Er/distinguuntur*
(86): distinguit P3 86 *ante a inter. scilicet EP3 (a. m. E)/a sentienti inter. EP3 (a. m. E);*
om. R/sentienti: sentiente EP3/ex: a EP3R/veniunt: venient L3 88 *post ergo scr. et*
del. ad P3 89 *et om. L3* 90 *verticationum corr. ex verticatio P3* 91 *percutit*
corr. ex percellit P3; corr. ex percidit a. m. E 92 *post distinctiva scr. et del. i S*
 94 *comprehenduntur . . . distinctiva (95) mg. a. m. S* 96 *declaratur corr. ex delectatur*
a. m. E/quod: quoniam EL3P3 97 *quam: quod EP3R* 99 *quidem om. C1EErP3R*

- 100 visus secundum reflexionem non comprehenditur a visu nisi in
 oppositione et cum est opposita illi. Sed forma eius pervenit
 ad visum secundum linearum rectarum verticationes que sunt
 lineae radiales extense a visu in partem oppositionis. Cum ergo
 visus senserit formam ex verticationibus linearum radialium,
 105 existimabit rem visam esse apud extremitates illarum linearum,
 quoniam nichil comprehendet ex visibilibus assuetis que sem-
 per comprehendit nisi apud extremitates linearum ymagi-
 natarum inter visum et rem visam, que sunt lineae radiales. Ex
 comprehensione ergo rei vise a visu secundum conversionem in
 110 visus oppositionem et secundum rectitudinem verticationum
 super quas forme reflexe perveniunt ad visum, videbitur quod
 sentiens sentit verticationem per quam venit forma et ex qua
 patitur visus a forma. Et cum sentiens sentit verticationem ex
 qua patitur a forma, comprehendit virtus distinctiva locum in
 115 quo extenditur illa verticatio, et comprehendet locum rei vise.
 Locus ergo rei vise comprehenditur a sentiente comprehensione
 larga ex comprehensione situs apud visionem, et comprehen-
 detur a virtute distinctiva larga comprehensione ex compre-
 hensione situs rei vise apud visionem, et comprehenditur vera
 120 comprehensione certificata ex comprehensione verticationis ex
 qua patitur visus a forma rei vise. Remotio autem rei vise est
 intentio que iam quievit in anima. Igitur apud perventum rei
 vise ad visum comprehendit virtus distinctiva locum rei vise
 cum quiete intentionis remotionis apud ipsam. Et adiunctio
 125 remotionis et loci est oppositio. Cum ergo virtus distinctiva
 comprehenderit locum rei vise et suam remotionem in simul,
 comprehendet eius oppositionem. Comprehensio ergo opposi-
 tionis est ex comprehensione loci rei vise et comprehensione

102 linearum . . . verticationes: verticationes . . . rectarum C1Er/post linearum scr. et del.
 rectitudinem S 106 quoniam . . . linearum (107) mg. L3/comprehendit: comprehen-
 dit P1RS 107 nisi: a visu Er; corr. ex a visu a. m. C1; corr. ex verus P3 109 ergo:
 igitur C1/conversionem: reflexionem R/in om. EP3R 110 post visus add. ad EP3
 111 perveniunt: proveniunt EP3 112 per . . . et inter. L3/per . . . verticationem (113)
 mg. a. m. S 113 visus inter. a. m. L3/a om. L3/et . . . forma (114) inter. L3/sentit:
 senserit L3/ante ex add. visus EP3R; add. per quam venit forma et P1 114 post
 patitur add. visus EP1P3R; mg. visus a a. m. C1/a om. ErL3S/post forma add. et P1/
 comprehendit: comprehendet C1Er/in: ex P3; alter. in ex a. m. C1 116 comprehenditur:
 comprehendetur R/sentiente corr. ex senti P3 117 post larga add. et C1EErP3R/ex
 om. Er; inter. a. m. C1 118 larga comprehensione transp. R 119 comprehenditur:
 comprehendetur EL3P1P3RS 120 ante certificata inter. et a. m. C1 121 post vise²
 scr. et del. ad visum S 122 perventum: punctum EErL3P3; corr. ex punctum C1
 125 virtus corr. ex visus P3 126 comprehenderit: comprehendit Er/et corr. ex ad S/
 in om. R/post simul add. etiam L3 127 oppositionem: oppositum EP3/ergo: autem
 C1 (inter. a. m.); mg. a. m. Er 128 post vise scr. et del. et comprehensione rei vise Er/
 et . . . visi (129) om. Er/post et add. ex EP3R/comprehensione²: comprehensio L3

remotionis rei vise in simul, et comprehensio loci erit secundum modum quem diximus. Cum ergo forma rei vise pervenerit in visum, sentiet sentiens locum membri sentientis in quem pervenit forma, et comprehendit virtus distinctiva locum rei vise ex verticatione per quam extenditur forma. Et intentio remotionis iam quiescit apud ipsam. Ipsa ergo comprehendit locum et remotionem in simul apud comprehensionem forme a sentiente. Igitur apud comprehensionem forme a sentiente comprehendet virtus distinctiva oppositionem. Secundum ergo hunc modum dictum erit comprehensio oppositionis.

[3.100] Et iam declaratum est quomodo visus comprehendit formam rei vise solo sensu. Apud ergo proventum forme rei vise in visu comprehendet sentiens colorem rei vise, et lucem eius, et locum visus qui colorabatur et illuminabatur ab illa forma. Et comprehendet virtus distinctiva locum eius, et remotionem apud comprehensionem lucis et coloris eius a sentiente. Et sic comprehenduntur lux et color, locus et remotio simul, scilicet in minimo tempore. Sed locus et remotio sunt oppositio, et lux et color sunt forma rei vise, et ex comprehensione forme cum comprehensione oppositionis sustentatur comprehensio rei vise in oppositione visus. Ergo comprehensio rei vise in oppositione visus non est nisi quia forma et oppositio comprehenduntur simul. Deinde propter frequentationem istius intentionis et multitudinem iterationis eius est facta forma signum sensui et virtuti distinctivae. Apud ergo forme proventum in visu comprehenditur a sentiente, et comprehendit virtus distinctiva oppositionem, et efficitur ex hoc ab ipso sentiente quidem comprehensio rei vise in suo loco. Secundum ergo hunc modum erit comprehensio rei vise in suo loco, et

129 remotionis *om.* C1Er/post et *scr. et del.* ex E/comprehensio *corr. ex* comprehensione L3 132 post forma *scr. et del.* et P1/comprehendit: comprehendet C1Er
 133 quam: quem P3/extenditur: extendetur S 134 iam *corr. ex in a. m.* E/ergo *corr. ex* autem S/comprehendit: comprehendet EP3R 135 et: est Er/in *om.* C1ErR
 136 sentienti¹²: sentiente R 138 dictum *om.* C1Er 139 est *om.* L3/comprehendit (140): comprehendet Er; comprehendat R 140 ergo proventum: perventum ergo R
 141 visu: visum R 142 post eius *add.* et locum eius P3 143 comprehendet: comprehendit C1Er 144 eius *om.* Er; *corr. ex* est a. m. C1 145 post color *add.* et C1Er/post remotio *add.* in EL3P3 146 scilicet *om.* EP3R/sed *corr. ex si a. m.* S
 147 oppositio: opposita EP3R 148 cum: et EP3R/post comprehensione *scr. et del.* forme cum comprehensione P1 150 post visus *scr. et del.* ergo comprehensio rei vise S 151 ante simul *add.* in EP3 152 istius *corr. ex* ipsius C1/iterationis: interdictionis Er; *corr. ex* interdictionis a. m. C1 153 ergo . . . proventum (154): perventum . . . forme R/forme *om.* EP3/forme proventum (154) *transp.* C1Er
 154 visu: visum R 155 ab . . . quidem (156) *om.* C1Er 156 quidem *om.* R/suo loco *transp.* P3/post loco *add.* et similiter de qualibet partium rei vise EP3R (partium: parte R) 157 suo loco *transp.* EP3

similiter de qualibet partium rei vise.

[3.101] Cum ergo remotio rei vise fuerit ex remotionibus
 160 mediocribus certificate quantitatis, erit locus rei vise in quo
 comprehenditur a visu locus verus. Et si remotio rei vise non
 fuerit ex remotionibus certificate mesure, erit comprehensio
 rei vise in oppositione certificata secundum oppositiones, quo-
 niam oppositio componitur ex ubi et remotione in eo quod
 165 remotio. Sed locus rei vise in quo comprehenditur a visu est
 estimatus, non certificatus, quoniam locus certificatus non
 comprehenditur nisi ex certificatione quantitatis remotionis.

[3.102] Situs vero superficierum visibilium apud visum
 dividuntur in duo: scilicet in directam oppositionem et obli-
 170 quationem. Superficies autem directa opposita visui est illa
 que, quando comprehenditur a visu apud rectam oppositio-
 nem, occurret axis radialis alicui puncto ex ea, et cum hoc erit
 axis elevata super superficiem elevatione equali. Et superficies
 obliquata est illa que, quando comprehenditur a visu apud
 175 obliquationem et occurrerit axis radialis alicui puncto ex ea,
 erit obliquata super superficiem non elevata super ipsam ele-
 vatione equali secundum omnes diversitates modorum obli-
 quationis.

[3.103] Termini vero superficierum visibilium, et linee que
 180 sunt in rebus, et spatia que sunt inter visibilia et inter partes
 visibilium dividuntur in duo quorum alterum est linee et spa-
 tia secantia lineas radiales et alterum est linee et spatia equidis-
 tantia lineis radialibus respicientia ipsas. Et linee et spatia
 secantia lineas radiales dividuntur secundum situm in duo, in
 185 obliquationem et directionem secundum divisionem situum et
 superficierum in ista duo. Linea autem directa est illa ad cuius

158 partium: parte R 161 verus: eius P1S 164 post oppositio scr. et del. oppo
 P3; scr. et del. n S/ubi: ubitate R/post quod add. est C1ErR 165 post locus scr. et del.
 remotio S 166 locus certificatus transp. P1/post locus add. non P3 168 post
 visibilium add. etiam EP3 169 dividuntur: dividitur EP3R 170 superficies:
 superficierum EP3 171 que: cuius axis radialis R; post quando add. superficies R/
 a visu om. P1/oppositionem (172) corr. ex visionem P1 172 occurret: occurrat C1;
 occurrit EL3P3R /axis radialis om. R/alicui: objecto P1S/cum...elevata (173): est simul
 elevatus R 173 elevata: elevationis EP3/super inter. S/post superficies scr. et del.
 eq P1 174 que: cuius axis radialis R/post quando add. ipsa R/comprehenditur corr.
 ex comprehenduntur P1 175 obliquationem corr. ex obliquationis P1/et om. R/
 occurrerit: occurrit P3/axis radialis om. R 176 erit: et est R/obliquata om. P1;
 obliquatus P3R; corr. ex obliquatus a. m. E/super¹ inter. L3/elevata: elevatus P1P3R;
 corr. ex elevatus a. m. E; corr. ex elevatam L3/super ipsam om. P3; mg. a. m. E 180 post
 rebus add. visibilibus C1Er 181 visibilium corr. ex divisibilium E/post visibilium scr.
 et del. et linee que sunt in rebus et secundum P1/est: sunt R/post spatia scr. et del.
 equidistantia L3 182 est: sunt R 184 secantia mg. P3; alter. in secantes a. m. E/
 secundum situm om. P1; inter. a. m. S 185 et² om. ErS

aliquod punctum perveniet axis radialis, et erit perpendicularis super ipsam, et linea obliquata est illa que, quando axis radialis venerit ad aliquod punctum eius, erit obliquatus super ipsum, non perpendicularis.

[3.104] Visus autem comprehendit obliuationem superficierum et linearum, et directionem earum, ex comprehensione diversitatis remotionum extremitatum superficierum et linearum et equalitatis earum. Quoniam quando visus comprehenderit superficiem rei vise, et comprehenderit remotiones extremitatum eius, et senserit equalitatem remotionum terminorum superficiei ab eo, aut equalitatem remotionum duorum locorum oppositorum equalis remotionis a loco superficiei ad quam intuetur quis, comprehendet superficiem esse directe oppositam, et iudicabit virtus distinctiva quod sit directa. Et cum visus comprehenderit superficiem rei vise, et comprehenderit remotionum extremitatum eius diversitatem, et non invenerit in superficie duo loca equalis remotionis a loco superficiei ad quam intuetur quorum remotio ab eo fuerit equalis, comprehendet superficiem obliquatam in respectu eius, et iudicabit virtus distinctiva quod sit obliquata.

[3.105] Et similiter de sitibus linearum et spatiorum directorum et obliquatorum; scilicet quod visus comprehendit directionem lineae et spatii quando senserit quod due remotiones duarum extremitatum lineae aut spatii ab eo sunt equales, aut quod due remotiones duorum punctorum lineae aut spatii quorum remotio a puncto ad quem intuetur quis (puncto scilicet lineae aut spatii) est equalis ab eo sunt equales. Et comprehen-

187 perveniet: pervenit *Er* 188 quando . . . radialis (189): axis . . . quando *R/post* quando *scr. et del. q P1*; *add. cuius R/post axis scr. et del. radi S* 189 venerit: pervenerit *C1ErR* 190 ipsum: ipsam *EP3R*; *alter. in ipsam L3* 191 *post* comprehendit *add. directionem et R* 192 *directionem: distractionem E; distinctionem P3R/post earum add. et S* 193 *remotionum: remotionem Er/extremitatum corr. ex extremitatem C1* 194 *equalitatis: equalium P1* 195 *superficiem . . . comprehenderit om. L3* 196 *post remotionum scr. et del. duorum locorum oppositorum P3/terminorum (197) om. ErL3S; inter. a. m. C1* 197 *superficiei . . . remotionum om. L3S/equalitatem corr. ex essentialitatem a. m. E; remotionum om. R* 199 *quam: quem P3* 200 *oppositam corr. ex oppositum a. m. C1/directa: recta C1EErL3P3* 201 *rei vise om. P1S; inter. a. m. E* 202 *remotionum: remotionem EErP3R/post eius add. et EP3R* 204 *eo: ea C1EErL3P3/equalis corr. ex inequalis C1Er* 205 *post superficiem add. esse C1Er/eius: sui R* 207 *post sitibus scr. et del. earum P1/spatiorum corr. ex spatium L3* 208 *obliquatorum: obliquorum P3R/comprehendit: comprehendet EL3P3; comprehendat R* 210 *ab . . . equales: sunt equales ab eo EP3R/aut² . . . equales (213) om. S* 212 *quem: quod R/intuetur: intuitur EP3/puncto . . . quis (217) mg. a. m. E* 213 *spatii corr. ex spatio Er/est . . . eo om. C1Er; inter. L3/ab eo om. EP1P3R/sunt equales om. R/post equales add. remotiones ille EP3; add. scilicet ille remotiones P1/comprehendit (214): comprehenderit P3*

dit obliuationem lineae aut spatii quando senserit quod due
 215 remotiones duarum extremitatum lineae aut spatii ab eo, aut
 quod due remotiones duorum punctorum equalis remotionis a
 puncto ad quem intuetur quis lineae aut spatii sunt diverse. Et
 ista equalitas et diversitas multotiens comprehenduntur a sen-
 220 tente per estimationem et per signa. Secundum ergo hunc mo-
 dum erit obliuationis comprehensio et directionis a visu.

[3.106] Et cum superficies tota aut linea tota fuerit directa
 visui, non erit quelibet pars eius per se directe opposita visui.
 Immo nulla pars eius est directe opposita visui per se nisi pars
 supra quam est axis apud directam oppositionem. Cum ergo
 225 movetur axis radialis super superficiem directam aut super
 lineam directam, quelibet pars per quam transit axis erit axis
 obliquatus super ipsam preter primam partem in qua est
 punctus super quem fuit axis perpendicularis. Et sic erit que-
 libet pars superficiei directe opposita et lineae directe opposita
 230 quando fuerit sumpta per se obliquata preter partem predic-
 tam. Et quando accipietur tota superficies aut tota linea, erit
 tota directa. Et cum punctus apud quem erit axis perpendicu-
 laris super superficiem aut lineam fuerit in medio superficiei
 aut lineae, erit superficies aut linea in fine directe oppositionis
 235 visui. Si autem punctus non fuerit in medio, erit superficies
 aut linea directa, sed non in fine directionis; et quanto magis
 punctus ad quem axis fuerit perpendicularis super superficiem
 aut lineam fuerit medio superficiei propinquior aut lineae, tanto
 magis erit superficies aut linea maioris directe oppositionis.

240 [3.107] Situs autem linearum et spatiorum equidistantium

214 ante obliuationem *add.* visus *R*/aut: et *Er*/post spatii *scr. et del.* et comprehendit
 obliuationem lineae aut *S*/post senserit *scr. et del.* remotiones *P3*/senserit quod *rep. P1*
 215 post duarum *scr. et del.* re *P3*/post eo *add.* sunt inaequales *R* 216 post punctorum
add. et *EP3R*/a puncto (217) *om.* *P3* 217 quem: quam *P3*; quod *R*/intuetur: intu-
 itur *P3* 218 et: aut *EP3*/et diversitas *om.* *L3*/comprehenduntur *alter. ex*
 comprehendunt in comprehenditur *L3* 219 per² *om.* *EL3P3R*/post secundum *add.*
 conclusio *E*/ergo *om.* *P3* 220 obliuationis comprehensio *transp. C1Er* 221 cum
inter. a. m. *Er*/post tota² *add.* linea *S* 222 quelibet pars *transp. L3*/visui² ... opposita
 (223) *om.* *L3* 223 nulla: nullo *Er*/est: fuerit *R* 224 supra: super *Er* 225 aut
 ... directam (226) *mg. a. m.* *L3* 226 quelibet ... ipsam (227): erit obliquatus super
 quamlibet ipsius partem supra quam transit *R*/pars *inter. L3*/per: super *EP3*
 228 quem: quod *ErR*; *corr. ex* quod *C1*/fuit axis: fuerit *R* 230 predictam (231)
om. *P3* 231 tota¹ ... linea: tota linea aut superficies *R* 232 tota *om.* *R*/tota directa
transp. EP3/punctus: punctum *R*/quem: quod *R* 235 visui: ad visum *R*/punctus:
 punctum *R*/non fuerit *transp. L3* 236 magis *om.* *R*/post magis *add.* fuerit *EP3R*
 237 punctus ad quem: punctum apud quod *R* 238 fuerit: fuit *L3*; *om.* *R*/post fuerit
add. in *EL3P1P3* (*scr. et del. L3*)/propinquior aut lineae: aut lineae propinquius *R*
 239 magis *om.* *R*/erit: erunt *C1ErL3S*/erit superficies *transp. P1*/maioris directe:
 directioris *R*

radialibus lineis comprehenduntur a visu ex comprehensione
oppositionis. Quoniam quando visus comprehenderit extremi-
tates linearum aut spatiorum que sequuntur et vicinantur visi-
bilia opposita illi et extremitates eorum propinquas que sequ-
untur eundem visum, comprehendet situs eorum, et compre-
hendet extensionem eorum in verticatione oppositionis.

[3.108] Secundum ergo istos modos erit comprehensio situ-
um superficierum linearum et spatiorum a visu respectu illius.

[3.109] Quedam autem superficies, et lineae, et spatia se-
cantia lineas radiales sunt valde magne obliquationis super
radiales lineas, et quaedam sunt modice, et quaedam sunt per-
pendiculares super lineas radiales, et sunt superficies et lineae
et spatia directe opposita visui. Extremitas autem remotior
cuiuslibet superficierum et linearum et spatiorum maxime obli-
quationis super lineas radiales sequitur partem remotam a
visu, scilicet partem sequentem extremitates linearum radiali-
um. Et extremitas propinquior sequitur partem propinquam
visui, scilicet partem sequentem visum. Et quando visus com-
prehenderit aliquam lineam vel aliquod spatium, statim com-
prehendet duo ubi sequentia extremitates illius lineae aut illius
spatii. Et similiter, quando visus comprehenderit aliquam
superficiem, comprehendet ubitates sequentes extremitates
illius superficiei ex comprehensione extensionis illius super-
ficiei in longitudine et latitudine. Cum ergo visus comprehen-
derit superficiem obliquam super lineas radiales, et fuerit illa
superficies maxime declinationis, comprehendet ubitatem
visus sequentem extremitatem remotiorem apud comprehen-
sionem superficiei, et comprehendet ipsam esse sequentem
extremitates linearum radialium, et comprehendet ubitatem
sequentem extremitatem propinquiorem, et comprehendet

241 radialibus lineis *transp.* EP3R 243 aut: et C1Er/et: etiam P3; *inter.* C1ErL3 (a. m. C1Er)/et vicinantur *om.* R 244 *post* opposita *add.* visui R/illi *inter.* a. m. E/*post* illi *add.* visui E/*post* eorum *scr. et del.* que P3 245 comprehendet¹ *corr.* ex comprehen-
deret S 248 *post* superficierum *add.* et C1Er 250 valde magne *transp.* L3/valde
... obliquationis: obliquationis ... magne R/*post* valde *scr. et del.* n C1 251 et¹ ...
radiales (252) *mg.* a. m. S 252 lineas radiales *transp.* L3 253 extremitas *corr.* ex
extremitates P3 254 superficierum: superficiei R/linearum: lineae R/spatiorum:
spatii R/maxime ... radiales (255) *om.* R 257 extremitas *corr.* ex extremitates P1
258 comprehenderit (259): comprehendit EP3 260 duo ... sequentia: duas ubitates
sequentes R/illius lineae *transp.* EP3 261 *post* similiter *scr. et del.* ? S/comprehenderit:
comprehendet EP3/aliquam: aliquem P1S 262 ubitates *corr.* ex veritates L3
266 ubitatem *corr.* ex veritatem L3/ubitatem visus (267) *transp.* ER 267 visus *om.*
P3/*post* sequentem *add.* ubitatem P3 269 extremitates *corr.* ex extremitatem L3/
ubitatem *corr.* ex veritatem ErL3 270 propinquiorem: remotiorem Er; *corr.* ex
remotiorem a. m. C1

ipsam esse sequentem illud quod est prope visum; et similiter de linea et spatio maxime obliquationis. Et cum visus perceperit quod una duarum extremitatum superficiei, aut lineae, aut spatii sequitur ubitatem remotam a visu, et quod altera
 275 extremitas sequitur ubitatem propinquam visui, statim percipiet remotionem unius duarum extremitatum illius superficiei, aut lineae, aut spatii, et appropinquationem alterius. Et cum perceperit remotionem unius duarum extremitatum, aut lineae, aut spatii, aut superficiei, et appropinquationem alterius,
 280 us, statim percipiet obliquationem situs illius superficiei, aut lineae aut spatii. Obliquatio ergo superficierum, et linearum, et spatiorum obliquatorum super lineas radiales extranee obliquationis comprehenditur a visu ex comprehensione duarum ubitatum extremitatum eorum.

285 [3.110] Declinatio autem et directa oppositio linearum, et superficierum, et spatiorum modice obliquationis et directorum visui non comprehenduntur a visu vera comprehensione certificata nisi remotio eorum sit mediocris et respiciens corpora ordinata comprehensa a visu. Et comprehenderit ex mensuris
 290 eorum corporum mensuras remotionum extremitatum illarum superficierum, et linearum, et spatiorum, et comprehenderit equalitatem duarum remotionum duarum extremitatum superficiei, aut lineae, aut spatii aut inequalitatem earum. Quoniam nulla ubitatum sequentium extremitates superficierum, et linearum, et spatiorum directe oppositorum aut declinantium
 295 modica declinatione est sequens visum; sed extremitates eorum opposite sequuntur ubitates dextras et sinistras, aut superiores, aut inferiores. Si ergo visus non comprehenderit mensuras remotionum illius quod est huiusmodi a visu, non

271 illud: aliud Er 272 perceperit (273): percepit P1 274 sequitur: sequentur EP3; sequetur L3; sequantur R/ubitatem corr. ex veritatem L3/altera extremitas (275) transp. L3 275 sequitur: sequatur R/ubitatem corr. ex veritatem L3/percipiet (276): perciperet C1S/percipiet remotionem (276) transp. S 276 post remotionem scr. et del. d C1/extremitatum corr. ex extremitatem L3/illius superficiei (277) om. R 277 post spatii add. aut superficiei R/et¹ inter. a. m. S/appropinquationem: propinquiorem P3; corr. ex propinquationem a. m. S/alterius om. P3 278 perceperit: percepit L3; corr. ex comperit EP3 (a. m. E)/unius om. C1Er; inter. L3 279 appropinquationem: propinquationem L3 280 ante statim add. et C1S; mg. et² (277) . . . alterius (279/280) S 283 ex om. L3 284 ubitatum corr. ex veritatem L3 286 et² . . . comprehensione (287) mg. a. m. S/directorum visui (287): directionis R 287 post comprehensione scr. et del. et S 288 eorum: earum C1/respiciens: respiciat R 289 post et add. nisi S 291 post et² scr. et del. remo L3; scr. et del. superfic P3 292 equalitatem: equalitatum Er; corr. ex equalitatum a. m. C1 295 oppositorum: oppositarum EP3 296 est sequens: sequitur R 297 et: aut EL3P3R 299 illius . . . est: eorum quae sunt R/post est scr. et del. est S

- 300 comprehendet diversitatem et inequalitatem remotionum
extremitatum eorum oppositorum aut equalitatem eorum. Et
cum hoc non comprehenderit, non comprehendet obliquatio-
nem eorum nec directionem. Cum ergo superficies, et lineae, et
spatia fuerint maxime remotionis, et fuerit obliquatio eorum
5 modica, non poterit visus comprehendere eorum obliquatio-
nem, nec poterit distinguere inter obliquum et rectum, quoniam
quantitates remotionum superficierum, et linearum, et spati-
orum quorum remotio est maxima non certificantur a visu, sed
existimantur. Et quando remotio eorum fuerit magna, et fuerit
10 cum hoc obliquationis modice, erit differentia que est inter
remotiones extremitatum eorum oppositorum valde modica,
fere carens quantitate respectu quantitatum remotionum eo-
rum. Et cum visus non certificaverit quantitates remotionum
extremitatum eorum, non comprehendet diversitatem que est
15 inter remotionem extremitatum eorum. Et cum non compre-
henderit diversitatem que est inter remotiones extremitatum
superficiei, et lineae, et spatii, existimabit remotiones illas esse
equales, et non comprehendet obliquationem illius superficiei,
aut lineae, aut spatii. Et cum non comprehenderit obliquatio-
20 nem illius superficiei, aut lineae, aut spatii, existimabit ipsum
esse directum. Et obliquatio superficierum, et linearum, et
spatiorum quorum remotio est maxima non comprehendetur a
visu quando fuerit modica. Visus ergo comprehendit omnes
superficies, et lineas, et spatia que sunt maxime remotionis et
25 minime obliquationis quasi directe oppositas, et non certificat

300 comprehendet *corr. ex* comprehendit P3/diversitatem *om. R/et om. C1EErP3R/*
inequalitatem: inequalitatum C1EErP3; *corr. ex* equalitatem S 1 extremitatum *om.*
EP3/oppositorum *om. R/equalitatem: inequalitatem P1/eorum om. R* 2 cum hoc:
si haec R/post hoc *scr. et del. non* comprehendere P3 3 et² *om. S* 4 fuerint: sunt L3/
post fuerint *scr. et del. m S/fuerit corr. ex* fuerint P3 5 eorum obliquationem (6)
transp. C1ErR 6 quoniam: quam Er/quoniam quantitates (7) *corr. ex* quam qualitates
a. m. C1 7 remotionum *om. L3S* 8 maxima: magna ER 9 quando: cum
EP3R/eorum fuerit *transp. S/fuerit¹: fuit P1/magna: maxima C1Er/fuerit cum hoc (10):*
fuerint ipsa R 10 obliquationis: obligationis L3/obliquationis modice *transp. R/*
que est: quoque S; *corr. ex* quoque L3 11 remotiones extremitatum: remotas
extremitates EP3R 12 remotionum: remotionis L3/ eorum (13): earum C1Er
13 non . . . cum (19) *mg. a. m. S* 14 non . . . eorum (15) *mg. a. m. E/ante que add.*
remotionum R/que . . . remotionem (15): remotionem que est inter EP3 15 re-
motionem *om. R/remotionem extremitatum transp. C1/extremitatum: extremitates*
EP3R/eorum *om. P3/post et scr. et del. non P1* 16 remotiones: extremitates P3
17 superficiei: superficierum EP3/et¹ *om. C1EL3R* 18 comprehendet: comprehen-
dit C1ErL3 19 et . . . spatii (20) *om. P3* 20 illius *om. C1Er* 22 com-
prehendetur: comprehenditur R 23 quando . . . modica *om. R/post ergo scr. et del.*
non Er/comprehendit: comprehendet EP3/ante omnes *scr. et del. o C1* 24 sunt
inter. L3 25 obliquationis *corr. ex* obliquationes Er/ante quasi *scr. et del. et C1/*
oppositas: oppositionis P3; opposita R

situs eorum nec distinguit inter obliquum et directe oppositum, sed comprehendit obliquum et directum secundum unum modum.

[3.111] Et similiter situs superficierum et linearum et spatiorum quorum remotio est mediocris, quando non fuerit respiciens corpora ordinata, aut visus non comprehenderit corpora respicientia remotiones eorum, et non certificaverit quantitates remotionum eorum, tunc situs, scilicet, non certificatur a visu. Nec distinguit visus inter obliquum eorum et directum, sed accipit situm eorum estimatione, et fortasse existimabit illud quod est huiusmodi esse directum, quamvis sit obliquum. Et cum superficies, et lineae, et spatia fuerint in remotione mediocri, et remotiones eorum fuerint respicientes corpora ordinata, et comprehenderit visus illa corpora et quantitates eorum, comprehendet quantitates remotionum extremitatum illarum superficierum, et linearum, et spatiorum. Et comprehendet equalitatem remotionum extremitatum eorum oppositorum, si fuerint extremitates ille equales, et inequalitatem eorum, si fuerint inequales. Et cum comprehenderit equalitatem remotionum extremitatum superficierum, aut lineae, aut spatii, aut inequalitatem eorum, comprehendet directionem illius superficierum, aut lineae, aut spatii, aut eorum obliuationem certificata comprehensione.

[3.112] Et similiter obliuatio linearum, aut superficierum, aut spatiorum que sunt maxime obliuationis non comprehenditur a visu nisi sint in remotione mediocri respectu magnitudinis eorum. Nam visus non comprehendit ubitates sequentes extremitates superficierum, aut lineae, aut spatii nisi quando comprehenderit qualitatem extensionis illius superficierum, aut lineae, aut spatii. Sed visus non comprehendit qualitatem extensionis superficierum, aut lineae, aut spatii nisi quando fuerit in remotione

26 eorum *om. P1* 27 directum: rectum EP3R/unum modum (28) *transp. C1Er*
 29 similiter situs *transp. C1Er* 30 fuerit: fuit L3/fuerit respiciens (31) respexerit R
 31 comprehenderit: comprehendit P3 32 respicientia *corr. ex rei E* 33 tunc situs
 scilicet *om. R/post visu scr. et del. scilicet non P1* 34 distinguit visus *transp. C1Er*
 35 estimatione *corr. ex estimative C1/estimabit: estimabitur P3; corr. ex estimabat S*
 37 et¹ *om. L3/mediocri (38) corr. ex modica L3* 38 fuerint respicientes: respexerint
 R/ordinata *corr. ex coordinata P3* 39 post corpora *add. ordinata EP3R/quantitates:*
quantitas P1S 40 illarum . . . extremitatum (42) *mg. L3/illarum superficierum (41)*
transp. EP3R 41 comprehendet: comprehendit L3 43 ille *om. P1* 44 equali-
 tatem *mg. a. m. C1* 45 superficierum: superficierum R; *corr. ex superficierum EP3 (a. m.*
E)/lineae: linearum R/spatii: spatiorum R 47 post certificata *scr. et del. obliqua P1*
 50 comprehenditur (51): comprehenduntur EP3 51 post nisi *add. ipsa R/sint:*
 fuerit C1 52 visus: virtus L3 53 quando *om. Er* 54 qualitatem: quantitatem
 R; *corr. ex quantitatem a. m. EP3* 55 sed . . . spatii (56) *mg. L3/qualitatem: quanti-*
 tatem R 56 fuerit *om. P1*

mediocri respectu quantitatis illius superficiei, aut lineae, aut spatii. Declinatio ergo superficiei, aut lineae, aut spatii secantium lineas radiales, quando fuerit maxima, comprehendetur a visu ex comprehensione ubitatum extremitatum eius. Et si fuerit modice obliquationis aut directe oppositionis, comprehendetur a visu esse obliquum aut esse directum ex comprehensione quantitatum remotionum extremitatum eorum oppositorum. Et visus non certificat qualitatem situum superficierum, et linearum, et spatiorum que sunt maxime obliquationis nisi quando certificaverit qualitatem extensionis eorum, et non certificat situm superficierum, et linearum, et spatiorum que sunt modice obliquationis aut directe oppositorum nisi quando certificaverit quantitates remotionum extremitatum eorum, et comprehenderit inequalitatem remotionum extremitatum eorum oppositorum aut equalitatem earum. Sed visus raro certificat situs visibilium. Et plura que comprehendit visus ex sitibus visibilium non comprehendit nisi per estimationem. Sustenatio ergo visus in comprehensione situum visibilium non est nisi secundum estimationem. Cum ergo aspiciens aspexerit et voluerit certificare situm alicuius superficiei, aut situm alicuius linearum que sunt in visibilibus, aut situm alicuius spatiorum que sunt in superficiebus visibilium, intuebitur formam illius rei vise et qualitatem extensionis illius superficiei, aut lineae, aut spatii. Si ergo forma illius rei vise in qua est illa superficies, aut linea, aut spatium fuerit manifesta certificata, et fuerit obliquatio illius superficiei, aut lineae, aut spatii maxima, comprehendet visus obliquationem eius vere ex comprehensione qualitatis extensionis eius et ex comprehensione duarum ubitatum extremitatum eius oppositorum. Et si forma illius rei vise fuerit manifesta, et non fuerit maxime obliquationis, et remotio eius fuerit respiciens corpora ordinata, videbit corpora respicientia remotiones extremitatum eius, et

58 declinatio: declaratio EP3/post ergo scr. et del. remotio P1/secantium (59): sequantium P3 59 post lineas add. aut P3 60 ex om. EP3R 62 post directum add. visibile R 64 oppositorum om. R 65 ante que scr. et del. maximum S 68 oppositorum (69): oppositionis R 69 quando: ante P1S 70 post extremitatum add. remotionum P1S 71 oppositorum: oppositarum C1EErP3/earum om. R 75 secundum: per EL3P3R 76 ante aspexerit scr. et del. pot P1/aspexerit et om. C1Er 77 situm: situs S/linearum: lineae R 78 situm om. S/spatiorum: spatii R/que sunt om. R 81 illa superficies transp. L3/post aut¹ scr. et del. au P3 82 illius: istius E 83 post visus scr. et del. vis Er 84 qualitatis corr. ex qualitate P1 85 oppositorum: oppositarum C1EErL3P3; om. R; corr. ex oppositum S 86 post vise add. que comprehenderit L3 (que inter.) 87 post eius scr. et del. non C1ErL3/fuerit om. EErL3P3RS; mg. a. m. C1/respiciens: respiciet EP3; respexerit R/ordinata . . . corpora (88) inter. L3/post ordinata scr. et del. tunc P1

considerabit quantitatem eorum, et comprehendet remotionem
 90 illius superficiei, aut linee, aut spatii et quantitatem obliquati-
 onis eius aut directionem eius ex comprehensione quantitatum
 remotionum extremitatum eius.

[3.113] Et si forma rei vise non fuerit manifesta, aut fuerit
 manifesta sed obliquatio non fuerit maxima, et remotio non
 95 fuerit respiciens corpora ordinata, non comprehendet visus
 certitudinem situs huiusmodi superficiei, aut linee, aut spatii.
 Et cum hoc, quando visus comprehenderit formam non mani-
 festam, et non invenerit remotiones eius esse respicientes cor-
 pora ordinata, statim percipiet quod situs illius superficiei, aut
 100 linee, aut spatii non certificatur.

[3.114] Secundum ergo istos modos comprehendit visus
 situs superficierum visibilium et situs linearum et spatiorum
 que sunt in superficiebus visibilium, scilicet que omnes sunt
 secantes lineas radiales.

105 [3.115] Quod vero est ex spatiis que sunt inter visibilia
 distincta in rebus remotioribus maximis—scilicet quando fuerit
 remotio utriusque visibilium que sunt apud duas extremitates
 spatii remotio maxima—comprehendetur ergo a visu tunc quasi
 directe oppositum, quamvis sit obliquum, quoniam non com-
 110 prehendit diversitatem que est inter remotiones extremitatum
 eius. Et si alterum duorum visibilium que sunt apud extremi-
 tates duas spatii fuerit propinquius altero, et senserit visus
 appropinquationem eius, comprehendit spatium quod est inter
 ea esse obliquum secundum quod comprehendit ex appropin-
 115 quatione propinquiore illorum duorum visibilium et ex remoti-
 one remotioris illorum. Et si alterum duorum visibilium fuerit
 propinquius, sed non visus comprehenderit appropinquatio-
 nem eius, non sentiet obliquationem spatii quod est inter ea.

89 eorum: earum *Er*; *corr. ex earum C1/post* comprehendet *scr. et del.* quantitatem *P1*
 90 aut¹ . . . quantitatem *corr. ex* aut spatii et quantitatem aut linee *Er* 92 extremitatum
 eius *transp. Er* 93 aut . . . manifesta (94) *inter. L3; om. P3* 94 non¹ *om. R/maxima*
 . . . fuerit (95) *om. S* 95 fuerit respiciens: respexerit *R* 96 superficiei *corr. ex*
 superficierum *P1* 97 cum hoc *om. R* 98 non: si *EL3P3; om. R/esse* respicientes:
 respicere *R* 99 *post* situs *scr. et del.* percipiet *S/aut* linee (100) *inter. a. m. S*
 100 *post* spatii *add. esse P1S* 103 sunt secantes (104): secant *R* 106 in *corr. ex*
ex P1 107 utriusque: virtus que *S* 108 spatii . . . maxima: maxima . . . remotio
L3/remotio maxima transp. EP3R/comprehendetur: comprehenditur EP3R/ergo om.
EP3R/post visu scr. et del. ergo E 109 sit *om. C1; inter. a. m. Er* 110 remotiones:
 remotiores *P3* 111 extremitates duas (112) *transp. C1EErL3P3R* 112 *post* spatii
scr. et del. remotio maxima comprehendetur ergo a visu *C1/visus om. P1* 113 appropin-
 quationem *corr. ex* propinquationem *S/comprehendit: comprehendet R*
 114 appropinquatione (115) *alter. in approximatione EP3 (a. m. E)* 117 non: si *S/non*
 visus *transp. R/visus* comprehenderit *transp. C1Er/appropinquationem* (118):
 appropinquatione *L3* 118 eius . . . obliquationem *rep. P1*

Situs ergo superficierum, et linearum, et spatiorum secantium
 120 lineas radiales non certificatur a visu nisi sit remotio eorum
 mediocris, et cum hoc certificat visus equalitatem aut inequali-
 tatem remotionum extremitatum eorum. Si autem visus non
 certificaverit equalitatem remotionis extremitatum eorum, aut
 inequalitatem, non poterit certificare situm illorum.

125 [3.116] Et plura illorum que comprehenduntur a visu ex
 sitibus visibilium non comprehenduntur nisi per estimationem.
 Si ergo fuerint in remotione mediocri, non erit magna diversitas
 inter situm comprehensum a visu per estimationem et verum
 situm, et si fuerint in remotione maxima, non distinguet inter
 130 obliquum et directum. Quoniam visus, quando non compre-
 henderit inequalitatem duarum remotionum duarum extreni-
 tatum rei vise, comprehendet ipsas esse equales, et sic iudic-
 abit ipsam rem visam esse directam.

[3.117] Secundum ergo istos modos erit comprehensio situ-
 135 um superficierum, et linearum, et spatiorum per sensum visus.

[3.118] Situs vero partium rei vise adinvicem, et situs ter-
 minorum superficierum rei vise aut superficierum eius adinvicem,
 et situs visibilium distinctorum adinvicem (que collocantur sub
 ordinatione) comprehenduntur a visu ex comprehensione loco-
 140 rum visus ad que perveniunt forme partium et ex comprehen-
 sione ordinationis partium forme que perveniunt ad visum a
 virtute distinctiva. Quoniam forma cuiuslibet partium super-
 ficiei rei vise pervenit in aliquam partem partis superficierum
 membri sentientis in quam pervenit forma totius. Et cum su-
 145 perfacies rei vise fuerit diversorum colorum, et fuerint inter
 partes eius differentie per quas distinguuntur partes adinvi-
 cem, erit forma perveniens in visum diversorum colorum, et
 erunt partes eius distincte secundum distinctionem partium

121 cum hoc: simul R/post hoc add. non R/visus corr. ex visum P3 122 si corr. ex
 situs Er/si . . . eorum (123) mg. L3 123 remotionis corr. ex remotionum S
 124 illorum: eorum C1Er 125 que inter. a. m. E/ante a scr. et del. a visu S
 127 post ergo add. ipsa R/in remotione: intentione L3 129 fuerint: fuerit EL3P1P3S/
 distinguet: distinguit L3 131 duarum² inter. L3 133 rem corr. ex esse a. m. E/
 visam om. P1S 135 linearum: lineae P1 136 rei corr. ex reis P1/adinvicem: inter
 se R 137 superficierum: superficierum EP3/ante rei scr. et del. et P3/aut . . . eius om. P1/
 superficierum: superficierum R/adinvicem: inter se R 138 adinvicem: inter se R
 139 ordinatione: ordine P1S 141 que perveniunt: pervenientis R/perveniunt:
 pervenit C1ErL3; pervenerit EP3/ad visum om. EP3/a: ex L3; per R 142 virtute
 distinctiva: virtutem distinctivam R/post virtute scr. et del. distiva P1/post quoniam
 add. enim R/partium: partis C1Er/superficiei (143) om. P1 143 partis om. R
 144 et: unde R/cum: in L3 146 distinguuntur: distinguitur Er; distinguantur R;
 corr. ex distinguitur L3/partes² om. P3/adinvicem (147): inter se R 147 perveniens
 corr. ex venientis P1/in: ad EL3P3R 148 distinctionem partium transp. R

superficie rei vise. Et sentiens sentit formam, et sentit quamlibet partium forme ex sensu colorum illarum partium et lucis que est in eis, et sentit loca formarum partium in visu ex sensu colorum partium illarum et lucis illarum, et virtus distinctiva comprehendit ordinationem illorum locorum ex comprehensione diversitatis colorum partium forme et ex comprehensione differentiarum partium. Et sic comprehendit dextrum et sinistrum, superius et inferius ex comparatione illorum adinvicem, et comprehendit contiguum et separatum.

[3.119] Situs vero partium rei vise adinvicem secundum accessionem et remotionem—scilicet secundum prominentiam et fundationem—comprehenduntur a visu ex comprehensione quantitatis remotionum partium ab eo et comprehensione diversitatis remotionum partium secundum magis et minus. Situs vero partium rei vise, quando fuerit in remotione mediocri, adinvicem secundum accessionem et remotionem comprehenduntur a visu, et hoc cum comprehenderit visus quantitatem illius remotionis, et comprehenderit quantitates remotionum partium eius, et comprehenderit inequalitatem que est inter remotiones partium ab eo et equalitatem. Si autem visus non certificaverit quantitates remotionis eius et quantitatem remotionum partium eius, non comprehendet visus ordinationem partium eius secundum accessionem et remotionem apud visionem. Si autem fuerit ex visibilibus assuetis que cognoscuntur a visu, comprehendet ordinationem partium eius secundum preminentiam et profundationem, et figuram superficie eius per cognitionem, non sola visione. Et si fuerit ex visibilibus extraneis que visus non cognoscit, comprehendet superfici-

149 superficie: superficie L3 150 illarum partium *transp. C1Er/post partium² scr. et del. forme S* 152 partium illarum *transp. P3/illarum²: earum C1Er* 153 ordinationem: ordinem R/locorum: colorum C1Er 154 partium forme *om. P3* 156 ante superius *add. et C1Er/comparatione corr. ex comprehensione S/adinvicem: inter se R* 157 et¹ . . . adinvicem (158) *inter. L3/post et¹ add. sic R/post comprehendit add. etiam R/separatum: separatim P1* 158 adinvicem: inter se R 159 scilicet *om. P3/prominentiam: praeeminentiam R* 160 et *inter. P3/fundationem: profundationem P3R; alter. in profundationem a. m. C1* 161 ab eo: a visu R 163 fuerit: fuerint EP3R; fuit L3 164 adinvicem: inter se R/comprehenduntur (165): comprehenditur C1Er 165 hoc *om. C1Er/hoc cum transp. EP3/cum om. Er; inter. a. m. C1/comprehenderit visus transp. R* 166 quantitates . . . comprehenderit (167) *om. R* 167 partium *corr. ex partitium P3* 168 ab eo: a visu R; *inter. a. m. S/si: sic S* 169 non *om. P3; inter. E/remotionis: remotionum P1S/quantitatem: quantitates C1ErR* 170 ante visus *scr. et del. eius P1* 171 ante apud *add. eius P1* 172 ante si *scr. et del. eius S/post fuerit add. aliquid R* 173 comprehendet: comprehenditur P1 174 profundationem: profunditatem EP3R; fundationem L3 175 per: apud P3/ante non *scr. et del. partium P1* 176 extraneis *corr. ex extraneus S/cognoscit: cognoscet L3P1S*

em eius quasi planam quando non certificaverit quantitates
remotionum partium eius. Et ista intentio apparet quando
visus aspexerit aliquod corpus convexum aut concavum et
180 fuerit in remotione maxima, quoniam tunc visus non compre-
hendet concavitatem aut convexitatem, sed comprehendet
ipsum quasi planum.

[3.120] Et situs partium superficiei rei vise adinvicem in
diversitate ubitatum et in separatione et in continuatione non
185 comprehenduntur a visu nisi ex comprehensione partium forme
pervenientium in visu, et ex comprehensione diversitatum
colorum et differentiarum per que distinguuntur partes, et ex
comprehensione ordinationis partium forme a virtute distinc-
tiva. Et situs partium rei vise superficiei adinvicem in accessi-
190 one, et etiam secundum remotionem respectu visus, non com-
prehenduntur a visu nisi ex comprehensione quantitatis remo-
tionis partium et ex comprehensione inequalitatis et equalitatis
quantitatum remotionum eorum. Ordinatio ergo partium se-
cundum accessionem et remotionem illius cuius quantitates
195 remotionum partium certificantur a visu comprehenditur a
visu. Ordinatio autem partium illius remotionum partium
cuius quantitates non certificantur a visu non comprehen-
duntur a visu. Ordinatio autem partium rei vise distinctarum
comprehenditur a visu ex comprehensione locorum visus in que
200 perveniunt forme illarum partium et ex comprehensione dis-
tinctionis in visu a virtute distinctiva; et similiter de visibilibus
distinctis. Termini autem superficiei rei vise aut superficierum
eius et ordinatio eorum comprehenduntur a visu ex compre-
hensione partis superficiei eius in quam pervenit color illius
205 superficiei et lux eius a visu et ex comprehensione terminorum
illius partis et ordinationis circumferentie illius partis a virtute

178 eius *om. P1S* 179 aspexerit: inspexerit *EP3R* 180 tunc visus *transp. EL3P3R*
181 concavitatem aut convexitatem: convexitatem aut concavitatem *EP3R*
183 adinvicem: inter se *R* 184 in² *om. C1EErP3/non: et S* 186 pervenientium:
provenientium *L3*; pervenientis *R/visu: visum R/ex om. R/diversitatum: diversi-*
tatis *R* 187 que: quas *EP3R/distinguuntur: distinguitur Er/et² om. S; ex om. P3*
188 a . . . distinctiva (189): per virtutem distinctivam *R* 189 rei vise superficiei:
superficiei rei vise *C1EErP3R/adinvicem: inter se R/accessione (190) corr. ex actione L3*
190 etiam *om. L3* 192 et¹ . . . partium² (196) *om. P1/ex om. P3/inequalitatis et*
equalitatis: equalitatis et inequalitatis *R* 193 eorum: earum *EL3P3R/post partium*
add. rei visae R 195 *post partium add. eius S* 196 autem: vero *R* 197 non²
inter. P1 198 *post visu scr. et del. ordinatio (196) . . . visu (198) (certificantur:*
certificatur) *S* 199 que: qua *ErP3; corr. ex qua a. m. C1* 200 perveniunt:
proveniunt *EP3* 201 in visu a *corr. ex visu a. m. E/a . . . distinctiva: per virtutem*
distinctivam *R/similiter: si nichil Er/corr. ex si nichil a. m. C1/ante de add. est R*
202 vise *corr. ex visus C1* 203 *post et scr. et del. di P3* 206 *post ordinationis add.*
illius *P3/a . . . distinctiva (207): per virtutem distinctivam R*

distinctiva. Secundum ergo istos modos comprehendit visus
situs partium visibilium, et situs partium superficierum visi-
bilium adinvicem, et situs terminorum superficierum, et situs
210 partium distinctarum visibilium adinvicem, et situs visibilium
distinctorum adinvicem.

[3.121] Corporeitas vero, que est extensio corporis secun-
dum trinam dimensionem, comprehenditur a visu in quibus-
dam corporibus et in quibusdam non. Tamen homo distingu-
215 ens iam quietum est apud ipsum quod non comprehenditur
sensu visu nisi corpus, et sic, quando ipse comprehendit visi-
bile, sciet statim quod est corpus, quamvis non comprehendat
extensionem eius secundum trinam dimensionem. Et visus
comprehendit in omnibus corporibus extensionem eorum se-
220 cundum longitudinem et latitudinem ex comprehensione super-
ficierum corporum oppositorum illi. Cum ergo comprehenderit
superficiem corporis, sciendo quod illud visibile est corpus,
comprehendet statim extensionem illius corporis secundum
longitudinem et latitudinem. Et non remanet nisi dimensio
225 tertia. Et quedam corpora continentur a superficiebus planis
secantibus se oblique adinvicem, et quedam continentur a
superficiebus concavis aut convexis, et quedam continentur a
superficiebus diversarum figurarum secantibus se oblique
adinvicem, et quedam continentur ab una superficie rotunda.
230 Corpus ergo quod continetur a superficiebus secantibus se
cuius una superficies est plana, quando comprehenditur a
visu, et fuerit superficies eius plana opposita visui et directa
ei, et fuerint superficies residue secantes superficiem directe
oppositam perpendiculares super superficiem directe opposi-
235 tam aut oblique super ipsam ad partem strictam ex parte pos-
teriori superficiei directe opposite, non apparebit visui ex eo

208 et . . . visibilium (209) *om. P1S* 209 adinvicem: inter se *R/superficierum:*
visibilium *P1S/post superficierum scr. et del.* distinctorum adinvicem corporeitas vero
que est extensio corporis *S* 210 *post distinctarum add. vel superficierum P1S/*
visibilium *inter. a. m. E/adinvicem: inter se R* 211 adinvicem: inter se *R*
212 corporis *om. EL3P3R* 213 dimensionem: diversionem *S/post dimensionem*
add. et L3 214 et in quibusdam *inter. L3/homo distinguens (215): apud hominem*
distinguentem *R/distinguens iam (215) transp. C1* 215 apud ipsum: principium *R*
216 comprehendit: videt *C1Er*; comprehendet *R* 217 sciet *corr. ex fiet S* 218 eius
om. EP3/dimensionem: diversionem S/et: etiam L3/post visus scr. et del. non L3
219 comprehendit: comprehendet *C1ErL3/omnibus om. R* 221 ante corporum *scr.*
et del. et P1 222 visibile *corr. ex visibilium Er* 224 latitudinem *corr. ex*
altitudinem *P1* 226 adinvicem *om. R/et . . . convexis (227) rep. P1* 229 adin-
vicem *om. R/ab: sub C1/una superficie transp. P1* 230 ergo: autem *EL3P3R*
232 *post fuerit scr. et del. in S* 233 ei et fuerint: et *R/secantes: secuerint R*
234 *post oppositam¹ add. aut EP3R/perpendiculares . . . oppositam (235) om. Er/super*
superficiem: superficie *S* 235 oblique *corr. ex aliquo a. m. Er/strictam: districtam L3*

nisi superficies directe opposita tantum. Ergo ex huiusmodi corporibus non comprehendit visus nisi longitudinem et latitudinem tantum; ergo non sentit corporeitatem corporum huiusmodi. Corpus autem quod continetur a superficiebus secantibus se, quando superficies eius fuerit opposita visui, sed non secundum directam oppositionem, et fuerit sectio istius superficiei cum alia superficie illius corporis comprehensa a visu ita quod poterit comprehendere duas superficies in simul, comprehendetur a visu tunc eius corporeitas. Quoniam comprehendet obliquationem superficiei corporis ad eius profunditatem, quare comprehendet extensionem corporis secundum profunditatem. Et comprehendet ex superficie obliqua extensionem in longum et latum, et sic comprehendet corporeitatem huiusmodi corporum.

[3.122] Et similiter, quando una superficierum corporis fuerit directe opposita visui, et fuerint superficies secantes illam superficiem aut una illarum obliqua super superficiem directe oppositam ad amplum ex parte posteriori superficiei directe opposite, quoniam visus comprehendet in tali corpore superficiem directe oppositam et superficiem oblique secantem superficiem directe oppositam. Et comprehendet etiam sectionem istarum superficierum, et sic, sicut diximus, comprehendet corporeitatem illius corporis. Et generaliter dico quod quodlibet corpus in quo visus potest comprehendere duas superficies secantes se comprehendet corporeitatem in illo.

[3.123] Corpora autem in quibus est superficies convexa comprehensa a visu, et fuerit illud quod continet ipsum una superficies aut multe superficies, visus poterit comprehendere corporeitatem eius ex comprehensione veritatis eius, quoniam quando superficies convexa fuerit opposita visui, erunt remo-

237 *post opposita add. visui P1* 239 *corporum om. R* 241 *quando: quanto S/ fuerit: fuit C1L3* 242 *sectio: secatio P3; corr. ex secatio E* 244 *quod poterit: ut possit R/ in om. R* 245 *eius om. P1S/ quoniam: quando C1ErP1* 246 *ante obliquationem scr. et del. eius C1* 248 *post profunditatem inter. cum a. m. Er/ et: cum EL3P3R; om. L3; alter. in cum C1S (a. m. C1)/ comprehendet: comprehenderit C1EErP3R*
251 *post similiter add. erit R/ superficierum: superficies EP3* 252 *fuerit directe transp. R* 253 *illarum corr. ex linearum P1* 254 *amplum: partem amplam R*
255 *quoniam: quando S/ corpore superficiem (256) transp. EP3* 256 *directe om. P3/ post superficiem² scr. et del. a Er* 258 *istarum superficierum transp. C1Er/ superficierum om. EP3* 259 *corporeitatem corr. ex corporeitates S/ quodlibet (260): omne EP3R* 260 *corpus om. Er; inter. C1L3 (a. m. C1)/ visus potest transp. EP3R*
261 *comprehendet... illo: comprehendetur in sua corporeitate a visu R/ illo: illa C1Er; corr. ex illa L3* 262 *corpora: corporum R/ quibus: qua Er; corr. ex qua a. m. C1*
263 *fuerit om. R/ ipsum: ipsa P1S/ post ipsum add. vel ipsa EP3; add. est aut R*
264 *post superficies² add. corporeitatem R/ poterit comprehendere transp. R*
265 *corporeitatem eius om. R* 266 *quando: si R*

tiones partium eius a visu inequales, et erit medium eius propinquius extremitatibus visui. Et cum visus comprehenderit convexitatem eius, comprehendet quod medium eius est sibi
 270 propinquius extremitatibus. Et cum senserit quod medium eius est propinquius illi et quod extremitates sunt remotiores, sentiet statim quod superficies est exiens apud ipsum ab ultimis tendentibus ad posterius, et sic sentiet extensionem corporis in profunditate respectu superficiei directe opposite. Et
 275 ipse comprehendet extensionem illius corporis secundum longitudinem et latitudinem ex comprehensione extensionis superficiei convexae secundum longitudinem et latitudinem. Et similiter, si alia superficies corporis preter superficiem directe oppositam fuerit convexa, et comprehenderit visus convexitatem eius, quoniam visus etiam comprehendet extensionem eius
 280 secundum trinam dimensionem.

[3.124] Corpus autem in quo est superficies concava comprehensa a visu, quando visus senserit aliam superficiem illius corporis et senserit sectionem eius cum superficie concava,
 285 tunc sentiet obliquationem illius corporis superficiei, et cum senserit obliquationem illius superficiei, statim sentiet corporeitatem eius. Si autem superficies eius concava fuerit comprehensa a visu, et non apparuerit visui alia superficierum residuarum, non comprehendet visus corporeitatem huiusmodi corporis, nec visus comprehendet ex huiusmodi corporibus nisi
 290 extensiones eius secundum duas dimensiones corporis tantum. Visus autem non sentiet corporeitatem huiusmodi corporum nisi per scientiam precedentem tantum, non per sensum trium dimensionum illius corporis. Et superficies concava extenditur

268 visui: visus R/comprehenderit: comprehendit P1S 270 post propinquius *scr. et del.* et quod extremitates eius P3/extremitatibus . . . propinquius (271) *mg. L3/ extremitatibus . . . illi (271) mg. a. m. E* 271 et *om. L3/post extremitates add. eius EP3R* 272 est . . . apud: exit ad R 275 illius corporis *transp. P1R* 276 et latitudinem *om. L3P1/ex . . . latitudinem (277) mg. L3* 280 quoniam: quando P1/quoniam visus *om. R/etiam comprehendet transp. R* 282 corpus autem: si vero corpus R/superficies concava *transp. L3* 283 a visu *inter. a. m. E/quando om. R/visus . . . superficiem: aliam superficiem . . . visus R/illius corporis (284) om. R* 284 post senserit *scr. et del. sen P3* 285 illius . . . superficiei: superficiei . . . illius EP3R/corporis . . . obliquationem (286) *om. Er/et . . . superficiei (286) mg. L3* 286 post illius *scr. et del. superficiei corporis P1* 287 eius²: illius EL3P3; *om. R/concava fuerit transp. EP3R* 288 superficierum *corr. ex superficiem P3* 289 corporeitatem *corr. ex extremitatem P3/huiusmodi: illius C1EErL3P3R* 290 nec *corr. ex in S/corporibus alter. in corpore a. m. C1* 291 extensiones: extensionem L3/corporis *om. R/corporis tantum transp. EP3* 292 visus autem: et R/corporum *om. P1S* 293 tantum *inter. a. m. E* 294 dimensionum *corr. ex dimensionem S/post concava scr. et del. est P3/extenditur etiam (295) transp. EP3R*

295 etiam in profunditate propter propinquitatem extremitatum
eius visui et remotionem medii, sed non comprehenditur ex
extensione profunditatis nisi extensio vacuitatis, non extensio
corporis visi cuius superficies est illa superficies concava.

[3.125] Comprehensio ergo corporeitatis a visu non est
300 nisi ex comprehensione obliquationum superficierum corporum.
Et obliquationes superficierum corporum per quas significatur
visui quod corpora sint corpora non comprehenduntur a visu
nisi in corporibus quorum remotio est mediocris. In corporibus
autem maxime remotionis quorum remotio non certificatur a
5 visu non comprehendit visus obliquationes superficierum. Et
sic non comprehendit corporeitatem eius per sensum visus,
quoniam in talibus corporibus non comprehendit visus situs
partium superficierum eorum adinvicem, nec comprehendit
ipsas nisi planas. Et sic non comprehendit obliquationes su-
10 perficierum, et sic non comprehendit corporeitatem. Visus
ergo non comprehendit corporeitatem corporis maxime remoti-
onis cuius remotio non certificatur illi.

[3.126] Et ipse comprehendit corporeitatem corporum ex
comprehensione obliquationum superficierum corporum, et
15 obliquationes superficierum corporum non comprehenduntur a
visu nisi in visibilibus mediocris remotionis quorum situs parti-
um superficierum adinvicem comprehenduntur a visu. Et pre-
ter ista visibilia non comprehendit corporeitatem eius visus, et
non comprehendit corporeitatem eius nisi per scientiam ante-
20 cedentem tantum.

[3.127] Figura autem rei vise dividitur in duo quorum alter-
um est figura circumferentie superficiei rei vise aut circumfer-
entie alicuius partis rei vise. Secundum autem est figura cor-
poreitatis rei vise aut figura corporeitatis alicuius partis rei
25 vise—et iste modus est forma superficiei rei vise cuius corpor-

295 profunditate: profunditatem *P1S/post* propter *scr. et del. ex P3* 296 visui: ad
visum *R/sed: et L3/post non scr. et del. extenditur P1/ex inter. L3* 297 post extensione
scr. et del. propter P1 298 visi: nisi *C1ErL3P1P3S; corr. ex nisi a. m. E/superficies est*
mg. a. m. E/superficies concava corr. ex concava superficies P3 300 obliquationum:
obliquationis *EL3P3R/post* obliquationum *add. corporum vel P1S* 1 obliquationes:
obliquitates *EP3R* 2 sint: sunt *L3/corpora om. P3* 4 quorum . . . remotionis (11/
12) *mg. L3* 8 adinvicem: inter se *R* 10 post sic *add. denique R* 14 et . . . non
(15) *mg. L3* 17 adinvicem: inter se *R* 18 ista visibilia: istorum visibilibus
corporeitatem *R/comprehendit corr. ex comprehendit Er/eius om. R/visus om. C1Er/*
post visus add. tantum S/et . . . eius (19) om. R 19 comprehendit corporeitatem
transp. L3/antecedentem (20): antecedentium L3 20 tantum *om. S* 21 autem:
vero *C1Er* 22 circumferentie¹ *inter. a. m. L3/superficie inter. EL3/post aut add. ex P3*
23 ante alicuius *add. superficiei rei vise P1 (superficiei inter.)/vise om. P1* 24 ante
alicuius *add. rei vise S/alicius . . . vise¹ (25) corr. ex partis rei vise alicuius C1*

eitas comprehenditur per sensum visus aut forma partis superficiei rei vise cuius corporeitas comprehenditur. Et omne quod visus comprehendit ex figuris visibilibus dividitur in istos modos.

- 30 [3.128] Figura vero circumferentie superficiei rei vise comprehenditur a sentiente ex comprehensione circumferentie forme que pervenit in concavum nervi communis et ex comprehensione circumferentie partis superficiei membri sentientis in quam pervenit forma rei vise, quoniam in utroque istorum
35 locorum figuratur circumferentia superficiei rei vise. Quem ergo istorum locorum averterit sentiens poterit comprehendere in eo figuram circumferentie rei vise. Et similiter figura circumferentie cuiuslibet partium superficiei rei vise comprehenditur a sentiente ex sensu ordinationis partium terminorum partis forme. Et cum sentiens voluerit certificare figuram circumferentie
40 superficiei rei vise aut figuram circumferentie alicuius partis rei vise, movebit axem radialem super circumferentiam rei vise. Et sic per motum certificabit situm partium terminorum forme superficiei aut partis superficiei que est in superficie membri
45 sentientis et que est in concavo nervi communis, quare comprehendet ex certificatione situum terminorum forme figuram circumferentie superficiei. Secundum ergo hunc modum erit comprehensio figure circumferentie rei vise et figure circumferentie cuiuslibet partis superficiei rei vise per sensum visus.
- 50 [3.129] Forma autem superficiei rei vise non comprehenditur a visu nisi ex comprehensione situum partium superficiei rei vise et ex dissimilitudine situum partium superficiei rei vise et consimilitudine eorumdem. Et certificatur forma superficiei ex comprehensione diversitatis inequalitatis remotionum partium superficiei rei vise et equalitatis earum, aut inequalitatis
55 elevationum partium superficiei et equalitatis earum. Quoni-

28 visibilibus: visibilium *P3*; corr. ex visibilium *a. m. E* 30 post vero scr. et del. s *P3* / post vise scr. et del. comprehendit et *E* 34 istorum *om. P3* 35 quem: quoniam *C1ErP1*; quemcunque *R*; quando *S* 36 post ergo *mg.* in utroque *a. m. C1* / averterit: animadverterit *R* 38 comprehenditur a sentiente (39): a . . . comprehenditur *L3* 39 sensu: visu *P1* 41 superficiei . . . circumferentie *inter. L3* / alicuius *om. EP3R* 43 per . . . certificabit: certificabit per motum *C1Er* / certificabit: certificabis *S* 44 aut . . . superficiei *om. R* 45 que *om. EL3P3R* / est *om. R* / quare: quia *P1* 47 post superficiei *add. rei EP3R* (*inter. E* / post rei *add. visae R*) 48 circumferentie rei vise: rei vise circumferentie *L3* / circumferentie² corr. ex circumferentia *C1* 49 ante cuiuslibet scr. et del. rei vise *S* / superficiei *om. P3* 52 et *om. P1* / et . . . vise *inter. L3* / dissimilitudine: consimilitudine *EP3R* / post dissimilitudine *add.* et similitudine eorumdem *EP3* (et similitudine *inter. a. m. E*) / situum . . . vise *om. R* / partium . . . eorumdem (53) *om. EP3* 53 consimilitudine: dissimilitudine *R* / eorumdem: earum *P1S* / post eorumdem *add.* situum *R* 54 remotionum corr. ex remotionis *a. m. E* 56 ante et scr. et del. rei vise *S*

am convexitas superficiei non comprehenditur a visu nisi ex
comprehensione propinquitatis partium mediarum in super-
ficie et remotionis partium in terminis, aut ex inequalitate ele-
vationum partium eius quando superficies superior corporis
60 fuerit convexa. Et similiter convexitas termini superficiei non
comprehenditur a visu nisi ex comprehensione propinquitatis
medii et remotionis extremitatum quando convexitas eius op-
ponitur visui, aut ex inequalitate elevationum partium eius
65 quando gibbositas eius fuerit inferius aut superius, aut ex
inequalitate dextri partium eius aut sinistri eius quando gib-
bositas eius fuerit dextra aut sinistra.

[3.130] Concavitas autem superficiei, quando opponitur
visui, comprehenditur a visu ex comprehensione remotionis
70 partium mediarum et appropinquatione extremitatum ter-
minorum. Et similiter est de concavitate terminorum super-
ficiei quando opponitur visui. Et visus non comprehendit
concavitatem superficiei quando concavitas fuerit opposita
superius, aut inferius, aut apud latus nisi quando superficies
75 concava fuerit in parte abscisa et apparuerit arcualitas termini
eius que est versus visum.

[3.131] Planities autem superficiei comprehenditur a visu
ex comprehensione equalitatis remotionis partium et consimili-
tudinis ordinationis eorum, et similiter rectitudo termini super-
80 ficiei quando terminus opponetur visui. Rectitudo termini
autem superficiei, et arcuitas et curvitas eius quando superfi-
cies fuerit opposita visui, et fuerint termini continentes ipsam,
comprehenduntur a visu ex ordinatione partium eius adin-
vicem.

85 [3.132] Convexitas autem superficiei rei vise que oppone-

57 *post nisi add. aut R* 58 *propinquitatis corr. ex diversitatis L3* 59 *partium om. P1/ex om. P3* 62 *post visu scr. et del. n Er/post nisi add. aut R* 63 *quando: quoniam Er/eius inter. a. m. E* 65 *quando: quoniam P3; corr. ex quoniam a. m. E/ inferius: deorsum R/ inferius . . . fuerit (67) mg. a. m. E/ superius: sursum R* 66 *dextri om. R; inter. L3/post eius¹ add. quod in eo dextrum est R/post aut add. in Er/ sinistri: sinistrum R/eius² om. R* 69 *post visui inter. et a. m. E* 70 *ante et scr. et del. a P3* 71 *et om. R/superficiei (72): superficierum P1* 73 *opposita: posita P1S* 74 *superius: sursum R/ inferius: deorsum R/apud: ad R/apud latus: in planis EL3P3* 75 *termini corr. ex terminorum P1* 77 *superficiei: superficierum EP3R* 78 *equalitatis corr. ex qualitatis L3/remotionis: remotionum EP3R* 79 *eorum: earum EP3R/post similiter add. comprehenditur R* 80 *termini autem (81) transp. C1ErR* 81 *autem: aut P1S; enim R/et arcuitas om. P3/arcuitas: arcualitas R; alter. in arcualitas a. m. C1/e²: aut EL3P3R* 82 *fuerint om. R/continentes: continuerint R/ipsam: ipasam S* 83 *comprehenduntur: comprehenduntur EP3; comprehenditur R/adinvicem (84): inter se R* 85 *autem: ergo C1EErL3P3R/opponetur (86): opponitur EP3R*

tur visui, et concavitas eius, et planities eius comprehenduntur
a visu ex comprehensione diversitatis remotionum partium
superficieiei, aut elevationum earum, aut latitudinum earum, et
equalitatis earum, et ex quantitatibus excessus remotionis par-
90 tium, aut elevationum, aut latitudinum earum adinvicem. Et
similiter convexitas et concavitas eius, et planities cuiuslibet
partis rei vise comprehenditur a visu ex comprehensione ex-
cessus remotionum partium illius partis, aut excessus elevati-
onum aut latitudinum eorum, aut equalitatis earum. Et prop-
95 ter istam causam non comprehendet visus concavitatem et
convexitatem nisi in visibilibus quorum remotio est mediocris.
Visus autem comprehendit propinquitatem quarumdam par-
tium superficieiei et remotionem quarumdam per corpora inter-
venientia ipsi et superficieiei et per corpora respicientia remotio-
100 nes partium quorum appropinquatio et remotio certificantur a
visu. Et cum quedam partes superficieiei fuerint prominentes et
quedam profunde, comprehendit visus prominentiam et pro-
funditatem illarum per obliquationes superficierum partium, et
sectiones partium, et curvitates earum in locis profunditatis, et
105 per situs superficierum partium adinvicem. Et hoc erit quando
visus non comprehenderit illam superficiem ante, nec aliquam
huiusmodi generis. Si autem illa res visa fuerit ex visibilibus
assuetis, comprehendet visus formam eius et formam super-
ficieiei per cognitionem antecedentem. Forma autem rei vise que
110 continetur ex superficiebus secantibus se et diversorum situum
comprehenditur a visu ex comprehensione sectionis superficie-
rum eius, et ex comprehensione situs cuiuslibet superficierum
eius, et ex comprehensione forme cuiuslibet superficierum eius.

86 ante visui scr. et del. a E/eius¹ om. P1/eius² om. EP3R 87 remotionum: remotionis
EL3P3R 88 superficieiei: superficierum Er/elevationum corr. ex elevationem S/
latitudinum alter. ex latitudinem in latitudine S/latitudinum . . . equalitatis (89) om. Er/
et . . . earum (89) om. EP3R; inter. L3 89 equalitatis: equalitate L3P1S/earum om. S/
et . . . earum (90) mg. a. m. E 90 earum: eorum P1S/adinvicem: inter se R
91 eius om. R 94 eorum: earum C1ErP3R/aut: et C1Er/equalitatis: equalitas Er
95 comprehendet: comprehendit R 97 comprehendit: comprehendet C1/
quarumdam om. P1; corr. ex quorumdam L3/partium (98) . . . quarumdam (98) om. R
98 superficieiei: superficierum P1/quarumdam: quorumdam P1S; corr. ex quorumdam
L3/post per add. quedam EP3/post corpora add. quedam P1/intervenientia (99): venientia
Er; corr. ex venientia a. m. C1 99 ante ipsi add. inter ipsum R/ipsi et om. Er; inter.
a. m. C1/superficieiei: superficiem R 100 quorum: quarum P3R/certificantur: certifi-
catur R 102 post profunde add. et L3/comprehendit: comprehendet R
103 obliquationes: obliquationem EL3P3R/partium inter. a. m. S/et . . . partium (104)
mg. L3 105 adinvicem: inter se R 106 illam superficiem transp. L3
107 huiusmodi: huius C1R 108 formam²: formarum S 109 forma mg. P3
110 secantibus inter. L3/se om. P3 111 superficierum (112): superficieiei C1EErL3P3R
112 et . . . eius¹ (113) om. P1/ex om. S 113 et . . . eius² om. P1; mg. a. m. E/forme
cuiuslibet transp. C1Er; om. R/superficierum: superficieiei EP3/eius²: earum inter se R

[3.133] Forme ergo figurarum rerum visarum quarum cor-
 115 poreitas comprehenditur a visu comprehenduntur ex compre-
 hensione formarum superficierum earum et ex comprehensione
 situum superficierum earum adinvicem. Et forme superficie-
 rum visibilium quarum partes sunt diversi situs comprehen-
 duntur a visu ex comprehensione convexitatis, et concavitatis,
 120 et planitiei partium superficierum eorum visibilium, et premi-
 nentie et profunditatis partium superficie. Secundum ergo
 hunc modum erit comprehensio formarum superficierum visi-
 bilium et figurarum earum. Et cum sentiens voluerit certificare
 formam superficie rei vise aut formam alicuius partis rei vise,
 125 movebit visum in oppositione eius, et faciet transire axem
 radialem super omnes partes eius donec sentiet remotiones
 partium eius, et situs cuiuslibet illarum apud visum, et situm
 illarum adinvicem. Et cum sentiens comprehenderit remotio-
 nes partium superficie et situs earum, et comprehenderit pre-
 130 minentiam et profunditatem illarum, comprehendet formam
 illius superficie rei vise, et certificabit figuram eius. Et multo-
 tiens errat visus in eo quod comprehendit ex formis superficie-
 rum visibilium et formis figurarum visibilium, et non percipit
 errorem. Quoniam convexitas parva, et concavitas parva, et
 135 prominentia, et profunditas parva non bene comprehenduntur
 secundum accessum ad visum, quamvis eorum remotio sit
 mediocris, nisi sit propinqua valde visui.

[3.134] Visibilia ergo quorum forme comprehenduntur a
 visu sunt illa quorum quantitates partium superficierum com-
 140 prehendentur a visu et quorum excessus et equalitas remotio-
 num partium comprehenduntur a visu, et visibilia quorum

114 ergo: igitur P1R 115 comprehenditur: comprehenduntur S/post visu scr. et del.
 a S/comprehensione (116) ... ex (116) rep. P1 117 adinvicem: inter se R 119 post
 comprehensione add. formarum superficierum earum et ex comprehensione
 superficierum earum adinvicem et forme superficierum visibilium quarum partes sunt
 diversi situs comprehenduntur a visu ex comprehensione EL3P3 (mg. a. m. E/post
 comprehensione¹ add. situum L3/comprehensione² om. L3) 120 ante et¹ add.
 comprehensione L3/eorum visibilium: in visibilibus R/preminetie (121): promi-
 nentie EP3R 121 profunditatis corr. ex profunditas L3/post profunditatis add.
 visibilium EP3/ergo hunc (122) corr. ex hunc ergo P3 122 formarum superficierum
 transp. EP3R 123 post cum scr. et del. senserit P1/post certificare scr. et del. forma P3
 124 formam¹ corr. ex formarum S 125 visum corr. ex ipsum L3/oppositione:
 oppositionem R/faciet: faciat Er 126 sentiet: sentiat R/remotiones om. EP3
 128 illarum: earum EL3P3R/adinvicem: inter se R/remotiones (129): remotionem EP3
 129 superficie: superficierum EL3P3R/et² inter. L3/preminetiam (130): prominen-
 tiam R 130 illarum om. R 131 certificabit: certificabis S 132 formis corr.
 ex forma P1 134 parva² om. L3 135 prominentia: preminetia P1/bene
 om. EP3R 139 comprehenduntur (140): comprehenditur P1 140 et¹ inter. L3/
 excessus: recessus EP3/equalitas: qualitas ErS; equalitates P1R

forme certificantur a visu sunt illa quorum quantitates remoti-
onum partium et quorum quantitates excessus remotionis par-
tium certificantur a visu. Et similiter figure circumferentiarum
145 superficierum visibilium et figure circumferentiarum partium
superficierum visibilium non certificantur a visu nisi sint in
remotionibus mediocribus, et certificaverit visus ordinationem
terminorum earum et situum partium terminorum earum adin-
vicem, et certificaverit angulos earum. Et quorum situs termi-
150 norum non certificantur a visu nec anguli eorum, si habuerint
angulos, non certificabit visus figuras eorum. Omnes ergo
figure visibilium comprehenduntur a visu secundum modos
quos declaravimus.

[3.135] Magnitudo vero et quantitas rei vise comprehen-
155 duntur a visu, sed qualitas comprehensionis eius est ex intenti-
onibus dubitabilibus in qualitate comprehensionis magnitudi-
nis. Et plures illorum opinantur quod quantitas magnitudinis
rei vise non comprehenditur a visu nisi ex quantitate anguli qui
fit apud centrum visus quem continet superficies pyramidis
160 radialis cuius basis continet rem visam, et quod visus compar-
at quantitates rerum visarum ad quantitates angulorum qui
fiunt a radiis qui continent res visas apud centrum visus. Et
non sustentatur in comprehensione magnitudinis nisi super
angulos tantum. Et quidam illorum opinantur quod compre-
165 hensio magnitudinis non completur in comparatione ad angu-
los tantum, sed per considerationem remotionis rei vise et situs
eius cum comparatione ad angulos.

[3.136] Et veritas est quod non est possibile ut sit compre-
hensio quantitatum rerum visarum a visu ex comparatione ad
170 angulos quos res vise respiciunt apud centrum visus tantum,
quoniam eadem res visa non diversatur in quantitate apud
visum, quamvis remotiones eius diversentur diversitate non

145 et . . . visibilia (146) *om. C1Er* 146 visibilia *corr. ex visibilia S/sint: sit L3*
147 remotionibus: remotioribus *C1Er* 148 et . . . earum *om. P1/situum: situm R/*
adinvicem (149): inter se R 149 *post certificaverit scr. et del. visus ordinationem S/*
quorum: in quibus R 150 *eorum om. R* 151 *post angulos add. in ijs R/eorum:*
earum EL3P3; om. R/ergo: igitur P1 152 *comprehenduntur corr. ex*
comprehenduntur S 154 *post et add. etiam C1EErP3/comprehenduntur (155):*
comprehenditur C1Er 155 *qualitas: equalitas P3* 156 *dubitabilibus: dubitatibus*
Er/in . . . magnitudinis¹ (157) om. R 157 *illorum om. R* 158 *anguli corr. ex angeli*
S/qui: que C1Er 159 *fit: sit C1L3P1S/continet: continent EP3/superficies:*
superficiem E 162 *qui . . . centrum om. P1* 163 *sustentatur: substantatur EP3*
164 *quidam: quidem P3* 168 *est¹: eius L3/sit om. E; mg. P3* 170 *quos . . .*
quantitate (171) mg. L3 171 *post visa scr. et del. fuerit S* 172 *post eius scr. et del.*
o L3/diversentur: diversantur L3P3

magna. Quoniam quando res visa fuerit prope visum, et com-
prehenderit visus quantitatem eius, et postea fuerit elongata a
175 visu, non multum diminuetur eius quantitas apud visum quan-
do remotio secunda fuerit mediocris. Et nunquam diversatur
quantitas alicuius rei vise assuete apud visum quando remoti-
ones eius diversantur et cum fuerint ex remotionibus medio-
cribus.

180 [3.137] Et similiter corpora equalia diversarum remotio-
num, quando remotio remotissimi illorum fuerit mediocris,
comprehenduntur a visu equalia. Sed anguli quos respicit una
eadem res visa in remotionibus diversis mediocribus diversan-
tur diversitate alicuius quantitatis. Quoniam, quando res visa
185 fuerit remota a visu per unum cubitum, deinde si elongetur a
visu donec fuerit eius remotio per duos cubitos, erit inter duos
angulos qui fiunt apud visum ab illa re visa magnus excessus.
Et tamen non comprehendit visus rem visam in remotione duo-
rum cubitorum minorem quam in remotione unius cubiti. Et
190 similiter, si elongetur a visu per tres cubitos aut quattuor, non
videbitur minor, quamvis anguli qui fiunt apud visum diver-
sentur diversitate extranea.

[3.138] Et etiam iterum, si in superficie alicuius corporis
signetur figura quadrata equalium laterum et rectorum angu-
195 lorum, et elevetur illud corpus donec eius superficies in qua est
quadratio sit prope equidistantiam visus et ita quod visus cum
hoc comprehendat figuram quadratam, comprehendet visus
figuram quadratam equalium laterum, et cum hoc anguli quos
respiciunt latera quadrata apud centrum visus erunt inequales
200 quando centrum visus fuerit prope superficiem in qua est quad-
ratio. Et tamen visus comprehendet latera quadrati equalia.

[3.139] Et similiter, quando in circulo extrahuntur dyametri

173 visa *om. R/comprehenderit visus (174) transp. R* 174 visus: ipse *R* 175 post
multum *add. non C1EL3P3R (inter. L3)* 176 ante remotio *add. eius EP1P3R/secunda*
om. EP1P3R 177 apud: ipsum *P1*; propter *S* 178 cum: tamen *C1EErL3P3*; *om.*
R/remotionibus: remotioribus S 181 post remotio *scr. et del. remotionum C1Er; scr.*
et del. remotionis L3/remotissimi om. C1EErL3P3R/post remotissimi scr. et del. c P1
182 comprehenduntur: comprehenduntur *EP3R/post una add. et C1R (inter. a. m. C1)*
184 quando . . . visa: res visa quando *C1Er* 186 eius remotio *transp. C1/cubitos*
. . . inter *mg. L3/duos² om. L3* 187 qui fiunt *om. P3/fiunt: fuerint C1Er/visa om. L3*
188 tamen *corr. ex cum S* 190 post si *scr. et del. eg P3* 191 fiunt: fuerint *C1Er*
193 iterum: verum *S; om. R/si om. S* 194 post equalium *scr. et del. q P3* 195 eius
superficies *transp. R* 196 quod: ut *R/cum hoc (197) om. R* 198 quadratam:
quadrilateram *EL3P3R/et . . . equalia (201) mg. a. m. E/cum hoc: tamen P1RS/hoc*
inter. L3 199 quadrata: quadrati *P1RS/quadrata . . . latera (201) mg. a. m. L3/erunt*
inequales om. C1EErL3P3R 201 ante et *add. erunt diversi C1EErP3R; add. erunt*
inequales L3/et om. EP3/tamen: cum nihilominus R; corr. ex tantum S/comprehendet:
comprehendat R 202 quando: cum *P1S*

diversorum situum, deinde elevetur superficies in qua est circulus donec sit prope equidistantiam visus, erunt anguli quos
 205 respiciunt dyametri circuli apud centrum visus diversi magna diversitate secundum diversitatem situs dyametrorum. Et tamen visus non comprehendit dyametros circuli nisi equales quando remotio eorum fuerit mediocris.

[3.140] Si ergo comprehensio rerum visarum esset ex
 210 comparatione ad angulos tantum qui fuerint ex visibilibus apud centrum visus, non comprehenderentur latera quadrati equalia, nec comprehendentur dyametri circuli equales, nec circulus comprehenderetur rotundus, nec comprehenderetur una res visa in remotionibus diversis unius quantitatis. Ex experimentatione ergo istarum intentionum, patet quod comprehensio quantitatum rerum visarum non est ex comparatione ad angulos tantum.

[3.141] Et cum hoc declaratum est, modo certificemus qualitatem comprehensionis magnitudinis. Et iam declaratum
 220 est quod sustentatio in comprehensione plurium sensibilibus non est nisi super argumentationem et distinctionem. Magnitudo autem est una intentionum que comprehenduntur ratione et argumentatione, et radix super quam sustentatur virtus distinctiva in distinctione quantitatis magnitudinis rei vise est
 225 quantitas partis visus in qua pervenit forma rei vise. Et pars in qua pervenit forma rei vise determinatur et mensuratur per angulum qui est apud centrum visus quem continet piramis radialis continens rem visam et partem visus in qua pervenit forma rei vise. Pars ergo visus in qua pervenit forma rei vise et
 230 angulus quem continet piramis radialis continens illam partem sunt radix quam non possunt sensus et distinctio vitare in

203 elevetur: elevatur R/post est scr. et del. superficies c P3 204 sit: si Er
 205 magna diversitate (206) transp. EP3R 207 tamen: cum L3 208 eorum: circulorum R/post fuerit scr. et del. remotio P3 210 post qui add. prius EP3/fuerint: fuerunt E; fiunt R; fierint S 211 comprehenderentur: comprehenduntur EP1P3/latera quadrati transp. R/quadrati: quadrata P3 212 equalia corr. ex equaliam P1/comprehendentur: comprehenduntur EP3; comprehenderentur R 213 comprehendetur^{1,2}: comprehenderetur R/ante rotundus add. circulus R/comprehendetur² alter. ex comprehendantur in comprehendatur S 214 remotionibus: rebus R/post quantitatis add. et L3P1S/ex om. EL3P3R 215 ergo: igitur R 218 modo: quomodo R 221 super: per L3/distinctionem: extensionem EErP3; corr. ex extensionem C1L3S (a. m. C1S) 223 post radix scr. et del. qua S 224 post in add. comprehensione vel EP3 225 qua: quam EP3R 226 qua: quam R/vise om. P3; inter. a. m. E 227 quem: que P1 228 continens corr. ex continentem S/qua: quam R 229 pars . . . vise mg. a. m. C1Eer/post ergo scr. et del. rei P3/qua: quam C1ErR 230 continet: tinet P3/post radialis add. est S/post continens scr. et del. rem E 231 sunt: ut S/possunt: possint P1S; potest R

comprehensione magnitudinis rei vise.

[3.142] Sed tamen non sufficit virtuti distinctive in comprehensione magnitudinis consideratio anguli tantum, aut
 235 consideratio partis visus respicientis angulum tantum, quoniam una res visa, quando comprehenditur a visu, et est prope ipsum, comprehendet sentiens locum visus in quem pervenit forma rei vise, et comprehendet quantitatem illius loci. Deinde, quando illa res visa elongabitur a visu, comprehendetur
 240 etiam a visu, et comprehendet sentiens locum visus in quem pervenit forma eius secundo, et comprehendet quantitatem loci. Et manifestum est quod locus visus in quem pervenit forma eius primo et locus visus in quem pervenit forma eius secundo diversantur secundum quantitatem, quoniam locus
 245 forme in visu erit secundum quantitates anguli quem respicit illa res visa apud centrum visus. Et quanto magis elongabitur res visa, tanto magis strictificabitur piramis continens ipsam, et eius angulus, et locus visus in quem pervenit forma. Et cum sentiens comprehenderit locum in quem pervenit forma rei vise,
 250 et comprehendit quantitatem loci, comprehendet diminutionem loci apud remotionem rei vise a visu.

[3.143] Et ista intentio multotiens et sepe revertitur ad visum, scilicet quod visibilia semper elongantur a visu, et visus ab eis, et appropinquant visui, et visus illis, et visus comprehendit ipsa, et comprehendit diminutionem locorum formarum
 255 illorum in visu apud remotionem, et comprehendit augmentationem locorum formarum illorum in visu apud appropinquationem. Ex frequentia ergo istius intentionis quievit in anima

232 magnitudinis: magnitudinum L3/rei . . . comprehensione (233/234) mg. L3
 233 virtuti om. EEerL3P3; mg. a. m. C1 234 magnitudinis om. L3 235 respicientis:
 respiciens C1Er/angulum: anguli P1/quoniam (236): quia C1 236 quando inter.
 a. m. E 238 rei . . . forma (241) mg. a. m. E/loci corr. ex locis P3 239 visa om. P1S
 240 comprehendet: comprehendit P1/quem: quantum EP3 243 post eius¹ scr. et del.
 secundo C1ErL3/primo . . . quantitatem (244) mg. C1ErL3 (a. m. C1Er) 244 post
 quoniam scr. et del. est S 245 visu: visum Er 247 post tanto scr. et del. n C1/
 strictificabitur: angustabitur R/ipsam: ipsum EP3 248 post eius scr. et del. et L3/
 locus inter. L3/forma . . . pervenit (249) om. P1 249 post pervenit scr. et del. rem S
 250 comprehendit: comprehenderit EP3R/loci corr. ex locis S/comprehendet:
 comprehendit S 252 multotiens et om. R/revertitur corr. ex revertetur S
 253 quod: quando P3/semper: saepe R; alter. in sepe L3 254 illis: simul P1S/
 comprehendit (255) corr. ex comprehendet Er 255 ante ipsa add. ipsam et visus
 comprehendit C1EEerL3P3 (mg. a. m. E) 256 illorum: illarum P1R/apud: propter
 P1/apud . . . visu (257) mg. a. m. E/augmentationem (257): argumentationem Er; corr.
 ex argumentationem C1L3 (a. m. C1) 257 ante locorum scr. et del. quantitatis rei vise
 P3/post formarum scr. et del. in S/illarum: illarum R 258 ante ex add. quare ad
 comprehensionem quantitatis rei vise adiungit virtus distinctiva remotionem rei vise
 ad angulum piramidis radialis qui est in centro oculi EL3P1P3R (mg. a. m. L3/qui alter.
 in que a. m. E)/ex om. S/ergo: igitur P1/post istius scr. et del. rei vise P3

apud virtutem distinctivam quod, quanto magis res visa elon-
 260 gatur a visu, tanto diminuitur locus forme eius in visu et angu-
 lus quem respicit res visa apud centrum. Et cum hoc est, est
 quietum in distinctione quod locus in quem pervenit forma rei
 vise, et angulus quem respicit res visa apud centrum visus, non
 erit nisi secundum remotionem rei vise a visu. Et cum hoc qui-
 265 etum est in anima, quando virtus distinctiva distinxit quan-
 titatem rei vise, non considerabit angulum tantum, sed consid-
 erabit angulum et remotionem in simul, quoniam quietum est
 apud ipsam quod angulus non erit nisi secundum remotionem.
 Quantitates ergo visibilium non comprehenduntur nisi per dis-
 270 tinctionem et comparisonem. Comparatio autem per quam
 comprehenditur quantitas rei vise est comparatio basis pira-
 midis radialis, que est superficies rei vise, ad angulum pira-
 midis et ad quantitatem longitudinis pyramidis, que est remo-
 tio rei vise a visu. Et consideratio virtutis distinctivae non est
 275 nisi in parte superficiei membri sentientis in quem pervenit
 forma rei vise cum consideratione remotionis rei vise a super-
 ficie visus, quoniam quantitas partis in quam pervenit forma
 nunquam erit nisi secundum quantitatem anguli quem respicit
 illa pars apud centrum visus. Et non est inter remotionem rei
 280 vise a superficie visus et remotionem eius a centro visus in
 maiori parte diversitas operans in remotionem.

[3.144] Et etiam iam declaratum est quod sentiens com-
 prehendit verticationes que sunt inter centrum visus et rem-
 visam, que sunt verticationes linearum radialium, et compre-
 285 hendit verticationum ordinationem, et ordinationem visibilium,
 et ordinationem partium rei vise. Et cum sentiens comprehen-
 dit hoc, virtus distinctiva comprehendit quod iste verticatio-
 nes, quanto magis elongantur a visu tanto, magis ampliabuntur
 spatia que sunt inter earum extremitates. Et ista intentio iam
 290 etiam quietata est in anima, et cum hoc quietum est etiam in ani-
 ma quod linee radiales, quanto magis elongabuntur a visu,

259 res . . . elongatur (260): elongatur res visa R 260 post visu¹ add. ex EP3 (scr. et del. E) / post tanto add. magis R / post diminuitur scr. et del. distinctiva S 261 est² inter. L3
 262 distinctione: diffinitione EP3; anima R; corr. ex diffinitione C1ErL3S (a. m. C1ErS) /
 post pervenit scr. et del. fi S 264 erit: erunt C1Er / et om. S 265 distinxit:
 distinguet R 267 in om. R; inter. P1 269 ergo: igitur P1 272 superficies:
 superficiei EP3 275 quem: quam EP3R; alter. in quam a. m. S 276 cum . . . vise
 inter. L3 282 iam om. P1S 285 verticationum corr. ex verticationem C1P1
 286 partium inter. a. m. E / comprehendit (287): comprehenderit L3P3 288 tanto
 . . . visu (291) mg. a. m. E / ampliabuntur: ampliantur R 290 cum hoc: praeterea R /
 est² om. Er

- tanto magis erit res visa que est apud earum extremitates maior. Cum ergo visus comprehenderit aliquam rem visam, et comprehenderit terminos eius, comprehendet verticationes ex
 295 quibus comprehendit terminos illius rei vise. Et verticationes ex quibus comprehenderit terminos rei vise sunt lineae continentes angulum qui est apud centrum visus quem respicit illa res visa, et sunt lineae continentes locum visus in quem pervenit forma rei vise. Cum ergo visus comprehenderit verticationes,
 300 ymaginabit virtus distinctiva extensionem istarum linearum a centro visus usque ad terminos rei vise. Et quando cum hoc comprehenderit quantitatem remotionis rei vise, ymaginabit quantitatem longitudinum istarum linearum et quantitatem spatii quod est inter extremitates earum, et spatia que sunt
 5 inter extremitates istarum linearum sunt dyametri rei vise. Et quando virtus distinctiva ymaginabit quantitatem anguli, et quantitatem longitudinum linearum radialium, et quantitatem spatiorum que sunt inter extremitates earum, comprehendet quantitatem rei vise secundum suum esse.
- 10 [3.145] Verticationes autem que extenduntur inter centrum visus et terminos cuiuslibet rei vise comprehense a visu comprehenduntur a sentiente et a virtute distinctiva, et sentiens et virtus distinctiva comprehendunt quantitatem partis visus in qua pervenit forma illius rei vise. Et cum virtus distinctiva
 15 comprehenderit verticationes linearum radialium, comprehendet situs eorum adinvicem, et comprehendet appropinquationem et remotionem earum adinvicem, et comprehendet qualitatem extensionis earum. Et nichil remanet quo completur comprehensio magnitudinis rei vise nisi quantitas remotionis
 20 rei vise.

292 magis *om. R/* que est *om. R/* earum: eorum *EP3/* extremitates *corr. ex* extremitatem *L3/* maior: minor *EP3R/* *corr. ex* minor *a. m. C1* 295 comprehendit: comprehendet *EP3R/* illius *om. R* 296 comprehenderit: comprehendet *EP3R/*; comprehendit *L3P1*
 300 ymaginabit: ymaginabitur *C1EErP1P3R* 1 terminos: terminum *C1/* cum hoc: simul *R* 2 remotionis rei vise: rei vise remotionis *S/* ymaginabit: ymaginabitur *EP1P3R/*; *alter. ex* ymaginabili *in* ymaginabitur *C1Er* 3 post longitudinum *add. sive* quantitatem longitudinis *EP3/et inter. L3* 4 post earum *add. est C1Er* 5 extremitates: extremitas *E* 6 ymaginabit: ymaginabitur *C1EErP1P3R* 7 quantitatem²: quantitates *Er* 10 ante inter *add. secundum suum esse L3* 11 cuiuslibet *inter. a. m. S/post visu add. et S/comprehenduntur (12): comprehenditur E* 12 virtute *corr. ex* virtutes *P3/et² . . . distinctiva (13) inter. L3* 13 quantitatem *corr. ex* quantitates *P1/post visus scr. et del. distinctiva* comprehendit *S* 14 qua: quam *P1RS/* forma *om. P1/* illius *om. P1S* 15 comprehenderit: comprehendit *P1S* 16 eorum: earum *EP3R/* adinvicem: inter se *R/post adinvicem scr. et del. et comprehendet situs eorum adinvicem S/post comprehendet² scr. et del. eo Er* 17 et remotionem *om. R/* remotionem: remotionum *P1/* qualitatem (18): quantitatem *EL3P3/*; *alter. in* quantitatem *a. m. Er* 19 nisi . . . vise (20) *om. P1*

[3.146] Et iam declaratum est in qualitate comprehensionis remotionis rei vise quod cuiuslibet rei vise remotio comprehenditur a visu aut certe aut estimatione. Et cum virtus distinctiva comprehenderit situs linearum radialium continentium terminos rei vise, et quantitatem partis que est inter ipsas et superficiem membri sentientis, que est quantitas anguli, et ymaginaverit cum hoc quantitatem remotionis rei vise, statim ymaginabit quantitatem anguli et remotionis in simul. Et cum ymaginaverit quantitatem anguli et quantitatem remotionis in simul, comprehendet quantitatem rei vise secundum quantitatem anguli et secundum quantitatem remotionis in simul. Et virtus distinctiva ymaginat quantitatem remotionis cuiuslibet rei vise comprehense a visu, et ymaginat verticationes continentes terminos eius, et per istam ymaginationem perveniet apud ipsam forma pyramidis continentis rem visam et quantitas basis eius que est res visa. Et sic perveniet illi quantitas rei vise.

[3.147] Et significatio quod comprehensio magnitudinis rei vise erit per comparisonem magnitudinis ad remotionem rei vise est quia visus, quando comprehenderit duo visibilia diverse remotionis et respicientia eundem angulum apud centrum visus—scilicet ut radii transeuntes per extrema primi illorum perveniant ad extrema secundi—et primum illorum non cooperuerit totum secundum, et comprehenderit visus remotionem cuiuslibet illorum comprehensione certificata, semper visibile remotius comprehendetur a visu visibili propinquiore maius. Et quanto magis visibile remotius elongabitur, et visus certificaverit quantitatem remotionis eius, tanto magis comprehendetur maius. Verbi gratia, quod quando visus aspexerit parietem remotum a visu remotione mediocri, et certificaverit

23 aut estimatione *corr. ex* estimatione aut *S/estimatione*: estimative *C1Er* 25 *post* ipsas *add.* lineas radiales *EP3R*; *inter.* lineas radiales *L3S* (*a. m. S*)/et superficiem (26): superficiei *C1ErL3S* 26 ymaginaverit (27): imaginata fuerit *R* 27 cum hoc: simul *R/ymaginabit* (28): imaginabitur *R* 28 in *om. R/ymaginaverit* (29): imaginata fuerit *R* 29 quantitatem² *om. R/in om. EP3R* 31 in *om. R* 32 ymaginat: ymaginabit *L3*; imaginatur *R/vise om. S*; *scr. et del. P1* 33 ymaginat: imaginatur *R* 34 eius: illius *EP3R*/istam ymaginationem *transp. EL3P3R*/apud: ad *R* 35 forma: formam *EL3P3*/basis: lucis *S* 36 illi: ad illam *R* 37 significatio: significat *Er*; *corr. ex* significat *a. m. C1*/quod comprehensio *corr. ex* comprehensio quod *C1/post* comprehensio *scr. et del. m P3* 38 erit: fit *R/post* comparisonem *scr. et del. m C1* 39 *post* vise *scr. et del. et E/est inter. L3* 40 eundem: eiusdem *S* 41 ut *om. P3* 42 perveniant: pervenient *L3/cooperuerit* (43): cooperuit *P1* 43 totum secundum *transp. P1/post* et *add. cum P1* 45 remotius *corr. ex* remotionis *L3* 46 maius *corr. ex* magis *C1*/magis *alter. in* maius *a. m. C1*/magis . . . remotius: remotius . . . magis *R/visibile* remotius *transp. EP3* 48 ante maius *scr. et del. visus E*; *scr. et del. m P3*/quod *om. R/quando*: non *Er*/visus: aliquis *R* 49 remotione mediocri: remodiocri *P3*

- 50 visus remotionem illius parietis et quantitatem eius, et certifi-
caverit quantitatem latitudinis eius, deinde apposuerit aspici-
ens manum uni visui inter visum et parietem et clausit alter-
um oculum, inveniet tunc quod manus eius cooperiet portio-
nem magnam illius parietis. Et comprehendet quantitatem
55 manus eius in illa dispositione, et comprehendet quod quan-
titas cooperta a manu ex pariete est multo maior quantitate
manus eius, et visus comprehendet verticationes linearum
radialium, et comprehendet angulum quem continent lineae
radiales. Tunc ergo visus comprehendit quod angulus quem
60 respiciunt manus et paries est idem angulus, et tunc etiam
comprehendit quod pars cooperta manu eius est multo maior
manu. Et cum ita est, virtus distinctiva in illa comprehensione
comprehendit quod remotius duorum visibilium diverse remo-
tionis respicientium unum angulum est maioris quantitatis.
65 [3.148] Deinde, quando visus in illa dispositione auferetur,
et aspexerit alium parietem remotiorem illo pariete, et opposu-
erit manum eius inter visum et illum parietem, inveniet quod
illud quod cooperitur ex secundo pariete est maius illo quod
cooperitur ex primo. Et cum tunc aspexerit celum, inveniet
70 quod manus eius cooperiet medium illius quod apparet de celo
aut magnam portionem illius. Tamen aspiciens non dubitabit
quin manus eius nichil sit respectu eius quod cooperitur de celo
secundum sensum. Declaratum est ergo ex ista experimentati-
one quod visus non comprehendit quantitatem magnitudinis
75 rei vise nisi ex comparatione magnitudinis rei vise ad quantita-
tem remotionis eius cum comparatione ad angulum, non ex
comparatione ad angulum tantum. Et si comprehensio quanti-
tatis magnitudinis esset secundum angulum tantum, oppor-

50 parietis *corr. ex partis* L3 51 aspiciens (52) *om. EP3R* 52 inter visum *om. Er*
53 cooperiet *corr. ex cooperet* L3 54 comprehendet: comprehendit C1S/post
comprehendit *scr. et del. quod* P3 55 in *om. EL3P3/illa: ista* R 56 cooperta:
corporea P1/a *om. L3* 57 manus *corr. ex maius S/post visus add. simul* R
59 comprehendit: comprehendet R/quem *corr. ex quod* S 60 paries *corr. ex pari-*
etes L3 61 comprehendit: comprehendet P1R/pars: paries *Er/post pars add.*
parietis EP3R/pars cooperta *corr. ex paries coopertus* L3/cooperta: coopertus *Er/post*
cooperta *add. cum E; add. a* P3 62 ita *corr. ex in a. m. C1/est: sit* R/illa comprehensione
transp. L3 63 remotius: remotiones EErL3; remotionis S; *corr. ex remotiones a. m. C1*
65 visus: quis R/auferetur: visum suum averterit R 66 illo: alio P3/opposuerit
(67): apposuerit EP1P3 67 eius: suam R/et . . . parietem *om. P3/illum om. P1*
68 maius: magis *Er* 69 cum *om. P3/cum tunc transp. L3* 70 post cooperiet *scr.*
et del. manum P3/medium illius *corr. ex illius medium* P3/post quod² *scr. et del. a* C1
71 illius: eius EP3R/post illius *scr. et del. quod apparet* S 72 eius²: illius EP3R/
cooperitur: cooperuerit ER; cooperuit P3 73 declaratum: determinabitur EP3R;
declarabitur *ErL3* 76 post angulum *scr. et del. et Er/non . . . angulum* (77) *inter. L3;*
om. P1 77 comprehensio *corr. ex comprehensione* S 78 ante esset *add. eius* EP3/
esset . . . angulum *inter. L3*

teret ut duo visibilia diverse remotionis respicientia unum an-
 80 gulum apud centrum visus viderentur equalia, et non est ita.
 Quantitas ergo magnitudinis rei vise non comprehenditur per
 distinctionem nisi ex ymaginatione pyramidis continentis rem
 visam a virtute distinctiva, et ex ymaginatione quantitatis
 anguli pyramidis cum ymaginatione longitudinis pyramidis, et
 85 ex comparatione basis pyramidis ad quantitatem anguli eius et
 ad quantitatem longitudinis eius in simul. Et hec est qualitas
 comprehensionis magnitudinis.

[3.149] Et propter multitudinem consuetudinis visus in
 distinctione remotionum visibilium, quando senserit formam et
 90 remotionem rei vise, statim ymaginabit quantitatem loci forme
 et quantitatem remotionis, et comprehendet ex congregatione
 duarum istarum intentionum magnitudinem rei vise. Sed ta-
 men quantitates remotionum visibilium sunt collocate sub
 magnitudinibus que comprehenduntur a visu. Et iam predic-
 95 tum est quod quedam quantitates remotionum visibilium com-
 prehenduntur certe et quedam estimative, et quod illa que
 comprehenduntur estimative comprehenduntur assimilatione
 remotionis rei vise ad remotiones sibi similibus ex visibilibus
 certificate remotionis, et quod remotiones certificate quantita-
 100 tis sunt ille que respiciunt corpora ordinata et continuata. Et
 ex comprehensione corporum ordinatorum continuatorum res-
 picientium ipsas a visu et ex certificatione quantitatum illorum
 corporum erit certificatio quantitatum remotionum visibilium
 que sunt apud extremitates eorum. Remanet ergo ad declaran-
 105 dum quomodo visus comprehendet quantitates remotionum
 visibilium respicientium corpora ordinata continuata et quo-
 modo certificat quantitates corporum ordinatorum continua-
 torum respicientium remotiones visibilium.

[3.150] Corpora ergo ordinata continuata respicientia

79 respicientia: super P3 (*inter.*); *corr.* ex respicientis *a. m. E* 83 ex *inter. S* 84 cum
 . . . pyramidis *om. P1R* 86 in *om. R*/qualitas: equalitas *EER P1P3*; *corr.* ex equali-
 tas L3 87 post magnitudinis *scr. et del. eius P1* 88 multitudinem: similitudinem
 P1/consuetudinis: assuetudinis *EER L3P3* 90 rei *om. S*/ymaginabit: imaginabitur *R*
 92 duarum istarum *transp. EP3R* 93 sub: in P1; *corr.* ex in L3S (*a. m. S*)/post sub *scr.*
 et del. vel in C1 94 magnitudinibus *corr.* ex magnitudinis *S* 95 post quod *add.*
 vis P3/remotionum *corr.* ex motionum *a. m. E* 96 certe . . . comprehenduntur² (97)
mg. a. m. S/illa: illae *R* 97 post comprehenduntur² *add.* ex *Er*/assimilatione: a
 similitudine *EL3P3R*; *alter.* ex assimilative in ex assimilatione *a. m. C1* 98 post ad
add. intentiones P3/remotiones: remotionis P3/similium *corr.* ex visibilium *S*
 99 post et *scr. et del.* quedam P1 100 respiciunt *corr.* ex recipiunt L3/et¹ *om. Er*; *inter.*
a. m. E 104 eorum *om. P1S*; *mg. a. m. C1*/ad *om. R* 105 comprehendit:
 comprehendit *Er*; comprehendat *R*; *corr.* ex comprehendendum P1 107 certificat:
 certificet *R* 108 post visibilium *scr. et del.* sunt in maiori parte *S* 109 ordinata
corr. ex ordinate L3

110 remotiones visibilium sunt in maiori parte partes terre. Et
visibilia assueta que semper comprehenduntur a visu et fre-
quentius sunt superficies terre, et corpus terre interiacet ipsa et
corpus hominis aspicientis. Et quantitates partium terre inter-
iacentium aspicientem et visibilia que sunt super faciem terre
115 respicientium remotionem istorum visibilium a visu semper
comprehenduntur a visu. Et comprehensio quantitatum par-
tium terre interiacentium aspicientem et visibilia que sunt su-
per faciem terre non est nisi ex mensuratione illarum adinvicem
a visu et ex mensuratione partium terre remotarum ab eo ad
120 partes terre propinquas illi quarum quantitates sunt certifi-
cantes. Deinde ex frequentatione comprehensionis partium terre
ab eo et ex frequentatione mensurationis illarum ab eo compre-
hendet quantitates partium terre que sunt apud pedes per cog-
nitionem et per assimilationem illarum ad eis similes iam prius
125 comprehensas. Visus ergo, quando aspexerit partem terre
interiacentem ipsum et rem visam, cognoscet quantitatem eius
propter frequentationem comprehensionis similium illi parti
terre. Et ista intentio est ex intentionibus quas sentiens ad-
quirit a principio crescentie. Et sic pervenient quantitates
130 remotionum visibilium assuetorum figurate in ymaginatione et
quiete in anima ita quod homo non percipit qualitatem quies-
centie earum.

[3.151] Quomodo vero est principium comprehensionis
partium terre inter ipsum et visibilia est secundum quod
135 narrabo. Principium earum cuius quantitas certificabatur a

111 que om. ErS; mg. a. m. C1 112 sunt om. C1S/post terre² inter. quod a. m. Er/post
interiacet add. inter R 113 interiacentium (114) corr. ex interiacentem C1 114 ante
aspicientem add. inter R/aspicientem: aspicientium L3; aspicientes P1/et om. L3P1S;
inter. a. m. C1/faciem: superficiem L3P3; corr. ex superficiem a. m. Er 115 res-
picientium: respicientes R/remotionem: remotiones Er/semper comprehenduntur (116)
transp. L3 116 quantitatum: quantitatis P1 117 post interiacentium add. inter
R/super faciem (118): superficiem L3; corr. ex superficiem a. m. Er 118 adinvicem:
inter se R 119 post visu scr. et del. et ex mensuratione illarum adinvicem a visu S
120 certificantes (121): certificate P3R; corr. ex certificate a. m. E 122 ab eo^{1,2}: a visu
R/ex om. Er 123 ante quantitates add. visus R/quantitates: quantitatem EL3P3R/
apud om. Er 124 per om. C1EP3R/ante illarum scr. et del. eorum P1/ad eis: per R
125 ergo om. P1/aspexerit: inspexerit P3 126 ante ipsum add. inter R; add. et S/post
visam add. et S/cognoscet: comprehendet Er; cognoscit P1 128 post ex add.
illis EP3R 129 post principio scr. et del. quiescentie vel C1/crescentie: quiescentie
PIR; corr. ex quiescentie a. m. S/sic om. L3 130 ymaginatione: imaginationem R
131 quiete: quietem R/ita om. P3/quod: ut R/percipit: percipiat R/quiescentie (132)
corr. ex quiescie L3 132 ante earum mg. vel quantitatem quiescentem a. m. E
133 quomodo: unde R/vero est transp. L3/est: sit R/est principium transp. P3
134 post terre add. interiacentium C1EErL3P3R (mg. a. m. C1)/ipsum: visum P3
135 principium: primum Er/earum: eorum P3; eius R; corr. ex eorum a. m. E/
certificabatur: certificabitur Er; certificatur R

visu est illud quod est apud pedes, quoniam quantitas illius
quod est apud pedes comprehenditur a visu et a virtute
distinctiva. Et virtus certificat ipsam per mensuram corporis
hominis, quoniam illud quod est apud pedes semper mensura-
140 tur ab homine sine intentione per pedes eius, quando ambulat
super ipsum, et per brachium eius, quando extenditur manus
ad ipsum. Et omne quod est prope hominem ex terra semper
mensuratur per corpus hominis, et sine intentione, et visus
comprehendit istam mensurationem et sentit ipsam. Et virtus
145 distinctiva comprehendit istam mensurationem, et intelligit
ipsam, et certificat ex ea quantitates partium terre continua-
tarum cum corpore hominis. Quantitates ergo partium terre
propin quarum homini iam sunt intellecte apud sentientem et
apud virtutem distinctivam, et iam forme earum sunt ymagi-
150 nate apud virtutem distinctivam et quiete in anima. Et visus
comprehendit istas partes terre semper, et sentiens sentit
verticationes que extenduntur a visu ad extremitates istarum
partium apud comprehensionem illarum a visu et apud con-
siderationem corporis terre a visu, et comprehendit partes
155 superficiei membri sentientis in quas perveniunt forme istarum
partium terre, et comprehendit quantitates partium visus et
quantitatem angulorum quos respiciunt iste partes visus. An-
guli ergo quos respiciunt partes terre propinque homini intelli-
guntur apud sentientem secundum transitum temporis, et forme
160 eorum sunt ymagine in anima. Et quantitates longitudi-
num linearum radialium que extenduntur a centro visus ad
extremitates partium terre propin quarum homini comprehen-
duntur a sentiente et a virtute distinctiva, et certificantur ab
ea, quoniam longitudines istarum verticationum semper men-
165 surantur per corpus hominis sine intentione. Si ergo homo fue-
rit erectus et aspexerit terram apud pedes eius, erunt longi-

136 est apud pedes: apud pedes est *Er* 138 *post et scr. et del.* virtus vel *C1*/virtus:
visus *C1EL3P3R*; *alter. in visus a. m. S* 139 *post est add.* ex terra *EErL3P3R*/semper:
super *P3S*/mensuratur (140): mensuram *EP3* 141 super ipsum *om. C1P1S*/per *om.*
P1/extenditur: extendit *EErP3R*/post extenditur *scr. et del. ? Er* 142 ex terra: extra
S/terra: certa *P1* 143 corpus *corr. ex corporis S/et¹ om. C1EErL3P3R* 144 men-
surationem: mensuram *EP3R* 145 *post istam add.* mensuram vel *EP3*/
mensurationem: mensuram *R* 147 cum *corr. ex et a. m. E* 149 et... distinctivam
(150) *mg. a. m. C1*/earum *corr. ex illarum Er*/sunt ymagine (150) *om. P3*/ymagine
(150): conceptae *R* 150 et: sunt *P3*/quiete: virtute *P1* 154 corporis: partium *P1*
155 superficiei *corr. ex super situm a. m. C1*/perveniunt: pervenerint *P1* 156 visus
om. R 157 quantitatem: quantitates *R* 158 ergo: vero *P1R* 159 sentientem:
membrum sentiens *R* 160 ymagine: conceptae *R* 163 certificantur:
certificatur *EL3* 164 *post quoniam add.* vero *R*/verticationum *corr. ex intentio-*
num P1 166 et *om. P3*/erunt *inter. a. m. Er*

tudines linearum radialium secundum quantitatem erectionis
hominis, et virtus distinctiva intelliget certe quod remotio
interiacens visum et partem terre est quantitas erectionis
170 hominis.

[3.152] Et longitudes locorum terre continuatorum cum
corpore hominis sunt intellecte et percepte quantitates apud
virtutem distinctivam, et forme earum sunt quiete in anima.
Cum ergo visus aspexerit partem que est apud pedes, statim
175 sentiens comprehendet verticationes pervenientes ad extre-
mitates illius partis, et ymaginabit virtus distinctiva quantitates
longitudinum verticationum pervenientium ad extremitates
earum et quantitates angulorum quos continent ille verticatio-
nes. Et cum virtus distinctiva ymaginaverit quantitates lon-
180 gitudinum verticationum et quantitates angulorum quos con-
tinent verticationes, comprehendet quantitatem spatii que est
inter extremitates illarum verticationum certa comprehensione.
Secundum ergo hunc modum certificantur quantitates partium
terre continentium aliquam partium terre per sensum visus.

[3.153] Deinde quantitates partium terre sequentium istas
partes in remotione comprehenduntur a visu ex comparatione
quantitatum partium linearum radialium que extenduntur ad
extremitates earum ad quantitates radialium que extenduntur
ad primas partes que sequuntur hominem. Et sic comparat
190 virtus distinctiva lineas radiales tertio loco venientes ad radios
secundos communes prime parti et secunde, et percipit quanti-
tatem augmentationis tertii radii super secundum. Et cum hoc
senserit, sentiet quantitatem tertii radii, et ipse comprehendet
quantitatem secundi radii certa comprehensione. Erunt ergo
195 duo radii continentes partem secundam terre note quantitatis
apud virtutem distinctivam, et similiter erit situs eorum notus
apud ipsam. Et cum comprehenderit longitudinem duorum

169 *post interiacens add. inter R* 171 *et inter. a. m. Er/et . . . hominis (172) mg. a. m. S/post et inter. sic a. m. C1/terre om. L3* 172 *sunt om. P3* 173 *earum: eorum ErR*
174 *ergo: igitur P1* 175 *comprehendet: comprehendit P1/pervenientes alter. in pertinentes a. m. S/ante ad scr. et del. vel pertinentes C1* 176 *ymaginabit: imagina- bitur R* 177 *pervenientium: provenientium P1* 179 *ante et scr. et del. n C1/ ymaginaverit: imaginata fuerit R* 184 *continentium . . . terre om. EEEL3P3R; scr. et del. C1* 185 *terre om. EL3P3R* 189 *post ad scr. et del. extremitas P1/post et scr. et del. et Er* 191 *secundos: secundo EEEL3P3R/post secundos add. venientes EL3P3R* 192 *radii om. P1/secundum corr. ex tertium a. m. E/hoc om. R* 193 *post senserit scr. et del. senserit P1/radii om. L3/ipse: ipsa Er; alter. in ipsa C1L3 (a. m. C1)/comprehendet: comprehendit Er* 194 *secundi corr. ex tertii a. m. E/comprehensione: comprehensionem Er* 195 *partem secundam transp. EL3P3R/quantitatis: quanti- tates L3* 196 *eorum notus corr. ex earum notus P3* 197 *cum inter. P1/duorum: duarum Er*

200 radorum et situm eorum, comprehendet spatium quod est
 inter extremitates eorum certa comprehensione. Secundum ergo hunc modum comprehendet virtus distinctiva etiam quantitates partium terre sequentium partes continentes pedes.
 [3.154] Et etiam partes sequentes partes continentes pedes
 205 semper etiam mensurantur per corpus hominis. Quoniam,
 quando homo ambulaverit super terram, mensurabitur terra
 super quam ambulat per pedes eius et passus, et comprehendet
 virtus distinctiva quantitatem eius. Et cum homo pertransierit
 locum in quo fuit et partes continuatas cum pedibus eius, et
 pervenerit ad illas partes sequentes, mensurabuntur etiam iste
 210 partes sicut mensurabantur etiam priores, et comprehendet
 etiam sequentes sicut comprehendebat priores. Et ista
 comprehensio erit certificata sine dubio, et sic certificabitur ab
 eo per comprehensionem istam secundam prima comprehensio.
 Si ergo quantitas eius non fuerit primo certificata, certificabitur
 secundo. Et ista commensuratio comprehenditur a sentiente
 215 semper, et utitur ipsa sine intentione sollicita, sed aspecta aliqua
 partium terre a visu, comprehendit sentiens et virtus distinctiva
 istam mensurationem per viam accidentalem sine intentione.
 Deinde propter frequentationem istius intentionis sunt iam
 certificate quantitates partium terre sequentium pedes et quan-
 220 titates eorum que sequuntur ipsas. Secundum ergo hunc
 modum acquirit sentiens et virtus distinctiva quantitates
 partium terre continentium hominem interiacentium visum et
 visibilia, et ista adquisitio est in principio crescentie hominis.
 Deinde adquiescunt quantitates remotionum visibilium
 225 assuetorum que sunt super faciem terre apud sentientem et
 apud virtutem distinctivam. Erit ergo comprehensio
 remotionum visibilium assuetorum que sunt super faciem terre

199 certa om. P3 200 etiam: secundum L3 202 partes² inter. a. m. E 203 etiam om. R/post per scr. et del. partes P1 204 ambulaverit corr. ex ambularet P1
 205 ambulat: ambulabat C1/comprehendet (206): comprehendit S 207 locum om. P1/fuit: fuerit C1EP3R 209 iste: ille EP3R; ipse P1/post partes add. sequentes EP3R/etiam² om. P1 210 ante etiam add. et P3/etiam om. Er 212 comprehensionem istam transp. P3 213 non om. P3; scr. et del. E/primo certificata transp. R/post primo add. non S 214 ista commensuratio transp. P3/commensuratio corr. ex mensuratio S 215 intentione: interisione P3; corr. ex intercisione a. m. E
 216 aliqua om. Er 217 accidentalem mg. a. m. C1 218 ante sine add. quia per ambulationem accidentalem C1 (scr. et del. accidentalem) 220 que om. C1S/sequuntur: sequitur P3; corr. ex sequitur S 221 quantitates (222): quantitatem P3
 222 continentium alter. in contingentium a. m. C1/interiacentium corr. ex interiacium P3 223 ante visum add. inter R/post principio scr. et del. quiescentie vel C1; add. ad L3/crescentie: quiescentie EEPr1R; corr. ex quiescentie L3S (a. m. S) 224 adquiescunt: quiescunt Er 225 super faciem: superficiem L3 227 visibilium om. L3

per cognitionem et assimilationem eorum adinvicem.

[3.155] Et est dicere comprehensionem quantitatum remo-
 230 tionum visibilium per acquisitionem a sentiente et a virtute
 distinctiva non quod ista comprehendit quot cubiti sunt in
 qualibet remotione; sed acquirit ex qualibet remotione et ex
 qualibet parte terre quantitatem ymaginatam et determinatam,
 et ad illas quantitates determinatas comparat quantitates
 235 remotionum visibilium quas comprehendit post. Et similiter
 acquirit ex cubito, et palma, et a qualibet quantitate mensura-
 ta quantitatem determinatam. Quando ergo aspiciens com-
 prehenderit aliquod spatium et voluerit scire quot cubiti fuerint
 in eo, comparabit formam adquisitam ex ymaginatione ex illo
 240 spatio ad formam adquisitam in ymaginatione ex cubito, et
 comprehendet per istam comparisonem spatii quantitatem
 respectu cubiti.

[3.156] Et etiam ex assuetudine hominis est quod, quando
 voluerit certificare aliquam intensionem, frequentabit aspectum
 245 eius, et distinguet intensiones eius, et considerabit tempus, et
 per illud comprehendet illam intensionem secundum veritatem.
 Aspiciens ergo quando prehenderit aliquam rem visam
 super faciem terre et voluerit certificare remotionem eius, intu-
 ebitor partem terre continuatam interiacentem ipsum et rem
 250 visam, et movebitur visus in longitudine ipsius. Et sic move-
 bitur axis radialis super illam partem, et mensurabit ipsam, et
 comprehendet ipsam secundum singulares partes, et sentiet
 partes eius parvas quando remotio illius ultimi spatii fuerit
 mediocris. Et quando visus prehenderit partes terre et
 255 prehenderit partes parvas, comprehendet virtus distinc-
 tiva quantitatem totius spatii, quoniam per motum axis radi-
 alis super spatium certificabit virtus distinctiva quantitatem

228 *post et add. per EErP3* 229 *comprehensionem corr. ex comprehensio a. m. S*
 230 *ante per add. esse R* 231 *post quod add. per R/ comprehendit: comprehenduntur*
C1S; comprehendant EP1P3; comprehendunt ErL3; comprehendat R/ ante quot add.
aspiciens R/sunt: sint R 232 *remotione² . . . qualibet (233) om. P1/ex² om. S*
 233 *ymaginatam om. R; corr. ex ymagine L3/et om. EL3P3R* 236 *palma: palmo R/*
a om. L3/mensurata (237): mensurativa C1Er; corr. ex mensurativa L3; alter. in
mensurativa a. m. S 238 *voluerit: voluit C1* 239 *ex¹: in Er* 240 *in: cum L3;*
alter. in cum a. m. E 243 *ex om. P1* 244 *frequentabit: iterabit R* 245 *eius¹:*
suum R/intensiones: intensionem P1/post et² scr. et del. considerationem P1/post tem-
pus scr. et del. eius S 246 *illam intensionem transp. L3* 248 *super faciem:*
superficiem L3 249 *ante ipsum add. inter R* 252 *ipsam mg. a. m. C1/singulares:*
singulas EL3P3R 253 *partes eius transp. P3/illius ultimi transp. Er* 254 *post*
visus scr. et del. fuerint ita quod cum E 255 *partes parvas corr. ex parvas partes Er*
 256 *totius: illius C1P1S/post totius scr. et del. corporis P1* 257 *quantitatem:*
quantitate P1

partis visus in quam pervenit forma illius spatii, et quantita-
 tem anguli quem respicit illud spatium, et quantitatem longi-
 tudinis radii qui extenditur ad ultimum spatii. Et cum iste due
 260 intentiones certificabuntur a virtute distinctiva, certificabitur
 quantitas partis terre vise. Et similiter quantitates longitudi-
 num corporum elevatorum a terra extensorum in parte remota,
 sicut parietum et montium, comprehenduntur a visu sicut com-
 265 prehenduntur quantitates partium terre, et comprehendet re-
 motiones visibilium respicientium ipsas ex comprehensione
 quantitatum longitudinum earum. Secundum ergo hunc mo-
 dum certificat visus quantitates remotionum visibilium que
 fuerint in remotionibus mediocribus et fuerint respicientia
 270 corpora ordinata continuata.

[3.157] Quedam autem visibilia que sunt super faciem terre
 habent remotionem mediocrem, et quantitates partium terre
 interiacentium visum et ipsa sunt quantitates mediocres. Et
 quedam sunt quorum remotio est maxima et extra mediocri-
 275 tatem, et quantitates partium terre interiacentium visum et
 ipsa sunt extranee magnitudinis. Et quantitates partium terre
 comprehenduntur a visu secundum modos quos narravimus.
 Illud ergo eorum quod est propinquum et mediocris quantitatis
 comprehenditur et certificatur a visu, et quod est ex eis extra-
 280 nee remotionis non certificatur a visu quantitas eius. Quoniam
 visus, quando consideravit spatia, comprehendit quantitates
 eorum dum senserit augmentationem longitudinis radii, et dum
 senserit angulos quos respiciunt partes parve partium spatii
 apud motum axis super spatium. Et certificabit quantitatem
 285 spatii dum senserit parvam augmentationem in longitudine
 radii et augmentationem parvam in angulo quem respicit spa-

258 partis visus: totius spatii L3/post visus add. in oculo C1S (inter. a. m. S)
 259 quem: quam P3 260 qui: que Er 261 certificabuntur inter. L3 262 partis
 om. L3/terre: rei Er/quantitates: quantitas P1/longitudinum (263) inter. L3 263 in
 ... remota inter. L3 264 parietum: iotum L3 265 partium corr. ex spatium L3/
 comprehendet: comprehenduntur R/remotiones (266) alter. in intentiones a. m. E
 268 remotionum: remotionis L3/que: quando EErL3P3R; alter. in quando C1S (a. m. S)
 269 in: ex EErL3P3R; alter. in ex C1S (a. m. S) 271 super faciem corr. ex super-
 faciem S 272 partium: spatium L3 273 ante visum add. inter R/quantitates
 ... sunt (276) mg. a. m. E 275 interiacentium: interiacium P3/ante visum add.
 inter R 278 eorum om. R; inter. a. m. E 279 post et² add. quantitas eius R/
 ex eis om. R/ex eis extranee (280): extranee ex eis L3 280 quantitas: quantitatis P3;
 om. R/eius om. R 281 post quando scr. et del. certifica L3/consideravit: considera-
 verit C1L3S; comprehendit P3; comprehenderit R; alter. ex comprehenderit in
 consideraverit a. m. E/post spatia add. et Er/comprehendit: comprehendet EErL3P3R
 282 eorum: eorundem EP3R/dum¹ inter. a. m. E 284 axis om. S 286 parvam
 inter. a. m. E

tium. Et cum remotio fuerit maxima, non sentiet augmentatio-
nem parvam in longitudine radii, nec sentiet motum radii super
parvam partem spatii cuius remotio est maxima, nec sentiet
290 angulum quem respicit parva pars remotionis maxime, nec cer-
tificabit longitudinem radii pervenientis ad extremum spatii,
nec certificabit quantitatem anguli quem respicit spatium illud.
Et cum non certificaverit longitudinem radii pervenientis ad
extremum spatii, nec certificavit quantitatem anguli quem res-
295 picit spatium, non certificabit quantitatem spatii.

[3.158] Et etiam, quando remotio fuerit maxima, partes
parve que sunt in ultimo spatii non comprehenduntur a visu
nec distinguuntur ab eo, quoniam parva quantitas in remotione
maxima latet visum. Cum ergo axis radialis movebitur super
300 spatium remotum maximum et perveniet ad remotionem maxi-
mam, transibit partem parvam spatii, et non sentiet sentiens
motum eius, quoniam pars parva in remotione maxima non
facit angulum sensibilem apud centrum visus. Cum ergo axis
radialis movebitur super spatium remotum, et senserit visus
5 quod ipse iam transierit partem aliquam spatii, quantitas illius
partis quam transivit non erit quantitas quam comprehendit
per sensum, sed erit maior. Et quanto magis augmentabitur
remotio spatii, tanto magis erunt partes latentes visum apud
ultimum spatii, et super quas latet motus radii visus, erunt
10 scilicet maiores. Quantitates ergo remotionum maximarum que
sunt super faciem terre non certificantur a visu, quoniam non
certificat quantitatem longitudinis radii pervenientis ad ulti-
mum earum nec quantitatem anguli quem respicit spatium
illud.

15 [3.159] Et etiam sentiens sentit certificationem quantitatis
spatii, quoniam visibile propinquum visui in remotione medio-
cri est magis certe visionis, scilicet, quia forme eorum sunt

287 remotio *corr. ex remom P3/augmentationem* (288) *corr. ex argumentationem S*
288 radii *om. EP3/super: propter EL3P3R* 289 spatii *corr. ex radii E/est om. S*
292 illud: istud L3 294 nec: et non R/certificavit: certificabit EP3; certificaverit L3R
295 post spatium *inter. illud a. m. C1; rep. illud (292) . . . spatii (295) EL3P3 (certificavit:*
certificaverit)/post spatii scr. et del. in C1 297 post parve *add. spatii EEEL3P3R/non*
inter. S 298 post remotione *scr. et del. ma C1* 299 axis *inter. L3* 300 maxi-
mum: maxime R 1 partem parvam *transp. Er* 2 pars *om. P3/pars parva transp.*
ER/post remotione add. eius P3 4 post radialis *scr. et del. motu P1* 5 partem
aliquam *transp. C1R/quantitas corr. ex quantitatis S* 6 post partis *add. spatii P3R/*
quam transivit mg. a. m. E 8 erunt *om. R/latentes: latebunt R* 10 scilicet
om. R 12 pervenientis *corr. ex pervenientes P1* 13 post earum *scr. et del. nec*
quantitatem longitudinis radii pervenientis ad ultimum earum S/quem: quam Er/
spatium illud (14) transp. ErL3P3R 15 certificationem: verticationem L3
16 visibile: visibilem E; *corr. ex visibilem P3/in . . . mediocri (17) om. R* 17 magis
certe: certioris R/quia forme *transp. P1/eorum: visibilium propinquorum R*

manifestiores et comprehenduntur a visu manifestiori compre-
 20 hensione. Et color et lux eorum sunt manifestiores, et situs
 superficierum eorum apud visum, et situs partium eorum, et
 forma partium eorum et partium superficierum sunt manifes-
 tiores visui. Et si in eis fuerit lineatio aut pictura aut partes
 parve, apparebunt visui manifestius. Et non est ita de visi-
 25 bilibus maxime remotionis. Quoniam res visa, quando fuerit in
 remotione maxima, non certificabit visus formam eius secun-
 dum suum esse, et dubitabit in colore, et luce, et forma super-
 ficierum eius, et nichil apparebit in ea ex subtilibus intentioni-
 bus et ex partibus parvis. Et ista intentio est manifesta sensui.
 Cum ergo visus comprehenderit aliquod spatium super faciem
 30 terre, statim postquam viderit ultimum eius et quedam visibilia
 in ultimo eius, sentiet quod illud spatium est ex spatiis medio-
 cribus aut ex spatiis maxime remotionis. Si vero certificaverit
 formam ultimi eius aut formam rei vise que est apud ultimum
 eius manifeste, et distinxerit cum hoc quantitatem illius spatii
 35 secundum modum predictum, tunc virtus distinctiva cum hoc
 comprehendet quod quantitas illius spatii est certificata ex
 comprehensione manifestationis forme ultimi eius aut forme rei
 vise que est apud ultimum eius. Si autem non certificaverit
 formam ultimi eius aut formam etiam rei vise que est apud ul-
 40 timum eius, non certificabit quantitatem illius spatii. Et cum
 hoc virtus distinctiva apud considerationem illius spatii com-
 prehendit quod etiam illud spatium non est certificate quanti-
 tatis propter latentiam forme ultimi eius aut forme rei vise que
 est apud ultimum eius.
 45 [3.160] Quantitates ergo remotionum visibilium distinguen-

18 manifestiori: manifestiore R 20 eorum²: earum C1P1S 21 eorum: ea-
 rum C1P1S 22 in eis fuerit: fuerit in eis L3/post aut scr. et del. fig P3/pictura corr. ex
 figura E 23 manifestius corr. ex manifeste C1 24 ante maxime scr. et del. parve
 E/maxime remotionis transp. EP3R/quando: quae R 25 formam eius om. R
 26 et² om. EL3P1P3R 28 est manifesta transp. EErL3P3R/post manifesta add.
 visui L3 29 super faciem: superficiem Er 30 postquam: sentiet priusquam R/
 eius inter. L3 31 sentiet om. R/spatiis: partibus P1; spatibus S 33 ultimum mg.
 a. m. P3 34 cum hoc: etiam R; inter. a. m. S 35 cum hoc: etiam R 38 ultimum
 corr. ex ultimul S; si . . . eius (40) mg. a. m. E 39 aut: ad S/formam etiam transp. P1/
 etiam om. EErL3P3R 40 eius inter. L3/post spatii scr. et del. comprehendit quod S/
 cum hoc (41) om. R 41 illius: istius EP3R/post spatii add. simul R/comprehendit
 (42): comprehendet EErL3P3R 42 quod etiam transp. C1/etiam om. EErL3P3R/
 illud: istud EL3P3R/non est corr. ex est non L3/post non scr. et del. a S 43 ante rei scr.
 et del. non C1/rei om. S; mg. a. m. C1 44 eius scr. et del. P1/post eius scr. et del. si
 autem non certificaverit formam ultimi eius aut etiam formam rei vise que est apud
 ultimum eius non certificabit quantitatem illius spatii et cum hoc virtus distinctiva
 apud considerationem illius spatii comprehendit quod etiam illud P1 45 quanti-
 tates corr. ex quano P1/distinguentur (46): distinguuntur EL3P3R

tur a visu, et qualitas comprehensionis quantitatum earum certificatur apud intuitionem, et quando aspiciens voluerit certificare quantitatem rei vise et certificare quantitatem remotionis rei vise, intuebitur remotionem et distinguet ipsam, et sic distinguetur ab eo remotio certificata a remotione non certificata. Et nichil est ergo ex remotionibus visibilium cuius quantitas sit certificata nisi remotiones respicientes corpora ordinata continuata, et cum hoc sunt remotiones mediocres. Quantitates ergo huiusmodi remotionum comprehenduntur a visu secundum modum quem declaravimus, et preter ista non certificantur a visu; sed existimantur et assimilantur, scilicet quia visus assimilat remotionem rei vise remotioni sibi similibus assuetis quorum quantitas remotionis est certificata iam ab eo. Et cum visus senserit iam latentiam forme rei vise propter remotionem, dubitabit in quantitate remotionis eius. Et remotio mediocris cuius quantitas certificatur a visu est remotio apud cuius ultimum non latet visum pars habens proportionem sensibilem ad totam remotionem. Et remotio mediocris respectu rei vise in qua visus comprehendit unam quantitatem rei vise est remotio mediocris apud cuius ultimum non latet pars illius rei vise habens proportionem sensibilem ad quantitatem rei vise quando visus intuebitur illam partem per se. Omne ergo spatium cuiuslibet partis longitudo, scilicet habens proportionem sensibilem ad quantitatem longitudinis spatii, comprehenditur a visu, et non latet visum ex partibus spatii que sunt apud ultimum eius nisi illud quod caret proportionem sensibili ad longitudinem illius spatii, et tale omne spatium est ex remotionibus mediocribus. Remotio autem que est extra mediocritatem in magnitudine est illa apud cuius ultimum latet quantitas habens proportionem sensibilem ad totam

46 *post quantitatum add. vel qualitatum EP3/earum om. P3/certificatur (47): certificantur P1S; corr. ex certificantur C1* 47 *intuitionem: intentionem EP1P3; corr. ex intentionem C1L3S (a. m. C1S)/ ante et add. vel intuitionem EP3* 48 *post vise scr. et del. intuebitur remotionem S* 50 *eo: ea P1S; corr. ex ipso C1/a . . . certificata om. P1* 51 *et om. EErL3P3R/est ergo transp. R/remotionibus: intentionibus EP3R* 53 *cum hoc: cuius etiam R/sunt: sint C1P1S/sunt remotiones transp. R/mediocres: mediocris Er; inter. a. m. E/quantitates: corr. ex quantitata P3; alter. in quantitate a. m. S* 55 *non: que S* 56 *quia: quod EL3P3R* 57 *sibi om. Er* 58 *iam om. P3* 59 *vise inter. a. m. E* 61 *post visu scr. et del. et S* 64 *vise inter. L3/unam: veram EP3R; alter. in veram a. m. C1* 66 *pars inter. L3* 67 *visus: virtus P3/post visus add. intuetur P3/per inter. L3* 68 *ergo: igitur P1/post spatium add. cuius EErL3P3 (inter. L3); add. in quo R/scilicet: est EErL3P3; om. R* 69 *habens: habet R* 72 *spatii corr. ex spatiis P3; corr. ex spatium S/tale omne transp. EErL3P3R* 73 *remotionibus mediocribus transp. P3* 74 *in inter. a. m. Er/post in add. longitudine vel EP3/magnitudine: longitudine R* 75 *proportionem corr. ex proportor P3*

illam remotionem. Et remotio que est extra mediocritatem respectu visus est illa in qua latet quantitas aliqua ex illa re visa habens proportionem sensibilem ad totam illam rem visam, aut latet aliqua intentio illius rei vise cuius latentia operatur in
 80 latentiam quiditatis illius rei vise.

[3.161] Et etiam sentiens comprehendet quantitatem remotionis rei vise ex quantitate anguli quem respicit res visa. Quoniam, quando visus comprehenderit visibilia assueta que sunt in remotionibus assuetis, statim apud comprehensionem cognoscet ipsa visus, et quando visus cognoverit ipsa, cognoscet
 85 quantitates magnitudinum eorum, quoniam quantitates magnitudinum eorum iam fuerunt certificate propter frequentationem comprehensionis cuiuslibet visibilium assuetorum, et iam sunt quiete in ymaginatione. Et visus, statim cum comprehendit
 90 rem visam assuetam, comprehendit partem visus in qua pervenit forma illius rei vise quam respicit illa pars. Et cum sentiens comprehenderit illam quantitatem magnitudinis rei vise per cognitionem, et comprehenderit angulum quem tunc respicit illa res visa, comprehendet quantitatem remotionis illius
 95 rei vise in illa dispositione, quoniam angulus quem respicit illa res visa non erit nisi secundum quantitatem remotionis. Et sicut sentiens recipit significationem super quantitatem magnitudinis et remotionem cum illo angulo, ita accipit significationem super quantitatem remotionis ex quantitate magnitudinis
 100 cognite apud ipsam cum illo angulo. Quoniam illa magnitudo non respicit illum angulum nisi ex illa eadem remotione aut ex remotione equali illi, non ex omnibus remotionibus. Et cum sentiens comprehenderit quantitatem remotionis illius rei vise assuete multotiens et frequenter in horis in quibus illa res visa
 105 respicit apud centrum visus simile illi angulo, et multotiens acceperat significationem super quantitatem magnitudinis illi-

76 illam om. L3/post et scr. et del. totum P3 77 post ex scr. et del. re visa S 80 latentiam: latentia EErL3P3/quiditatis: quiditas L3 81 comprehendet: comprehendit EErL3P3R; corr. ex comprehenduntur P1 82 post respicit add. illa EP3R 83 comprehendit: comprehendit L3R 85 post cognoscet add. ipsas EP3R 86 magnitudinum (87) om. L3P1; mg. a. m. E 87 fuerunt: fuerint L3P1P3; corr. ex fuerint E 88 comprehensionis cuiuslibet transp. EP3R 89 statim om. R/cum om. EP3; inter. L3/comprehendit: comprehendit EP3R 90 post assuetam add. statim R/qua: quam EErL3P3R 91 post cum scr. et del. senserit P1 92 illam om. EErL3P3R 96 visa inter. a. m. C1 97 recipit: respicit ErP1S/super: secundum P3 98 et: ex EP3R/post et inter. ex C1L3S (a. m. C1)/remotionem: remotione EP3; corr. ex remotione C1L3S (a. m. C1S) 100 apud ipsam corr. ex ipsam apud C1 101 illum: istum EP3; mg. C1L3 (a. m. C1)/angulum om. S; mg. a. m. C1/post angulum add. illa C1/aut ex remotione (102): vel C1L3P1S 102 illi corr. ex ei C1 104 assuete corr. ex assuei P3/post horis scr. et del. in horis P3 105 simile: similem R/illi inter. a. m. S 106 acceperat: accipit EP3; acceperit R/post acceperat inter. illam a. m. C1

us rei vise ex quantitate remotionis illius rei vise cum quantitate anguli qui est equalis illi angulo, virtus distinctiva intelliget quantitatem remotionis in qua comprehendit magnitudinem
 110 illius rei vise respectu illius anguli. Et cum virtus distinctiva intellexerit quantitatem remotionis illius rei vise respectu illius anguli, et comprehenderit in ista remotione magnitudinem illius rei vise respectu illius eiusdem anguli quando virtus distinctiva cognoverit illam rem visam, et cognoverit quantitatem magnitudinis eius quam ante comprehenderit, et comprehenderit statim quantitatem anguli quam tunc respicit illa res visa, cognoscet quantitatem remotionis secundum quam illa remotio respicit illum angulum. Sentiens ergo comprehendit quantitatem remotionum visibilium assuetorum ex comparatione anguli ad
 120 magnitudinem rei vise. Deinde propter frequentationem comprehendet sentiens remotionem rei vise assuete per cognitionem. Et erit quantitas anguli quem respicit res visa assueta apud comprehensionem eius cum cognitione illius rei vise signum super quantitatem remotionis illius rei vise, et plures
 125 remotionum visibilium assuetorum comprehenduntur secundum hunc modum. Et ista comprehensio non est in fine certificationis, tamen inter istam remotionem et remotionem certificatam non est maxima diversitas, et ex ista comprehensione opinati sunt mathematici quod magnitudo rei vise comprehenditur per angulum. Visibilia ergo assueta que sunt in
 130 remotionibus assuetis, quando visus comprehenderit ipsa et cognoverit quantitates remotionum istorum secundum istam viam, inveniet veritatem rei in maiori parte in quantitativis

107 ex . . . vise *inter. a. m. S* 108 illi *corr. ex illius Er* 110 et . . . anguli (112) *om. L3* 111 remotionis *om. EP1P3R* 112 comprehenderit: comprehendit *L3/illius om. L3R/illius rei vise (113): rei vise illius EErP3* 113 *post vise scr. et del. respectu illius rei vise S/quando . . . distinctiva om. R* 114 *ante cognoverit¹ add. et R* 115 comprehenderit¹: comprehendit *ErP1RS/et comprehenderit inter. L3/statim (116) om. R* 116 quantitatem *corr. ex magnitudinem P1/ante anguli add. illius EP3R/quam: quem EL3P3R* 118 ergo: igitur *P1* 119 remotionum: remotionis *P1/ex inter. a. m. Er/comparatione: operatione L3* 120 comprehendet (121): comprehendit *EEL3P3R* 122 res visa *transp. ErL3* 123 ante eius *add. anguli EL3P3R/post eius add. vel anguli eius C1S (inter. a. m. S)/illius corr. ex illis S/signum (124) . . . quantitatem (124) inter. L3* 124 remotionis . . . vise: illius rei vise remotionis *Er/illius . . . vise: rei vise L3 (inter.)* 125 remotionum: remotiones *EP3R/assuetorum om. S; mg. a. m. C1* 126 certificationis (127): certitudinis *EP3R* 127 tamen: cum *L3/istam remotionem transp. L3R* 128 *post est scr. et del. in fine certificationis S/diversitas corr. ex quantitas P3* 129 vise *om. ER; scr. et del. P3/comprehenditur (130): comprehendatur R* 130 *post angulum add. quando ergo visus comprehenderit R/ergo om. R/post que add. in Er* 131 quando *corr. ex quoniam L3P1/quando . . . ipsa om. R/comprehenderit: comprehendit EP3* 132 *post cognoverit scr. et del. ipsa S/istorum: ipsorum EP3; eorum ErL3/illorum R* 133 rei *om. R*

remotionum eorum, aut non erit inter illud quod comprehendit
 135 ex quantitibus remotionum eorum et inter remotiones veras
 magna diversitas.

[3.162] In illo autem quod visus comprehendit ex quantita-
 tibus remotionum visibilium extraneorum que non frequenter
 comprehendit, visus erratur in maiori parte, et cum hoc forte
 140 inveniet aliquando in eo quod comprehendit ex quantitibus
 earum secundum hunc modum. Secundum ergo istos modos
 quos declaravimus comprehenduntur quantitates remotionum
 visibilium per sensum visus.

[3.163] Et postquam declarata est qualitas comprehensio-
 145 nis quantitatum remotionum visibilium, et distincte sunt remo-
 tiones visibilium, distinguemus modo magnitudines visibilium
 que comprehenduntur a visu, et distinguemus comprehensio-
 nem illorum a visu. Dicamus ergo quod magnitudines quas
 comprehendit visus apud oppositionem sunt quantitates su-
 150 perficierum visibilium, et quantitates partium superficierum
 visibilium, et quantitates terminorum superficierum visibilium,
 et quantitates terminorum partium superficierum visibilium, et
 quantitates spatiorum que sunt inter terminos partium super-
 ficierum visibilium, et quantitates spatiorum que sunt inter
 155 visibilia distincta. Et isti sunt omnes modi quantitatum quas
 comprehendit visus apud oppositionem rei vise. Quantitas
 autem corporis rei vise non comprehenditur a visu apud oppo-
 sitionem, quoniam visus non comprehendit totam superficiem
 corporis apud oppositionem; et non comprehendit nisi illud
 160 quod sibi opponitur ex superficie corporis eius, quamvis cor-
 pus sit parvum. Et si visus comprehenderit corporeitatem
 corporis, non comprehendet quantitatem corporis eius, sed
 figuram corporeitatis tantum. Si ergo corpus fuerit motum, aut

134 eorum: ipsorum R/aut . . . eorum (135) *mg. a. m. S/inter illud corr. ex illud inter Er*
 135 *ex om. E/post eorum scr. et del. aut non erit inter illud quod comprehendit E/et . . .*
 remotionum (138) *mg. L3* 139 *erratur: errat R/hoc om. Er* 140 *aliquando:*
aliquid R/in eo inter. a. m. E/comprehendit corr. ex comprehendit Er 141 *earum:*
 eorum *P1R* 144 *post est scr. et del. quan P1* 145 *et . . . visibilium¹ (146) om. P3*
 146 *modo magnitudines: modos magnitudinis EL3P3/post visibilium² add. vel modos*
magnitudinis C1 148 *illorum: eorum C1P1; illarum R* 149 *comprehendit:*
comprehendet L3 150 *partium superficierum corr. ex superficierum partium P3*
 151 *visibilium¹ mg. L3* 152 *et¹ . . . visibilium om. EEP3R/terminorum om. L3/*
partium corr. ex spatium L3/post partium scr. et del. que sunt inter terminos L3
 154 *post visibilium rep. et² (152) . . . visibilium (154) EEP3 (post quantitates scr. et del.*
visibilium E/terminos partium: partes EP3)/post et add. spatia L3/quantitates inter.
a. m. S 156 *quantitas corr. ex quantitates S* 157 *post visu scr. et del. a visu S*
 159 *apud corr. ex aut S* 160 *post corporis add. aut ex superficieribus C1EErL3P3R (mg.*
a. m. C1)/eius inter. E/corpus (161) om. L3 161 *post sit inter. corpus L3* 163 *ergo:*
igitur P1/aut inter. L3

- visus moveatur ita quod visus comprehendat totam superfici-
 165 em corporis per sensum aut per significationem, tunc virtus
 distinctiva comprehendet quantitates corporeitatis eius per
 secundam argumentationem preter argumentationem qua usa
 est apud visionem. Et similiter virtus distinctiva, cum com-
 prehendet quantitatem corporeitatis cuiuslibet partium cor-
 170 poris, non comprehendet ipsam nisi per argumentationem
 secundam preter argumentationem que est apud visionem.
 Quantitates ergo quas visus comprehendit apud oppositionem
 non sunt nisi quantitates superficierum et linearum quas deter-
 minavimus tantum.
- 175 [3.164] Et iam declaratum est quod comprehensio magni-
 tudinis non est nisi ex comparatione basis pyramidis radialis
 continentis magnitudinem ad angulum pyramidis qui est apud
 centrum visus et longitudinem pyramidis, que est remotio mag-
 nitudinis rei vise. Et iam declaratum est quod quedam remo-
 180 tiones visibilium sunt certificate, et quedam estimate. Magni-
 tudines autem visibilium quorum est remotio certificata com-
 prehenduntur a visu ex comparatione magnitudinum earum ad
 angulos quos respiciunt ille magnitudines apud centrum visus
 et ad remotiones eorum certificatas. Comprehensio ergo quan-
 185 titatum remotionum huiusmodi visibilium erit comprehensio
 certificata. Quantitates autem remotionum visibilium quorum
 remotio est estimata et non certificata comprehenduntur a visu
 ex comparatione magnitudinis eorum ad angulos quos respici-
 unt ille magnitudines apud centrum visus et ad remotiones
 190 earum estimatas et non certificatas. Comprehensio ergo quan-
 titatum remotionum huiusmodi visibilium erit comprehensio
 non certificata. Cum ergo sentiens voluerit certificare quanti-
 tatem magnitudinis alicuius rei vise, movebit visum super suos
 dyametros, et sic movebitur axis radialis super omnes partes
 195 rei vise. Si ergo remotio rei vise fuerit ex remotionibus maxi-
 mis, statim apparebit sensui latentia forme eius, et manifes-
 tabitur sentienti quod quantitas eius non est certificata. Et si

164 quod: ut R/visus comprehendat *transp.* EP3R 167 preter: propter P1/preter
 argumentationem *inter. a. m. S/usa*: visa L3; *corr. ex* visa S 168 *post* similiter *add.*
 cum EL3P3; *add. si R/cum om.* EErL3R 172 quantitates *corr. ex* quantitas L3
 175 declaratum: determinatum L3 176 *ex corr. ex per a. m. Er* 177 magnitudinem
corr. ex magnitudine P3/qui: quod C1S; que L3 179 rei vise *transp.* C1Er/iam *om.*
 P1/quod *om. Er* 181 est remotio *transp.* EErL3P3R 184 *et om.* L3 186 autem:
 ergo L3 187 remotio *om.* P1 190 *post* ergo *scr. et del.* radiorum P1
 191 huiusmodi visibilium *transp.* EL3P3R 192 ergo: igitur P1 193 movebit:
 removebit P3/suos: illius R; *corr. ex* duos P1 195 si . . . vise *mg.* L3 197 *ante* quod
add. et P1/et si: si vero R

remotio rei vise fuerit ex remotionibus mediocribus, statim
 apparebit sensui verificatio visionis eius. Si ergo axis radialis
 200 moveatur super illud quod est huiusmodi visibilium, mensura-
 bit ipsum vera mensuratione, et comprehendet partes eius, et
 certificabit quantitates partium eius. Et per motum certificabit
 quantitates partium superficiei membri sentientis in qua per-
 venit forma illius rei vise et quantitatem anguli pyramidis quem
 205 respicit illa pars. Et cum voluerit certificare remotionem eius
 super corpus respiciens remotionem eius, et per motum certifi-
 cabit quantitatem corporis respicientis remotionem eius que est
 equalis secundum sensum longitudinibus linearum radialium.
 Et cum sentiens certificaverit quantitatem remotionis rei vise et
 210 quantitatem anguli quem continet pyramis continens rem vi-
 sam, certificabit quantitatem illius rei vise.

[3.165] Motus autem axis super partes rei vise non erit per
 girationem axis a loco centri et per motum eius per se super
 partes rei vise, quoniam iam declaratum est quod ista linea
 215 semper est extensa recte usque ad locum girationis nervi super
 quem componitur oculus. Et cum situs eius a visu non muta-
 tur, sed totus oculus movetur in oppositione rei vise, et medi-
 um loci, qui est locus sensus visus, opponitur cuilibet parti
 partium rei vise, et cum totus visus movebitur in oppositione
 220 rei vise, axis transibit per quamlibet partium rei vise. Et tunc
 forma cuiuslibet partium rei vise extenditur ad visum apud
 perventum axis ad ipsam super rectitudinem axis. Et cum hoc
 erit axis fixus in suo situ, et non mutabitur a suo loco respectu
 omnium partium totius oculi. Et erit giratio eius in ista dispo-
 225 sitione apud motum totius visus in loco nervi qui est apud
 concavum ossis tantum.

198 mediocribus: mediocris P1 200 post est add. in R/post huiusmodi add.
 mediocrum ES (inter. a. m. S); add. mediocrum P3/visibilium: visibilibus R 201 ip-
 sum: ipse C1P1S 202 partium . . . quantitates (203) om. P3 203 quantitates:
 quantitatem R 205 post cum add. sentiens R/eius om. E 206 post motum add.
 axis C1L3S (inter. L3; inter. a. m. S) 207 respicientis corr. ex respiciens S 210 pyra-
 mis corr. ex pyramidis P3 212 post erit scr. et del. nisi L3 213 axis om. P1; inter.
 a. m. S/post centri add. visus C1ErL3S (inter. L3; inter. a. m. ErS) 215 semper est
 transp. L3 216 cum: tamen C1ErL3S; quod R 217 sed: et P1R 218 cuilibet
 corr. ex cuiuslibet Er 219 post vise scr. et del. et tunc forma cuiuslibet partium rei vise
 extenditur ad visum apud perventum axis ad ipsam S/et: ergo R 220 axis . . . vise
 mg. L3/post quamlibet add. partem C1ErL3P1 221 extenditur: extendetur R/post
 apud scr. et del. c Er 222 ipsam: ipsum L3/post ipsam inter. rem a. m. Er/super:
 secundum L3/cum hoc om. R 223 post axis add. pyramidis P1/situ: loco EP3R
 224 post partium add. eius EL3P3/totius corr. ex totium S/post oculi scr. et del. et erit
 giratio eius in ista dispositione apud motum totius oculi L3/ista: sua P3 225 qui
 corr. ex quidem S 226 ossis: axis P3

[3.166] Et cum visus voluerit intueri rem visam et inceperit
intueri in extremitatem rei vise, erit tunc extremum axis super
partem extremam rei vise. Erit ergo in ista dispositione maior
230 pars totius rei vise in parte superficiei visus declinante aut
obliqua ab axe ad aliquam partem preter partem super quam
est axis, quoniam forma extremitatis eius erit in medio eius et
in loco axis in visu, et erit residuum forme obliquum ad aliam
partem ab axe. Deinde, quando visus movebitur post istam
235 dispositionem super aliam dyametrum rei vise, transferetur
axis ad partem sequentem illam partem illius, et erit forma
prime partis declinans ad alterum ubi oppositum ubitati ad
quam movetur axis. Iam deinde non cessabit forma declinare
dum axis movetur super illum dyametrum quousque axis per-
240 veniat ad ultimum illius dyametri rei vise et ad partem extre-
mam rei vise oppositam prime partis. Erit ergo forma totius
rei vise in ista dispositione obliqua ad ubi oppositum ubitati
ad quam prius fuit obliqua preter quam ultima pars extrema
que erat super axem et in medio visus. Et axis in toto isto
245 motu erit fixus in suo situ, et erit iste motus valde velox, et in
maiori parte est insensibilis propter velocitatem. Axis autem
non superponitur in suo motu terminis anguli quem respicit res
visa apud centrum visus, nec secatur latitudinem anguli quem
respicit aliquis dyametrorum rei vise, quoniam hoc non erit
250 nisi quando axis fuerit motus per se et totus oculus quiescens,
quod est impossibile. Sed totus oculus movetur apud intuitio-
nem, et axis movetur per motum eius. Sentiens autem non
comprehendit quantitatem anguli quem respicit res visa apud
centrum visus nisi ex comprehensione quantitatis partis super-
255 ficiei visus in qua figuratur forma rei vise et ex ymaginatione

227 *post cum scr. et del. to P3/voluerit corr. ex volueri P3/inceperit: ceperit Er; inceperit L3P1/inceperit intueri (228) transp. P3* 228 *in om. ErL3* 230 *declinante: declinate S* 232 *extremitatis om. C1EErL3P3R/erit inter. L3* 233 *post obliquum add. aut EErL3P1P3R (scr. et del. L3)/ante ad add. declinans R/aliam: aliquam ErL3* 234 *ante post scr. et del. istis quomodo P1/istam: illam EL3P3R* 235 *aliam: aliquam ErL3/transferetur: transferentur Er* 236 *post partem¹ scr. et del. visam P1/illius om. R/erit om. R* 237 *post partis add. illius L3/declinans: declinabit R/ad¹: super P3R; corr. ex super a. m. E/ubi: ubitatem R; corr. ex visi L3/ubitati corr. ex veritati S* 239 *illum: illam EP3R/axis² om. P3* 240 *et om. ErP1/post partem scr. et del. extrem C1* 241 *rei corr. ex rem L3/post vise scr. et del. n L3/partis: parti EErP1P3R* 242 *ubi: ubitatem R/oppositum: oppositionem E; oppositam R* 243 *quam²: quod C1P1S/extrema om. R* 244 *visus om. P1/toto isto corr. ex isto toto S* 245 *post suo scr. et del. in E* 247 *superponitur: supponitur EErP1P3RS/terminis: terminus C1L3P1R/post respicit add. illa EP3R/res... respicit (249) om. P1* 249 *aliquis: aliqua R/erit mg. a. m. C1* 250 *fuerit: fuit P3/quiescens: quieverit R* 251 *sed om. R/post totus add. enim R* 252 *movetur rep. P1* 255 *figuratur corr. ex fangantur P3*

anguli quem respicit illa pars apud centrum visus.

- [3.167] Et sensus visus comprehendit naturaliter quantitates partium visus in quibus figurantur forme, et naturaliter ymaginatur angulos quos respiciunt iste partes. Sentiens autem non certificat formam rei vise et quantitatem magnitudinis rei vise per motum visus nisi quia per istum motum comprehendit quamlibet partem partium rei vise per eius medium et per locum axis in visu. Et per istum motum movetur forma rei vise super superficiem visus, et sic mutabitur pars superficiei visus in qua fuit forma, quoniam forma rei vise apud motum erit in parte post aliam et partem post aliam in superficie visus. Et quotiens comprehenderit sentiens partem rei vise que est apud extremum axis, comprehendet cum hoc totam rem visam, et comprehendet totam partem superficiei visus in qua pervenit forma totius rei vise, et comprehendet quantitatem illius partis, et comprehendet quantitatem anguli quem respicit illa pars apud centrum visus. Et sic multotiens comprehendet sentiens quantitatem anguli quem respicit illa res visa; quare erit ab eo certificata, et quare etiam virtus distinctiva intelliget quantitatem anguli et quantitatem remotionis, et ex eis comprehendet quantitatem magnitudinis rei vise secundum veritatem. Secundum ergo hunc modum erit intuitio visibilium a visu et certificatio quantitatis magnitudinum rerum visarum per intuitionem.
- [3.168] Et etiam quando visus comprehendit quantitates longitudinum linearum radialium que sunt inter visum et terminos rei vise aut partes superficiei rei vise, sentiet equalitatem et inequalitatem earum quantitatum. Si autem superficies rei vise quam visus comprehendit fuerit obliqua, sentiet obli-

257 et: nam R/visus om. P1; inter. a. m. S 259 ymaginatur corr. ex ymaginantur C1L3
 261 motum¹ corr. ex motus L3 262 partem om. EP3R/vise corr. ex visus P1/post vise
 scr. et del. et L3 263 per¹ inter. a. m. C1/motum mg. a. m. C1 264 forma corr. ex
 formam S/post superficiem scr. et del. rei vise C1/superficiem visus inter. L3/mutabitur:
 mutatur EP3 265 qua corr. ex quam L3 266 post motum add. non ErL3 (scr. et
 del. L3)/et om. R/et partem transp. P1/et . . . aliam mg. P3/post aliam² om. R
 267 visus om. C1P1S 268 extremum: extremitatem L3/cum hoc: simul R
 269 rem visam corr. ex visam rem P3 270 qua: quam EErL3P3R/comprehendet:
 comprehendit C1EP1P3S 271 ante illius scr. et del. totius C1/illius partis transp. C1/
 comprehendet: comprehendit P3; alter. in comprehendit E 272 pars om. P3
 273 comprehendet: comprehendit Er 274 visa corr. ex via P3/et om. R/quare om.
 C1S/quare etiam transp. P1 276 et om. R/eis: quibus R 277 post erit add. intentio
 vel EP3/intuitio corr. ex intentio L3; alter. in intentio a. m. S/post intuitio scr. et del. vel
 intentio C1 279 intuitionem: intentionem EP3 280 comprehendit: comprehendet
 C1EP3R/quantitates: quantitatem Er 283 earum: eorum Er/autem om. R
 284 comprehendit: comprehenderit C1P1/fuerit: fuit P1/obliqua sentiet mg. a. m. S/
 sentiet corr. ex sentiens L3

285 quationem eius ex sensu inequalitatis quantitatum remotionum
extremorum eius. Et si superficies fuerit directe opposita, sen-
tiet directionem ex sensu equalitatis remotionum. Et sic non
latet quantitas magnitudinis eius virtutem distinctivam, quo-
niam virtus distinctiva comprehendit ex inequalitate remotio-
290 num extremorum dyametrorum spatii obliqui obliquationem
pyramidis continentis ipsum quarum sentiet excessum mag-
nitudinis basis eius propter obliquationem. Et non admiscetur
secundum assimilationem quantitas magnitudinis oblique mag-
nitudini directe opposite nisi quando comparatio fuerit ad
295 angulum tantum. Si autem comparatio fuerit ad angulum et ad
longitudines linearum radialium interiacentium visum et extre-
ma rei vise, non dubitabit in quantitate magnitudinis.

[3.169] Quantitates autem magnitudinis linearum et spatio-
rum comprehenduntur a visu ex comprehensione quantitatum
300 remotionum extremorum earum et ex comprehensione inequali-
tatis et equalitatis earum. Sed remotior et remotissima remo-
tionum mediocrium respectu rei vise quando res visa fuerit
obliqua est minor remotissima remotionum mediocrium respec-
tu illius eiusdem rei vise quando fuerit directe opposita. Quo-
5 niam remotio mediocris rei vise est in qua non latet visum pars
rei vise habens proportionem sensibilem ad totam rem visam.
Et cum res visa fuerit obliqua, angulus quem continent duo
radii exeuntes a visu ad aliquam partem rei vise oblique erit
minor angulo quem continent radii duo exeuntes a visu ad
10 illam eandem partem et ad illam eandem remotionem quando
res visa fuerit directe opposita visui. Et pars habens sensibi-
lem proportionem ad totam rem visam quando res visa fuerit
obliqua latet in remotione minori remotione in qua latet eadem

285 quantitatum remotionum *transp. S* 287 ante ex *add. eius Er* 288 latet: latebit
R/ ante eius *scr. et del. rei vise P1* 289 inequalitate *corr. ex equalitate P3* 290 ex-
tremorum dyametrorum *transp. EErL3P3R* 291 post ipsum *inter. spatium a. m. Er/*
quarum: quare *EErP3R*; quia *P1* 292 basis eius *transp. EP3R* 293 post quantitas
scr. et del. m Er/oblique: obliqua P3 296 radialium *mg. P1/ ante visum add. inter R*
297 rei *corr. ex res Er/ ante in add. virtus distinctiva R/quantitate: quantitatem P3*
298 quantitates *corr. ex quantitas Er/ autem magnitudinis: ergo magnitudinum*
EErL3P3R/ magnitudinis linearum transp. L3 300 earum: in illis *R/ ex om. C1/*
inequalitatis et equalitatis (1): equalitatis et inequalitatis *L3* 1 earum: eorum
L3P3R/ remotior et: remotio R 2 mediocrium: mediocrum *L3P3/ quando corr. ex*
quoniam *L3* 3 mediocrium: mediocrum *P3* 4 rei *corr. ex res Er/ post quando*
add. res visa EP1P3R 5 ante rei *add. respectu EErL3P3R/ est om. P3; inter. a. m. E/ est*
. . . vise (6) rep. P1 6 sensibilem: sensibilibum *EP3/ visam om. P1* 7 obliqua:
aliqua *C1Er/ continent: continet C1/ post continent scr. et del. anguli P3/ post duo scr. et*
del. anguli P3 8 partem rei vise: rei vise partem *L3/ erit: est S* 9 quem: que *P1/*
radii duo transp. R/ a visu om. C1 10 illam¹: aliam *Er/ eandem partem transp. C1/*
post partem add. a visu C1 13 remotione²: quam est remotio *R*

illa pars quando illa res visa fuerit directe opposita. Remotis-
 15 sima ergo remotionum mediocrium respectu rei vise obliqua est
 minor remotissima remotionum mediocrium respectu illius
 eiusdem rei vise quando illa res visa fuerit directe opposita.
 Et tota res visa obliqua latet in remotione minori remotione in
 qua latet illa res visa quando fuerit directe opposita, et dimi-
 20 nitur quantitas eius in remotione minori remotione qua dimi-
 nitur quantitas eius quando fuerit directe opposita.

[3.170] Magnitudines ergo rerum visarum quarum quanti-
 tates certificantur a visu sunt ille quarum remotio est mediocris
 et quarum remotio respicit corpora ordinata continuata, et
 25 comprehenduntur a visu ex comparatione illarum ad angulos
 pyramidum radialium continentium ipsa et ad longitudines
 linearum radialium. Remotiones autem mediocres respectu
 alicuius rei sunt secundum situm illius rei vise in obliquatione
 aut in directa oppositione. Et anguli non certificantur nisi per
 30 motum visus respicientis super dyametros superficiei rei vise
 aut super spatium cuius magnitudinem voluerit scire, et cer-
 tificatur remotio per motum visus super corpus respiciens
 remotiones extremorum illius superficiei aut illius spatii. Et
 generaliter forma remotionis et forma rei vise cuius remotio est
 35 mediocris (et cum hoc est respiciens corpora ordinata continu-
 ata) perveniunt communiter in ymaginatione simul apud intuiti-
 onem rei vise quando visus comprehendit corpus respiciens
 remotionem rei vise apud comprehensionem rei vise. Et sic
 virtus distinctiva comprehendet magnitudinem rei vise secun-
 40 dum quantitatem forme remotionis eius certificate coniuncte
 cum forma eius. Quantitates ergo huiusmodi visibilium tantum
 comprehenduntur a visu vera comprehensione. Secundum ergo
 hunc modum quem declaravimus comprehenduntur magnitudi-
 nes rerum visarum per sensum visus.

14 pars corr. ex partes P3/illa res transp. L3/remotissima (15): remotissa E
 15 mediocrium: mediocrum P3/obliqua: oblique EL3P3 17 directe: recta EP3; recte
 C1ErL3S/directe opposita transp. C1 18 post visa scr. et del. recta latet S/remotione²:
 quam est remotio R/in² inter. L3 20 ante qua add. in EErL3P1P3R 21 post
 quando add. si C1/fuerit: sit C1 25 comprehenduntur: comprehenditur ErL3
 26 ipsa: ipsas R/longitudines: longitudinem C1S 28 alicuius om. R/alicius rei
 transp. EP3/post rei¹ add. vise EErL3P3R/secundum mg. EP3 (a. m. E) 29 aut inter.
 a. m. E/in om. P3 30 respicientis: respicientes E; respiciens Er 31 voluerit: voluit
 EErL3P3 32 post motum scr. et del. ipsius C1 34 post forma¹ add. rei vise cum
 forma EErL3P3; add. et forma R/et forma om. EErL3P3R 35 cum . . . respiciens:
 respicit R 36 perveniunt: pervenerint P1/ymaginatione: imaginationem R
 37 quando: quoniam P1R/comprehendit: comprehendet S 38 comprehensionem:
 comprehensione Er 40 post forme scr. et del. rei vise E/eius inter. L3 41 tantum
 inter. a. m. E

- 45 [3.171] Quare vero res visa comprehenditur in maxima
remotione minoris quantitatis sue vere, et quare comprehendi-
tur quantitas rei vise in propinquissima remotione maior quan-
titate sua vera nos declarabimus illud, et dicemus causas eius
apud nostrum sermonem in erroribus visus.
- 50 [3.172] Distinctio vero que est inter visibilia comprehendi-
tur a visu ex distinctione formarum duorum corporum sive duo-
rum visibilium distinctorum pervenientium in visu. Sed in
distinctione que est inter quelibet duo corpora distincta, aut
erit lux aut corpus coloratum illuminatum, aut erit obscuritas.
- 55 Cum ergo visus comprehendit duo corpora distincta, forma
lucis, aut forma coloris corporis, aut forma obscuritatis que est
in loco distinctionis pervenit in partem visus interiacentem
duas formas duorum corporum distinctorum pervenientium
in visum. Lux autem, aut color, aut obscuritas fortassis erit in
- 60 corpore medio interiacente duo corpora continuata cum utro-
que corporum. Si ergo visus non senserit quod lux aut obscuri-
tas que est in loco distinctionis non est in corpore continuato
cum utroque corporum que sunt in eius lateribus, non sentiet
distinctionem duorum corporum. Et etiam superficies cuiusli-
- 65 bet illorum duorum corporum est obliqua ad locum remotionis
in loco distinctionis. Igitur forte erit obliquatio duarum super-
ficierum duorum corporum aut superficiei alterius duorum
corporum manifesta visui, et forte non. Cum ergo obliquatio
duarum superficierum duorum corporum aut superficiei alteri-
- 70 us duorum corporum fuerit manifesta visui, tunc sentiet visus
distinctionem duorum corporum. Visus ergo comprehendit
distinctionem corporum ex comprehensione utriusque intentio-
num quas diximus: aut ex comprehensione lucis in loco dis-

45 *visa corr. ex vera S/comprehenditur: comprehendatur R* 46 *sue vere: sua vera*
quantitate *R/vere corr. ex lineae L3/comprehenditur (47): comprehendatur R* 47 *re-*
motione om. L3/maior: minore Er; corr. ex maiore L3 48 *nos om. R/declarabimus:*
declaravimus C1S/illud: istud EL3P3/illud . . . eius om. R 49 *apud . . . in: in nostro*
sermone de R 51 *a corr. ex ex L3/sive om. EErl3P3* 52 *visu: visum EErl3P3R*
53 *inter om. P1S; mg. a. m. C1/quelibet om. S; mg. a. m. C1/quelibet . . . corpora: corpora*
quelibet P1/distincta corr. ex distinctiva L3/aut erit lux (54) om. P3 54 *erit¹: est*
EL3R/post aut¹ add. est EP3R/erit²: est R/obscuritas corr. ex curvitas P3 55 *visus*
om. P1/comprehendit: comprehenderit EErl3P3R; comprehendet S 57 *post pervenit*
scr. et del. in pervenit P3 58 *ante duas add. inter R* 59 *lux autem: et lux EErl3P3/*
autem: vero R/fortassis: forte P1; aliquando R/erit inter. a. m. E 60 *ante duo add.*
inter R/continuata: continuato C1EErl3 61 *post lux add. color R* 64 *etiam alter.*
in cum C1; corr. ex cum a. m. S/superficies: superficiei EP3 65 *obliqua corr. ex*
oblique L3; alter. in obliquatio P3/locum corr. ex loco P3 66 *post loco scr. et del. dis*
C1/distinctionis igitur transp. EL3P3R/igitur: ergo R/superficierum (67): forma-
rum P3 67 *post superficiei add. unius EErl3P3* 68 *post corporum scr. et del. aut*
superficiei S 72 *utriusque om. R* 73 *post lucis scr. et del. et coloris L3*

75 tinctionis, sentiendo quod illa lux est ex posteriori duarum
 superficierum duorum corporum distinctorum; aut ex compre-
 hensione corporis colorati in loco distinctionis, sentiendo quod
 illud est diversum ab utroque corporum distinctorum; aut ex
 comprehensione obscurationis loci distinctionis, comprehen-
 80 dendo quod illud est obscuritas et non corpus continuatum
 cum duobus corporibus; et ex comprehensione obliquationis
 utriusque superficierum duorum corporum in loco distinctionis
 aut obliquationis superficiei alterius duorum corporum. Omne
 ergo quod visus comprehendit ex distinctione corporum non
 comprehenditur nisi secundum aliquam istarum intentionum.
 85 [3.173] Distinctio autem forte erit inter duo corpora dis-
 tincta, et forte erit inter duo corpora non diversa—scilicet quod
 duo corpora sunt continuata secundum quasdam partes et
 diversa secundum quasdam inter se, ut digiti et membra ani-
 malis, et rami arborum. Et secundum utramlibet dispositio-
 90 num visus non comprehendit distinctionem nisi secundum
 modos quos declaravimus. Et forte contingit distinctio cor-
 porum per cognitionem et per scientiam antecedentem, sed illa
 comprehensio non est per sensum visus.
 [3.174] Et quedam distinctio corporum est ampla, et que-
 95 dam stricta. Distinctio vero ampla non latet visum in maiori
 parte propter apparentiam corporis respicientis distantiam
 distinctam, et propter hoc quod illud corpus apparet diversum
 ab utroque corporum distinctorum, et propter comprehensio-
 nem lucis et vacuitatis illuminati respicientis distantiam. Dis-
 100 tantia autem modica et stricta non comprehenditur a visu nisi
 in remotione in qua non latet visum corpus cuius quantitas est
 equalis quantitati amplitudinis distantie. Si autem distantia
 inter duo corpora fuerit stricta occulta, et fuerit remotio illius a
 visu similis illi in qua lateant corpora quorum quantitas est

74 lux om. P3/est om. ErS; mg. L3 75 duorum om. P1 77 post illud add. corpus
 EErL3P3R/distinctorum corr. ex distinctiorum S 78 obscurationis corr. ex obscuritatis
 EP3 (a. m. E) 79 illud: istud L3R/post non add. est EErL3P3R/post corpus scr. et del.
 illuminatum P1 80 duobus om. Er/et: aut R 83 ergo: igitur P1 84 com-
 prehenditur: comprehendit R/aliquam: aliam C1S 85 distincta (86) . . . corpora (86)
 mg. L3 86 erit om. E 87 continuata corr. ex continui S 89 rami: ram P1/
 utramlibet corr. ex utram Er 90 post secundum add. suos P1 91 contingit:
 comprehendetur EP3; comprehenditur ErL3R 92 et . . . antecedentem: antecedentem
 et per scientiam EP3 93 sensum corr. ex sensus P3 96 respicientis: aspicientis
 EL3P3; corr. ex aspicientis S 99 vacuitatis: vacuitatem EP3; corr. ex vacuitas P1/post
 vacuitatis add. aeris EP3/illuminati: illuminate L3/distantiam: distinctam P3/distantia
 (100): distinctio R 100 modica corr. ex mediata a. m. C1 102 amplitudinis:
 amplitudini ErL3 103 post stricta add. et EP3R 104 est . . . quantitas (105)
 om. P1

105 sicut quantitas amplitudinis distantie, non comprehendet
visus illam distantiam, etsi remotio duorum corporum a visu
sit ex remotionibus mediocribus, et visus comprehenderit duo
corpora vera comprehensione. Quoniam mediocris remotio est
110 illa in qua non latet omnino quantitas sensibilis respectu quan-
titatis totius remotionis, et vera comprehensio est illa inter
quam et veritatem rei vise non est diversitas sensibilis omnino
respectu totius rei vise. Amplitudo autem distantie forte erit
talis quantitatis carentis proportionem sensibili ad remotionem
rei vise et carentis quantitate sensibili respectu utriusque duo-
115 rum corporum distinctorum, quoniam distinctio forte erit
quantitatis unius capilli; et tamen istud diminutum non aufert
distantiam. Distantia igitur inter visibilia similiter
comprehenditur a visu secundum modos quos declaravimus.

[3.175] Continuatio autem comprehenditur a visu ex pri-
120 vatione distantie. Cum ergo visus non senserit in corpore ali-
quam distantiam, comprehendet ipsum esse continuum, et si in
corpore fuerit distantia occulta non comprehensa a visu, com-
prehendit visus illud corpus esse continuum, quamvis in eo sit
discretio.

125 [3.176] Et visus comprehendit continuationem et etiam
discernit inter continuationem et contiguationem ex compre-
hensione aggregationis duorum terminorum duorum corporum.
Et visus non iudicat contiguationem nisi postquam sciverit
quod utrumque duorum corporum contiguorum est diversum
130 ab altero, quoniam differentia que est inter duo contigua forte
invenitur in duobus corporibus continuis. Si ergo sentiens non
senserit quod utrumque duorum corporum contiguorum est
diversum ab altero et distinctum ab eo, non sentiet contigu-
ationem et iudicat continuationem.

107 sit: fuerit EP3 108 quoniam: autem R/quoniam mediocris transp. R/post
quoniam add. remotio EP3/remotio: rei P3; inter. a. m. E 112 erit: sit R 114 utri-
usque om. R 115 forte: forme EP3/post erit add. in R 116 quantitatis: quantitate
P3R/et om. EL3P3R/tamen: tum R/istud: illud R 117 post distantiam add. sensibilem
in visu R/distantia: distinctio P3 (mg.)/igitur: ergo L3/similiter om. EEerL3P3R
119 comprehenditur: similiter P1S; corr. ex similiter C1/post visu add. est P1S
120 ergo: igitur P1/corpore aliquam (121): aliquo corpore R 121 post distantiam
scr. et del. non E 123 illud corpus transp. EP3 125 et visus transp. Er; corr. ex visus
et L3/comprehendit: comprehendet C1; comprehenderit L3/post comprehendit add.
etiam EP3/et etiam transp. ErL3/etiam om. EP3R 126 et contiguationem om. P1
127 ante aggregationis scr. et del. g a L3/aggregationis corr. ex girationis a. m. L3/ter-
minorum: nervorum S; corr. ex corporum P3 128 post non scr. et del. conti P1/
contiguationem: continuationem P1 129 quod: ad Er (scr. et del.)/utrumque:
unumquodque P1 132 utrumque: unumquodque P1 134 iudicat: iudicabit
C1EErP1P3R/continuationem corr. ex continui P3

- 135 [3.177] Numerus comprehenditur a visu et numeri medi-
 etas, quoniam visus comprehendit in una hora multa visibilia
 distincta in simul, et cum visus comprehenderit distinctionem
 illorum, comprehendet quod quodlibet illorum est diversum ab
 alio, et sic comprehendet multitudinem. Et virtus distinctiva
 140 comprehendet numerum ex multitudine. Numerus ergo com-
 prehendetur per sensum visus ex comprehensione multorum
 visibilium distinctorum quando visus comprehenderit ipsa in
 simul, et comprehenderit distinctionem illorum, et comprehen-
 derit quod quodlibet illorum est diversum ab alio. Secundum
 145 ergo istum modum comprehenditur numerus per sensum visus.
 [3.178] Motus autem comprehenditur a visu ex compara-
 tione rei mote ad aliud visibile, quoniam visus, quando com-
 prehenderit visibile motum et cum ipso comprehenderit aliud
 visibile, comprehendet situm eius respectu illius visibilis moti.
 150 Et cum visibile fuerit motum et illud aliud visibile fuerit non
 motum, per motum visibilis illius moti situs visibilis illius moti
 diversabitur respectu illius visibilis non moti apud motum. Et
 cum visus comprehenderit ipsum, et comprehenderit cum eo
 aliud visibile, et comprehendit situm eius respectu illius visibi-
 155 lis, comprehendet motum eius. Motus ergo comprehenditur a
 visu ex comprehensione diversitatis situs rei vise mote respec-
 tu alterius.
 [3.179] Et motus comprehenditur a visu secundum aliquem
 trium modorum: aut ex respectu rei vise mote ad multa visi-
 160 bilia, aut ex respectu rei vise mote ad unum visibile, aut ex
 respectu rei vise ad ipsum visum. Primum autem quando
 visus comprehenderit rem visam et motum, et comprehenderit

135 *post numerus add. autem EEerL3P3; add. vero P1R/medietas (136) corr. ex meidietas S* 136 *hora corr. ex linea E* 137 *distincta in om. R* 138 *quod om. EP3R/quodlibet corr. ex quemlibet C1/est: esse EP3R/diversum: divisum Er* 139 *alio corr. ex altero E/comprehendet: comprehendit EL3P3R* 140 *comprehendet: comprehendit EP3R/comprehendetur (141): comprehenditur EL3P3* 142 *quando corr. ex quoniam S/comprehenderit: comprehendit R/in om. R* 143 *illorum... quodlibet (144) mg. EP3 (a. m. E); om. P1* 144 *diversum: divisum C1ErP1* 147 *visibile corr. ex visibilium P1/post visibile scr. et del. comprehendet situm eius respectu illius visibilis Er/visus quando transp. R/comprehenderit (148): comprehenderat Er* 148 *visibile corr. ex visibilem EL3* 149 *situm corr. ex sutum P3* 150 *post cum add. illud EP1P3R/post visibile² scr. et del. non P1/post non scr. et del. per P1* 151 *visibilis illius¹ transp. EL3P3R/visibilis illius² transp. EP3R* 152 *apud motum om. R* 153 *post et add. cum C1S/comprehenderit: comprehendit P1/comprehenderit cum eo: cum eo comprehendit EP3R* 154 *et om. EP3; inter. L3/comprehendit: comprehenderit ErL3; comprehendet R/illius om. P1* 155 *ante comprehendet add. et EP3R (inter. a. m. E)* 156 *mote: moti L3* 159 *ante aut scr. et del. predictorum C1/ex om. C1P1/post mote add. quidem L3* 160 *aut¹... visibile mg. P3/ex¹ om. C1S/mote om. P3* 161 *post vise add. mote C1P1R* 162 *post visam scr. et del. ad S/ante motum add. eius R/et² inter. L3*

ipsam respicientem aliquod visibile, deinde comprehenderit
 ipsam respicientem aliquod visibile diversum a primo, existen-
 165 te visu in suo loco, sentiet motum illius rei vise. Respectus
 autem rei vise mote ad unum solum visibile est quando visus
 comprehenderit rem visam motam, et comprehenderit situm
 eius respectu alterius visibilis, deinde comprehenderit situm
 eius qui mutatus est respectu illius alterius eiusdem visibilis,
 170 aut quod est remotius, aut quod est propinquius, aut quod est
 in parte altera, existente visu in loco suo, aut per mutationem
 situs alicuius partis rei vise mote respectu illius visibilis immo-
 ti, aut per mutationem situs partium eius respectu illius visibi-
 lis. Et secundum istum ultimum modum comprehendit visus
 175 motum visibilis moti circulariter quando homo comparaverit
 ipsum ad aliud visibile. Cum ergo visus comprehenderit situm
 rei mote vise, aut situm partium eius, aut situm alicuius partis
 eius, comprehendet motum rei vise mote.

[3.180] Respectus autem rei vise mote ad ipsum visum est
 180 quando visus comprehenderit rem visam motam, comprehen-
 det ubitatem eius et remotionem eius. Et cum visus fuerit qui-
 etus, et res visa fuerit mota, et tunc mutabitur situs rei vise
 mote respectu visus. Si ergo motus rei vise fuerit secundum
 spatium latum, mutabitur ubitas eius, et sentiet visus mutati-
 185 onem ubitatis eius, et cum visus senserit mutationem ubitatis
 eius, visu quiescente, sentiet motum eius. Et si motus rei vise
 fuerit in longitudine extensa inter ipsam et visum, aut res visa
 tunc elongabitur a visu per motum aut appropinquabitur. Et
 cum visus senserit elongationem aut appropinquationem eius,
 190 visu existente in suo loco, sentiet motum eius. Et si motus rei
 vise fuerit circularis, necessario mutabitur pars eius que oppo-
 nitur visui, et cum illa pars rei vise fuerit mutata, et sentiet

164 ipsam: ipsum *E* / aliquod: aliud *EP3* / post aliquod *add.* aliud *P1R* 165 sentiet
 corr. ex sentiei *P3* 166 mote corr. ex motum *C1*; corr. ex moti *P3* 167 motam
 ... eius (168) *om. P3* 168 post respectu *add.* unius *P1* / alterius corr. ex unius *a. m. ES* /
 visibilis corr. ex visibile *P1* 169 eiusdem *om. R* 170 est¹ *om. P3* 171 existente
 visu *transp. EP3R* / loco suo *transp. EL3P3R* 172 mote: motu *P1* 173 illius
 visibilis (174) *transp. EP3R* 174 istum ultimum *transp. C1ErS* 176 ergo: igitur *E*
 177 rei mote vise: vise rei mote *E* / mote vise *transp. L3P3R* 179 visum
rep. P1 180 comprehenderit: comprehendit *EP3R* 181 post eius² *add.* a
 visu *EP1P3R* 182 et² *om. R* / tunc *om. C1ErS*; *inter. L3* 185 eius *om. R*
 187 ipsam: ipsum *EL3R* / aut *om. R* / post aut *add.* tunc *EP3R* 188 tunc *om. C1EErL3P3* /
 appropinquabitur: appropinquabit *R* / ante et *add.* per motum *P1* 189 appropin-
 quationem corr. ex propinquationem *S* 190 visu existente corr. ex visus existenti
P3 / existente corr. ex extente *S* / post loco *add.* visus *EP3R* / rei vise fuerit (191) fuerit rei
 vise *EL3P3* 191 pars: situs *Er*; corr. ex situs *C1L3* (*a. m. C1*) / post pars *add.* rei vise *Er*;
add. rei *P3* / post eius *add.* vise *P3* 192 cum *om. EP3* / sentiet: senserit *R*

visus mutationem eius, visu existente in suo loco, sentiet motum rei vise. Secundum ergo istos modos comprehendet visus
 195 motum quando visus fuerit fixus in suo loco.

[3.181] Et visus etiam comprehendet motum secundum quemlibet istorum modorum, quamvis visus etiam moveatur. Et hoc erit quando visus senserit diversitatem situs rei vise mote, sentiendo quod illa diversitas non est propter motum
 200 visus et distinguendo inter diversitatem situs que accidit illi rei vise propter motum ipsius rei vise et inter diversitatem situs que accidit ei propter motum visus. Cum ergo visus senserit diversitatem situs rei vise et senserit quod diversitas situs eius non est propter motum visus, sentiet motum rei vise. Et forma
 205 rei vise mote movetur etiam in visu propter motum eius. Sed visus non comprehendit motum rei vise ex motu sue forme in visu tantum; immo visus non comprehendit motum rei vise nisi ex comparatione rei vise ad aliam secundum modos quos declaravimus. Quoniam forma rei vise quiescentis aliquando
 210 movetur in visu in quiete illius rei vise, et inde visus non comprehendit ipsam motam, quoniam visus, quando movebitur secundum oppositionem rerum visarum, movebitur forma cuiuslibet rei vise opposite visui in superficie visus apud motum eius, sive sit quiescens sive sit motum. Et quia visus iam
 215 assuetus est ad motum formarum rerum visarum in superficie eius cum quiete illarum rerum visarum, non iudicabit motum rei vise propter motum forme eius nisi quando in visu pervenerit forma alterius rei vise, et comprehenderit visus diversitatem situs forme rei vise mote respectu alterius forme rei vise aut ex
 220 mutatione formarum in eodem loco visus, que erit in loco circulari. Motus ergo non comprehenditur a visu nisi secundum modos quos distinximus.

[3.182] Comprehensio autem qualitatis motus est ex com-

193 suo loco *transp. E* 194 comprehendet: comprehendit *EP3R* 195 suo loco *transp. S* 196 etiam comprehendet *transp. EErL3P3R* 198 rei vise *transp. EP3*
 200 visus: eius *EErP3R*; *corr. ex eius L3/que: qui EP3/illi . . . accidit (202) om. L3/post illi scr. et del. ro P1* 201 vise¹ *om. R/ipsius: illius EP3* 202 post accidit *scr. et del. illi rei vise S/ergo: igitur P1* 203 et . . . vise (204) *om. EErL3P3/situs eius transp. R*
 205 propter: per *EP3* 207 comprehendit: comprehendint *P1* 208 secundum: sed *Er* 210 in²: cum *EErL3P3R*; *alter. in cum a. m. C1/illius om. EP3/post vise add. quidem L3/inde corr. ex tamen L3* 211 movebitur *corr. ex moverit P1* 214 sit quiescens: quiescat *R/sit² om. C1/sit motum: moveatur R* 215 assuetus: assuefactus *R* 216 iudicabit *corr. ex iudicad P3; corr. ex iudicabis S* 217 visu: visum *R* 218 alterius: alicuius *R/et . . . mutatione (220) mg. L3/post visus scr. et del. visus S/post diversitatem add. eius L3* 220 post mutatione *scr. et del. forme ex necessitate L3/post loco¹ scr. et del. minus P1* 223 qualitatis *corr. ex quantitatis Er/est: visus L3/post ex scr. et del. parte P1*

225 prehensione spatii super quod movetur res visa quando res
 visa movebitur secundum se totum, et visus certificat qualita-
 tem motus quando certificaverit figuram spatii super quod
 movetur res visa mota. Et cum res visa movebitur circulariter,
 visus comprehendet motum eius esse circularem ex compre-
 230 hensione mutationis partium eius sequentium visum apud ali-
 quam rem visam, aut ex respicientia alicuius partis illius ad
 diversa visibilia, unum post alterum, aut ad partes unius rei
 vise, unam partem post aliam, cum quiete totalitatis rei vise in
 suo loco.

[3.183] Et si motus rei vise fuerit compositus ex motu cir-
 235 culari et locali, visus comprehendet illum motum esse com-
 positum ex prehensione mutationis partium rei vise mote
 respectu visus, aut respectu alterius rei vise, cum prehensi-
 one motus totalitatis rei vise a suo loco. Secundum ergo istos
 modos visus comprehendit qualitates motus visibilium.

240 [3.184] Et visus non comprehendit motum nisi in tempore,
 quoniam motus non est nisi in tempore, et omnis pars motus
 non est nisi in tempore. Et visus non comprehendit motum rei
 vise nisi ex prehensione rei vise in duobus locis diversis
 aut secundum duos situs. Locus autem et situs rei vise non
 245 diversatur nisi in tempore. Cum ergo visus prehenderit
 rem visam in duobus locis diversis aut in duobus sitibus diver-
 sis, non erit nisi in duabus horis diversis. Sed inter quaslibet
 duas horas diversas est tempus. Visus ergo non comprehendit
 motum nisi in tempore.

250 [3.185] Et etiam dicemus quod tempus in quo visus com-
 prehendit motum non erit nisi sensibile, quoniam visus non
 comprehendit motum nisi ex prehensione rei vise in duo-
 bus locis diversis, in uno loco post alium, aut secundum duos
 situs diversos, unum situm post alium. Cum ergo visus com-

224 super: secundum P3/post quod scr. et del. n C1 225 visa om. C1/ante se scr. et
 del. situm S/totum: totam EP1P3; alter. in totam a. m. C1 227 movetur corr. ex
 movebitur S 228 post visus scr. et del. non certificat P1/eius om. Er 229 ante
 visum scr. et del. apud aliquam P1; scr. et del. eius sei P3/visum corr. ex visus S/apud:
 ante EErL3P3; alter. in ante a. m. S 234 compositus: oppositus P1 235 motum
 om. EP3R 236 post prehensione scr. et del. n C1 237 visus corr. ex motus E
 239 comprehendit: comprehendet C1 240 visus om. C1/nisi . . . motum (242) mg.
 a. m. E/post tempore add. visus C1 241 ante et scr. et del. quoniam motus P1
 243 nisi . . . vise om. P1P3/post vise² add. nisi Er 244 et inter. L3 245 diversatur:
 diversantur EErP1P3/tempore: temporibus EP3R/ergo: igitur P1 246 aut . . .
 diversis² (247) mg. a. m. E 247 erit: est R/post in add. duobus P3 248 duas om.
 C1/duas horas transp. EL3P3R/duas . . . diversas om. Er/post tempus add. medium
 EP3R/ergo om. P1 254 situm om. P1/comprehendit (255): prehenderit EP3R

255 prehendit rem visam motam in secundo loco et non compre-
henderit ipsam tunc in primo loco in quo comprehendit ipsam
ante, statim sentiet sentiens quod hora in qua comprehendit
ipsam in secundo loco est diversa ab hora in qua comprehen-
dit ipsam in primo loco, quare sentiet diversitatem duarum
260 horarum. Et similiter quando comprehenderit motum ex diver-
sitate situs rei mote, quoniam, quando comprehendit rem mo-
tam secundum situm secundum et non comprehenderit ipsam
tunc secundum primum situm secundum quem comprehendit
ipsam ante, statim sentiet diversitatem duarum horarum, qua-
265 re sentiet tempus quod est inter ipsas. Tempus ergo in quo
visus comprehendit motum est sensibile necessario.

[3.186] Et cum iste intentiones sunt declarate, narremus
modo quod coacervatur ex eis. Dicemus ergo quod visus com-
prehendit motum ex comprehensione rei vise mote secundum
270 duos situs diversos in duabus horis diversis inter quas est
tempus sensibile, et hec est qualitas comprehensionis motus a
visu.

[3.187] Et visus comprehendit diversitatem motuum se-
cundum velocitatem et tarditatem, et equalitatem motuum, ex
275 comprehensione spatiorum super que moventur visibilia mota.
Cum ergo visus comprehenderit visibilia duo mota, et compre-
henderit duo spatia super que moventur illa duo visibilia, et
senserit quod alterum duorum spatiorum que a duobus visi-
bilibus motis pertranseuntur in eodem tempore est maius
280 altero, sentiet velocitatem rei vise transeuntis super maius
spatium. Et cum duo spatia equalia super que moventur duo
visibilia fuerint pertransita simul aut in duobus temporibus
equalibus, et senserit visus equalitatem eorum spatiorum,

255 rem om. EP3; rep. P1/post in add. suo EP3R/secundo loco transp. EP3R
256 ipsam tunc transp. EP3R/in quo om. P1/comprehendit: comprehenderit C1L3/
ipsam ante (257) transp. EErL3P3R 257 sentiet sentiens transp. P1/post quod add.
in P1 258 secundo: primo L3/est . . . loco (259) om. L3 259 primo loco
transp. P1 260 quando comprehenderit transp. P1/comprehenderit: compre-
henderit P1 261 mote: visae R/quando: si R/comprehendit: comprehenderit EErL3P3R
262 secundum²: siderum P1; om. EErL3P3R 263 quem: quod ErL3 264 quare
(265): quarum ErL3 265 ergo: igitur P1 267 post cum add. omnes C1EErL3P3R
(mg. a. m. C1)/sunt: sint EP3R/narremus corr. ex narramus a. m. E 268 coacervatur:
coadcervat EP3/ergo: igitur P1 274 equalitatem: qualitatem C1ErL3P1S
275 super corr. ex semper P3/post visibilia scr. et del. a L3 276 visibilia duo transp.
EErL3P3R/duo mota transp. P1/comprehenderit (277): comprehendit L3 277 duo¹
om. EErL3P3R/super inter. L3 278 visibilibus (279): visibus Er; corr. ex visibus L3
279 post eodem scr. et del. loco P3/maius: magis P1 280 velocitatem corr. ex
voluntatem P3/post vise add. mote EP1P3R/super: per P1 281 equalia om. EErL3P3R/
duo om. EP3R 282 fuerint: sunt R; corr. ex sunt EP3 (a. m. E)/simul aut om.
EErL3P3R/duobus . . . equalibus (283): equalibus . . . duobus P1 283 eorum:
illorum EP3R

sentiet equalitatem motus duarum rerum motarum. Et simili-
 285 ter, si visus senserit equalitatem duorum spatiorum cum ine-
 qualitate duorum temporum duorum motuum, sentiet veloci-
 tatem motus rei mote transeuntis per spatium in minori tem-
 pore; et similiter, quando duo mota transierint in duobus tem-
 poribus equalibus per duo spatia equalia, et senserit visus
 290 equalitatem temporum et equalitatem spatiorum, sentiet
 equalitatem duorum motuum. Iam diximus qualiter visus com-
 prehendit motum et distinguit motum et qualitates eius et
 equalitatem et inequalitatem eius.

[3.188] Quies autem comprehenditur a visu ex comprehen-
 295 sione rei vise in tempore sensibili in eodem loco et in eodem
 situ. Cum ergo visus comprehenderit visum in eodem loco et
 secundum eundem situm in duabus horis diversis inter quas
 est tempus sensibile, comprehendet rem visam in illo tempore
 quiescentem. Et visus comprehendit situm rei vise quiescentis
 300 respectu alterius rei vise et respectu ipsius visus. Secundum
 ergo hunc modum erit comprehensio quietis visibilium a visu.

[3.189] Asperitas vero comprehenditur a visu in maiori
 parte ex forma lucis apparentis in superficie corporis asperi,
 quoniam asperitas est diversitas situs partium superficiei cor-
 5 poris, quare lux, quando orietur super superficiem illius cor-
 poris, partes prominentes facient umbram in maiori parte. Et
 cum lux pervenerit ad partes profundas, erunt cum ea etiam
 umbre, et partes prominentes erunt manifeste luci et disco-
 operte luci. Et cum in partes profundas venerint umbre, et
 10 super prominentes etiam non fuerit aliqua umbra, diversabitur
 forma lucis in superficie illius corporis. In superficie autem
 plana non est ita, quoniam superficiei plane partes sunt con-
 similis situs, et cum lux orietur super ipsas, erit forma lucis in
 tota superficie consimilis. Forma ergo lucis in superficie cor-
 15 poris asperi est diversa a forma lucis in superficie plana. Et

284 motus *om. EErL3P3R/similiter* (285) *corr. ex super P3* 285 inequalitate (286)
corr. ex in qualitate P3 288 duo *inter. L3/transierint corr. ex transiverint P1*
 290 temporum: temporis *EP3R/post spatiorum scr. et del. et L3* 291 iam . . . motum¹
 (292) *om. P3/qualiter corr. ex equaliter L3/comprehendit (292): comprehendat R*
 292 distinguit: distinguat *R/qualitates: qualitatem ER; corr. ex equalitatem P3*
 293 equalitatem *corr. ex qualitatem P1* 294 ex *om. EP3* 295 post sensibili *add.*
et P1/et om. P3; inter. L3 296 ergo: igitur *EL3P3* 297 eundem situm *transp. P1*
 298 est *mg. L3/est tempus transp. L3/tempus om. P1* 299 comprehendit *corr. ex*
comprehendet Er 300 post alterius *scr. et del. alterius C1* 1 ergo hunc *transp. P3*
 5 orietur: oritur *EL3P3R* 6 facient: faciunt *C1P1S; faciant P3* 7 ad: in *EL3P3/*
erunt corr. ex eirunt P3/ea: eo EErL3P3R/etiam: et Er 8 luci: luce *R* 9 luci: luce
R/venerint: veniunt EL3P3R 10 etiam *om. EErL3P1P3R* 12 superficiei *corr. ex*
superficies P1 14 post superficiei¹ *scr. et del. plana S*

visus cognoscit formam lucis que est in superficiebus asperis et
 formam lucis que est in superficiebus planis propter frequenta-
 tionem visionis superficierum asperarum et planarum. Cum
 ergo visus senserit lucem que est in superficiebus corporis
 20 secundum modum quem assuevit in superficiebus asperis,
 iudicabit asperitatem illius corporis. Et cum senserit lucem in
 superficie corporis secundum modum quem assuevit in super-
 ficiebus planis, iudicabit planitiem in superficiebus illius cor-
 poris.

25 [3.190] Et cum asperitas fuerit extranea, erunt partes pro-
 minentes alicuius quantitatis, et sic visus comprehendet pre-
 minentiam illarum partium, et comprehendet situm superficiei
 corporis ex comprehensione distantie que est inter partes. Et
 cum visus comprehenderit diversitatem situum partium super-
 30 ficiei corporis, comprehendet asperitatem eius sine indigentia
 ad considerandum lucem.

[3.191] Et etiam quando asperitas corporis fuerit extranea,
 et oriatur super ipsam lux, erit forma lucis in superficie eius
 etiam diversa maxima diversitate. Videbitur ergo ex diversi-
 35 tate forme lucis distantia partium et diversitas situs earum, et
 ex hoc apparebit asperitas corporis. Si ergo lux oriens super
 corpus asperum fuerit ex parte opposita superficiei aspere, et
 fuerit lux fortis, non comprehendet visus asperitatem huius
 corporis nisi quando comprehenderit prominentiam quarum-
 40 dam partium et profunditatem quarumdam. Si ergo asperitas
 huius corporis fuerit extranea, id est maxima, comprehendet
 visus distantiam partium et diversitatem situs eorum, et com-
 prehendet asperitatem corporis in maiori parte. Si autem as-
 peritas fuerit modica, et fuerint partes profunde et pori illius
 45 corporis in ultimitate parvitatibus, latebit visum in maiori parte,
 et nunquam visus comprehendet asperitatem huius corporis

16 ante asperis scr. et del. planis S 17 formam corr. ex forma a. m. Er 18 ante visi-
 onis scr. et del. visus C1/visionis superficierum corr. ex superficierum visionis C1/aspe-
 rarum corr. ex asperum P3 19 ergo: igitur P1/corporis inter. a. m. E 21 iudica-
 bit: indicabit Er/post lucem mg. que est a. m. C1 22 post secundum add. hunc L3
 25 partes om. Er; inter. L3/prominentes (26): preminentes S; alter. in preminentes
 a. m. C1 26 visus comprehendet transp. P1/preminetiam (27): promin-
 etiam EErL3P3R 28 corporis: corporum EErL3P3/distantie que est: que est dis-
 tantie E 30 indigentia corr. ex asperitate Er 31 ante ad add. et P1/considerandum:
 considerandam P1 32 etiam om. P1 33 ante et add. id est maxima ErP1 (inter.
 a. m. Er/maxima (??) Er)/oriatur: oritur R/ipsam: ipsum P1/eius etiam (34) om. L3
 34 etiam: et P1; om. EErP3R 35 forme om. R/et diversitas corr. ex diversitas et C1
 36 apparebit: apparet L3; om. P3/asperitas inter. a. m. Er 37 opposita corr. ex appo-
 sitorum P1 38 huius: huiusmodi EP3 40 ergo: autem P1 42 eorum: ea-
 rum EErL3P3R 44 fuerint partes transp. EErL3P3R/partes rep. P1 45 visum
 om. P3

nisi in magna appropinquatione cum intuitu partium superficiei corporis. Cum ergo visus distinxerit distantiam partium huiusmodi corporis, et prominentiam et profunditatem illorum, 50 comprehendet asperitatem eius. Si autem visus non distinxerit distantiam partium eius, nec prominentiam et profunditatem partium eius, non comprehendet asperitatem eius. Asperitas ergo comprehenditur a visu ex comprehensione diversitatis situum partium superficiei corporis aut ex forma lucis quam 55 visus assuevit in superficiebus corporum asperorum. Et visus etiam cognoscit asperitatem ex privatione consimilitudinis. Cum igitur visus nichil senserit in corpore ex consimilitudine, iudicabit eius asperitatem, sed multotiens errat visus in asperitate quando voluerit cognoscere ipsam per istam intentionem. 60 Quoniam erit superficies tersa, et non apparet eius tersitudo, quoniam tersi non apparent nisi in situ proprio.

[3.192] Planities autem, id est equalitas superficiei corporis, comprehenditur a visu in maiori parte ex forma lucis apparenti in superficie corporis plani quam assuevit videre in 65 superficiebus planis. Et cum lux que est in superficiebus corporis fuerit consimilis forme, cognoscet per ipsam planitiem superficiei. Et visus aliquando comprehendit planitiem per intuitum etiam. Cum ergo visus intuebitur superficiem corporis plani, comprehendet equalitatem partium eius, et sic comprehendet planitiem. 70

[3.193] Tersitudo autem, et est planities fortis, comprehenditur a visu ex scintillatione lucis in superficie sui corporis. Planities ergo comprehenditur a visu ex comprehensione equalitatis superficiei. Equalitas autem superficiei comprehenditur 75 a visu in maiori parte ex consimilitudine forme lucis in super-

48 ergo: igitur *P1* / partium . . . corporis (49): huiusmodi . . . partium *EP3* 49 huiusmodi: huius *EL3P3* / illorum: illarum *EEL3R* 51 eius *om. P1* 52 eius¹ *om. P3*
53 ergo: igitur *P1* 54 situum partium *corr. ex* partium situum *C1* / quam . . . assuevit (55): quamvis assuevis *P3* 55 *post* assuevit *add. comprehendere C1; add. videre R/ ante et scr. et del. et in P1* 56 etiam cognoscit *transp. R/ privatione: praenotione R/ consimilitudinis: consuetudinis EEL3P3; alter. in consuetudinis a. m. S/ post consimilitudinis scr. et del. vel consuetudinis C1* 57 igitur: ergo *C1RS/ visus om. P1/ consimilitudine: consuetudine EEL3P3; alter. in consuetudine a. m. S/ post consimilitudine scr. et del. vel consuetudine C1* 58 errat: errant *S* 60 tersa: vera *ErL3* 61 tersi: tersiones *C1P1*; tersio *L3*; tersitudo *R; alter. ex tersitudo in tersio EP3 (a. m. E)/ apparent: apparet EEL3P3R/ situ: visu P3* 62 id est: et *R* 63 apparenti (64): apparentis *P1R* 64 videre *inter. L3; om. S* 66 fuerit: fuerint *L3/ cognoscet: cognoscit EP3* 67 aliquando comprehendit *transp. EP3R/ post aliquando scr. et del. superficiei Er/ per . . . etiam (68) inter. L3* 71 *post* est *scr. et del. quod C1/ planities fortis transp. P1R* 72 sui *om. C1/ sui corporis transp. EL3P3R* 73 ergo: igitur *P1* 74 autem *om. C1EEL3P3* 75 consimilitudine: similitudine *EP3R/ forme lucis transp. S*

ficie corporis, et tersitudo comprehenditur a visu ex scintillatione lucis in superficie corporis et ex situ secundum quem reflectitur lux.

[3.194] Et forte in simul aggregantur asperitas et planities
 80 in eadem superficie, scilicet quod sint in superficie alicuius corporis partes diversi situs profunde et prominentes, et sint partes cuiuslibet partium diversi situs prominentium et profundarum ad partes quarundam consimilis situs, ita quod tota superficies sit aspera, et partes eius, aut quedam, sunt
 85 plane. Et asperitas huiusmodi superficiei comprehenditur a visu ex comprehensione diversitatis situs partium prominentium et profundarum, et planities partium comprehenditur ex forma lucis que comprehenditur a visu in superficiebus partium. Et aliquando visus comprehendit planitiem huiusmodi
 90 partium per intuitionem et ex comprehensione consimilitudinis superficiei cuiuslibet illarum. Secundum ergo istos modos comprehendit visus planitiem, et tersitudinem, et asperitatem.

[3.195] Diafonitas autem comprehenditur a visu per argumentationem ex comprehensione illius quod est in posteriori
 95 corporis diafoni. Et diafonitas corporis diafoni non comprehenditur a visu nisi quando fuerit in eo quedam spissitudo, et fuerit diafonitas eius spissior diafonitate aeris interiacentis visum et ipsum. Si autem fuerit in fine diafonitatis, non comprehendet visus diafonitatem eius, et non comprehendet nisi
 100 illud quod est in posteriori eius tantum. Et cum in eo fuerit quedam diafonitas, comprehendetur a visu propter illud quod est de spissitudine in eo. Et diafonitas eius comprehenditur ex comprehensione illius quod est in posteriori eius, quoniam, quando in posteriori corporis diafoni fuerit lux aut corpus

76 et . . . corporis (77) *om.* P3 79 in *om.* P1R/aggregantur: aggregatur R/post et² *scr.* et *del.* asperitas P1 80 scilicet . . . superficie *om.* P3 81 sint *corr.* ex sicut L3
 82 post partes *add.* profunde et prominentes et sint partes P1/diversi: diversit Er
 83 ad *corr.* ex aut a. m. S/post ad *add.* quasdam partes vel ad EP1P3R/quod: ut R
 84 sunt: sint R 85 post asperitas *add.* huius L3/huiusmodi: huius Er; *corr.* ex huius C1; *scr.* et *del.* L3 87 ex . . . comprehenditur (88) *om.* R 90 per *corr.* ex pro S/et *om.* P3/consimilitudinis: similitudinis EP3; assimilitudinis L3; *corr.* ex assimilitudinis a. m. C1 91 post illarum *add.* et EP3R/ergo *om.* EP1P3R 92 comprehendit: comprehenditur C1L3/tersitudinem: certitudinem Er 93 autem: quando P1S
 94 in . . . diafoni (95): ultra corpus diaphanum R 96 post quando *scr.* et *del.* certificaver P1/quedam spissitudo *transp.* EP3R 97 fuerit diafonitas *corr.* ex diafonitas fuerit S/eius *rep.* L3 98 ante visum *add.* inter R/autem *om.* C1EErP3/post fuerit *add.* diafonitas P1S/diafonitatis *om.* P1S 99 comprehendet: comprehendit P1S
 100 in . . . eius: ultra ipsum R/in² *om.* L3 101 post visu *add.* cum ErL3S (*scr.* et *del.* S) 102 et inter. a. m. Er; *mg.* L3/comprehenditur: comprehendetur C1EL3P3R 103 post illius *add.* quod est in posteriori illius P1/in . . . eius: ultra ipsum R/eius . . . posteriori (104) *inter.* L3 104 in . . . diafoni: ultra corpus diaphanum R

- 105 coloratum illuminatum, videbitur apparens in posteriori corporis diafoni. Et visus non sentit diafonitatem corporis quando senserit illud quod est in posteriori eius nisi cum senserit quod color et lux que comprehenditur in posteriori corporis diafoni est lux et color in posteriori corporis diafoni, et non est color et lux ipsius corporis diafoni. Si autem non, non sentiet diafonitatem corporis diafoni. Si ergo in posteriori parte corporis diafoni non fuerit lux nec corpus illuminatum, nec in circuitu eius, et non apparuerit in posteriori eius nec in alia parte aliqua lux aut color, diafonitas illius corporis non comprehenditur. Et hoc erit quando corpus diafonum fuerit applicatum in aliquo corpore spisso, et illud corpus spissum fuerit continens ipsum, aut respiciens ipsum contra quoque, et corpus diafonum fuerit obscuri coloris. Quoniam tunc visus non sentiet diafonitatem huius corporis.
- 120 [3.196] Et similiter quando in posteriori corporis diafoni fuerit locus obscurus, et non apparuerit in posteriori eius aliqua lux. Cum ergo visus senserit quod color quem comprehendit in posteriori corporis diafoni est color corporis in posteriori corporis diafoni, sentiet diafonitatem corporis diafoni. Et
- 125 similiter, quando corpus diafonum fuerit debilis diafonitatis, et fuerit corpus quod est in posteriori eius et corpora que sunt in circuitu eius debilis lucis, tunc diafonitas eius non comprehenditur a visu nisi apponeretur forma lucis. Cum enim cog-

105 apparens . . . diafoni (106): ultra corpus diaphanum R 106 diafonitatem *corr.* ex diafonitatis P3 107 senserit¹: sentit C1/in . . . eius: ultra ipsum R 108 et: aut L3/comprehenditur: comprehenduntur C1EL3P3R/in . . . diafoni¹ (109): ultra corpus diaphanum R 109 *post lux scr. et del.* ipsius corporis P3/in . . . diafoni: ultra corpus diaphanum R/*post in scr. et del.* posteriori diaphon P1/posteriori . . . lux (110) *om.* P1/corporis diafoni *transp.* S 110 corporis diafoni *transp.* C1/diafoni *om.* EErP3R; *inter. L3; corr.* ex diafonitati S/non² *inter.* P1; *om.* P3 111 in . . . diafoni (112): ultra corpus diaphanum R/parte *om.* EL3; *mg. a. m.* C1 112 fuerit: fuit P1/corpus *corr.* ex corporis S 113 in . . . eius: ultra ipsum R/aliqua . . . aliqua (114): aliqua alia parte ER 114 aliqua *om.* P3/*post lux scr. et del.* et color S/aut *corr.* ex et C1/diafonitas: diafonitatis ER; *corr.* ex diafonitatis L3/non comprehenditur (115) *om.* ER; *inter. L3* 116 in: cum C1EP3R; *alter. in* cum L3/corpore: tempore P1 117 fuerit continens: continuerit R/respiciens: respexerit R/contra: apparebit P1; et fuerit R/contra quoque *om.* S/quoque: edirecto C1/et *om.* R 118 fuerit: tunc P1S; *om.* R 119 huius *corr.* ex huius S 120 in . . . diafoni: ultra corpus diaphanum R/*post diafoni scr. et del.* fuerit S 121 in: scilicet L3/in . . . eius: ultra ipsum R/posteriori *corr.* ex postremo P1/eius *scr. et del.* P3 122 *post lux add.* non comprehenditur diafonitas eius C1EErL3P3R (*mg. Er/mg. a. m.* L3/comprehenditur: comprehenditur ER)/quem . . . diafoni (123): qui comprehenditur ultra corpus diaphanum R/comprehendit (123): comprehenderit EP3 123 est . . . diafoni¹ (124) *inter. EL3 (a. m. E)/post color add.* et color L3/in² . . . diafoni¹ (124): ultra corpus diaphanum R 124 corporis²: coloris EErL3P1S/*post corporis² scr. et del.* coloris C1 126 in . . . eius: ultra ipsum R 128 apponeretur: apponatur R; *alter. in* opponeretur C1/forma lucis: forti luci C1EErL3P3R/enim: autem C1EErL3P3R/cognoscet (129) *corr.* ex cognosceret C1

noscet lucem in posteriori eius, comprehendet diafonitatem.
 130 Secundum ergo istos modos comprehendit visus diafonitatem
 corporum diafonorum.

[3.197] Spissitudo comprehenditur a visu ex privatione
 diafonitatis. Cum ergo visus comprehenderit corpus et non
 135 senserit in ipso aliquam diafonitatem, arguet eius spissitu-
 dinem.

[3.198] Umbra vero comprehenditur a visu respectu lucis
 illuminantis aut partis lucis, quoniam umbra est privatio quar-
 umdam lucium cum illuminatione loci umbre ab extranea luce
 privata a loco umbre. Et cum senserit visus illud quod vicina-
 140 tur ipsum, et fuerit super illud corpus vicinatum lux fortior
 luce que est in loco umbre, sentiet obumbrationem illius loci et
 privationem a luce orienti super corpus vicinans illi. Quoniam,
 quando visus senserit aliquam lucem in aliquo loco, et caruerit
 ille locus luce solis aut aliqua luce forti, sentiet obumbrationem
 145 loci et privationem loci a luce solis aut ab illa luce forti. Et
 forte visus sentiet corpus faciens umbram, et forte non distin-
 guetur ab eo statim corpus obumbrans. Sed tandem visus,
 quando comprehenderit locum in quo est lux debilis et com-
 prehendit ultima corpora loco lucis debilis esse fortioris lucis
 150 illa luce debili, sentiet statim umbram illius loci. Secundum
 ergo hunc modum visus comprehendit umbram.

[3.199] Obscuritas vero comprehenditur a visu per argu-
 mentationem ex privatione lucis. Cum ergo visus comprehen-
 derit aliquem locum et non comprehenderit in ipso aliquam
 155 lucem, sentiet obscuritatem eius.

[3.200] Pulcritudo comprehenditur a visu ex comprehen-
 sione intentionum particularium quarum comprehensionis
 qualitas a visu est declarata. Quoniam unaqueque intentio-

129 in . . . eius: ultra ipsum R 130 secundum . . . diafonitatem om. P3/ comprehendit:
 comprehendet R/visus om. P1 134 senserit: sensit E 137 partis om. EErL3P3;
 inter. a. m. C1/post lucis scr. et del. umbre C1; add. illuminantis aut partis lucis P1; add.
 illuminantis R/post quoniam add. enim R/post umbra add. eius P1/post est scr. et del.
 illuminatio P3 138 lucium corr. ex lucem L3 139 et: itaque R/senserit: sensit
 E/vicinatur ipsum (140): est vicinum ipsi R 140 vicinatum: vicinum R
 141 obumbrationem: umbrationem EP3R; corr. ex umbrationem S 142 orienti:
 oriente R/vicinans: vicinum R 143 lucem corr. ex rem P1 144 solis om. EErP3;
 inter. C1L3 (a. m. C1)/obumbrationem: umbrationem S 145 ante loci¹ add. illius
 EP3R (post illius scr. et del. spatii P3)/loci¹ om. S/loci² om. C1EErL3P3R/post luce¹ add.
 orienti EP3/illa: alia C1EErL3P3R 146 post sentiet add. per C1L3 (scr. et del. L3)/
 faciens corr. ex sentiens L3 147 visus quando (148) transp. R 148 comprehenderit¹:
 comprehendit L3 149 post corpora add. in R/esse corr. ex est S 150 post statim
 scr. et del. o L3 151 ergo hunc transp. P3 154 comprehenderit: comprehendit
 L3S/ipso: eo EP3R 156 post pulcritudo add. autem P1R 158 a visu om. EP3R/
 post declarata add. ante EP3R/unaqueque: unamqueque Er

num particularium predictarum faciet per se aliquem modum
 160 modorum pulcritudinis, et per coniugationes illarum faciunt
 etiam alios modos pulcritudinis. Et visus non comprehendit
 pulcritudinem nisi in formis visibilium que comprehenduntur
 per sensum visus, et forme visibilium sunt composite ex inten-
 tionibus particularibus quarum distinctio iam est declarata. Et
 165 visus comprehendit formas ex comprehensione istarum inten-
 tionum; ipse ergo comprehendit pulcritudinem ex comprehen-
 sione istarum intentionum.

[3.201] Modi autem pulcritudinis qui comprehenduntur a
 visu in formis visibilium sunt multi. Quedam ergo habent
 170 unam causam ex intentionibus particularibus que sunt in
 forma, et causa quorundam non est nisi coniunctio intenti-
 onum adinvicem, non ipse intentiones, et causa quorundam
 est composita ex intentionibus et ex compositione illarum. Et
 visus comprehendit quamlibet ex intentionibus que sunt in
 175 qualibet forma per se, et comprehendit ipsas compositas, et
 comprehendit compositionem et coniugationem illarum. Visus
 ergo comprehendit pulcritudinem secundum diversos modos,
 et omnes modi ex quibus visus comprehendit pulcritudinem
 revertuntur ad comprehensionem intentionum particularium.

[3.202] Si vero iste intentiones particulares faciunt pulcri-
 tudinem et composite (et est dicere facere pulcritudinem indu-
 cere dispositionem in anima qua videtur ei quod sit res pulcra
 quod videtur), et hoc apparebit per modicam inspectionem.
 Quoniam lux facit pulcritudinem, et propter hoc apparebunt
 185 pulcra sol, et luna, et stelle, et non est in sole, luna, et stellis
 causa propter quam apparebunt decora nisi lux earum. Lux

159 predictarum: predicta P1S/modum om. EP3 160 modorum om. P1R/per om.
 P1RS/post per scr. et del. cog Er/coniugationes: coniunctionem C1; coniugationem EL3P3
 161 etiam alios transp. EP3 163 post ex scr. et del. ind P1 164 iam est transp. Er
 166 ipse . . . intentionum (167) mg. a. m. S/post ergo add. visus C1 168 qui: que ErL3;
 corr. ex que C1 169 in . . . visibilium inter. a. m. S/post ergo add. visibilia R
 171 coniunctio . . . adinvicem (172): intentionum . . . coniunctio EP3R 172 adinvicem:
 inter se R 173 compositione: comprehensione P1 174 comprehendit:
 comprehendet L3/post comprehendit scr. et del. quem P3/ex intentionibus: intentio-
 num C1EErL3P3R 176 coniugationem: coniunctionem C1 177 post ergo add.
 non P1/pulcritudinem: pulcritudines P1 178 post pulcritudinem scr. et del. vir-
 tutis P3 179 revertuntur ad comprehensionem om. P1/intentionum corr. ex inten-
 tione P3 181 post et¹ add. similiter P1; add. etiam R/composite corr. ex compose Er/
 post composite add. faciunt pulcritudinem C1; add. similiter EP3R/post pulcritudinem²
 add. est R/inducere (182) corr. ex inducte P1 182 videtur: videbitur EP3R/ei om.
 P3/res inter. P1/post pulcra add. aliquando C1 183 quod: que EP3R/quod videtur
 om. C1P1; inter. a. m. S/videtur corr. ex vero Er/hoc: hec C1; cum Er; corr. ex cum C1L3
 (a. m. C1)/post hoc scr. et del. et P1 184 apparebunt: apparebit C1 185 stelle:
 stella EErP1; corr. ex stella a. m. S/stellis: stella P1; corr. ex stella a. m. S

ergo per se facit pulcritudinem.

[3.203] Et color etiam facit pulcritudinem, quoniam quilibet color scintillans, sicut viridis, et roseus, et sibi similia, apparebunt pulcri visui, et delectatur visus in eis. Et propter hoc
190 apparebunt pulcri panni tincti, et flores, et viridaria. Color ergo per se facit pulcritudinem.

[3.204] Et remotio etiam aliquando facit pulcritudinem accidentaliter. Quoniam in quibusdam formis pulcris sunt macule et ruge que faciunt turpitudinem in formis, et cum elongabuntur in visu, latent ille intentiones subtiles que faciunt turpitudinem in illis formis, et apud latentiam illarum intentionum apparebit pulcritudo illius forme. Et similiter etiam in multis formis pulcris sunt intentiones subtiles per quas forma
200 est pulcra, sicut lineatio et ordinatio, et multe istarum intentionum latent visum in multis remotionibus mediocribus. Et quando sunt prope visum, apparebunt ille intentiones subtiles visui, et apparebit pulcritudo forme. Remotio ergo et appropinquatio faciunt pulcritudinem.

[3.205] Et situs aliquando facit pulcritudinem, et plures intentiones pulcre non apparent pulcre nisi propter ordinationem et situm tantum, quoniam omnes distinctiones ordinate quasi punctate non apparent pulcre nisi propter ordinationem. Et scriptura non apparet pulcra nisi propter ordinationem,
210 quoniam pulcritudo non est nisi ex substantione et directione figurarum litterarum et ex compositione earum adinvicem. Si autem compositio litterarum et ordinatio earum non fuerit secundum unam proportionem, scilicet suplet farraginis, ut una magna et alia parva littera, tunc non erit scriptura pulcra,

187 per se om. P1 188 et . . . pulcritudinem inter. a. m. S/etiam om. S 189 et roseus mg. a. m. C1/sibi similia: his similes R 190 delectatur: delcantur P1/in om. R 191 viridaria: viridia EP3R 193 et . . . pulcritudinem rep. P1/accidentaliter (194) corr. ex accidentalem P1 195 in om. C1EErL3P3/formis: formarum C1/elongabuntur (196): elongantur C1L3 196 post latent scr. et del. ruge P3 197 illarum corr. ex earum S 198 post apparebit add. quidem EP3/ante illius add. quidem C1L3 202 quando: que Er; corr. ex que L3/intentiones: remotiones EEerL3P3; corr. ex remotiones a. m. C1 203 ergo: extra Er; corr. ex extra L3 205 aliquando: autem P1/facit corr. ex fuit L3 206 apparent: apparebunt P1/ordinationem (207): ordinem EP3 208 quasi om. P3/punctate corr. ex preclare a. m. E/ordinationem: ordinem R 209 et. . . ordinationem om. ErP3S 210 nisi om. EL3P3/ex om. L3/post ex add. sub C1/substantione: distinctione C1; substitutione L3; substantiali P1S; om. R/ante et scr. et del. vel substantione vel substentatione C1; add. vel substantione vel subdistinctione L3/et om. ErP1RS 211 compositione: comparatione L3; corr. ex compressione a. m. C1/adinvicem: inter se R 212 earum om. R 213 suplet scr. et del. C1; om. R/farraginis corr. ex farragilus C1; om. R 214 et om. C1EErL3P3R/parva: una P1/littera om. C1EL3P3R/scriptura om. P3/scriptura pulcra transp. C1EL3R

- 215 quamvis figure litterarum per se sint bene posite. Et aliquando
apparet scriptura pulcra quando compositio eius fuerit propor-
tionalis, quamvis littere non sint in fine bone dispositionis.
Et similiter plures forme visibilium non apparent pulcre nisi
propter dispositionem et ordinationem partium adinvicem.
- 220 [3.206] Et corporeitas etiam facit pulcritudinem, et prop-
terea apparent pulcra corpora hominis et multorum ani-
malium.
- [3.207] Et figura facit pulcritudinem, et propter hoc luna,
et forme pulcre hominis, et multorum animalium, et arborum,
225 et plantarum non apparent pulcre nisi propter formas eorum,
aut propter figuras partium eorum, aut propter figuras eorum,
aut propter figuras partium forme.
- [3.208] Et magnitudo facit pulcritudinem, et propter hoc
apparet luna pulcrior stellis et stelle magne pulciores parvis
230 stellis.
- [3.209] Et divisio facit pulcritudinem, et propter hoc stelle
separate sunt pulciores stellis extensis et pulciores stellis
galaxie, et propter hoc candeles distincte sunt pulciores igne.
- [3.210] Et continuatio etiam facit pulcritudinem, et propter
235 hoc viridale continuum et plante spisse sunt pulciores dis-
tinctis.
- [3.211] Et numerus facit pulcritudinem, et propter hoc loca
celi multarum stellarum sunt pulciora locis paucarum stella-
rum, et propter hoc candeles multe numero in eodem loco nu-
240 merus earum facit pulcritudinem. Et propter hoc loca celi mul-
tarum stellarum sunt pulciora locis laterum.
- [3.212] Et motus hominis in sermone et operatione eius.
- [3.213] Et quies eius facit pulcritudinem, et propter hoc
apparet pulcra gravitas, et taciturnitas.

215 sint: sunt C1L3P1; corr. ex sunt S/bene posite transp. C1/aliquando corr. ex autem S
216 compositio: proportio P1 217 sint: sunt C1; sit E/bone om. C1 219 adin-
vicem: inter se R 220 propterea (221): propter hoc C1EErL3P3R 221 corpora
hominis transp. P1 223 post et² add. non P1/hoc om. Er 224 hominis: hominum
R/post multorum scr. et del. ai P3 226 partium . . . figuras (227) mg. a. m. E/post aut
scr. et del. ppp P1/figuras eorum transp. C1EL3P3R/eorum² . . . figuras (227) om. Er
228 facit pulcritudinem inter. a. m. Er; om. S 229 parvis stellis (230) transp. EP3R
234 et continuatio: continuato S 235 post plante add. continue et EP3R/post
pulciores scr. et del. sunt P3 238 locis: lucis Er 239 numero om. R/numerus
. . . facit (240): faciunt R 240 earum: eorum L3 (inter.); om. Er; corr. ex parum a. m.
C1/et . . . laterum (241) om. R/loca inter. a. m. E/multarum stellarum (241) corr. ex
stellarum multarum Er 241 sunt om. C1/laterum: claterum P3; corr. ex claritum
a. m. E 242 post et¹ add. etiam EP3R/et² . . . eius: facit pulchritudinem R/operatione:
spiratione P1S; quietate P3; corr. ex spiratione ErL3P3 (spiratione L3; a. m. ErP3); alter.
ex quietatione in spiratione a. m. E 244 pulcra . . . apparet (246) om. P3

- 245 [3.214] Et asperitas etiam facit pulcritudinem, et propter
hoc apparet villositas pulcra in multis pannis.
[3.215] Et planities etiam facit pulcritudinem, et propter
hoc apparet pulcra in pannis.
[3.216] Et diafonitas facit pulcritudinem, et propter hoc
250 apparent de nocte micantes diafoni.
[3.217] Et spissitudo facit pulcritudinem, quoniam color,
et lux, et figure, et lineatio, et omnes intentiones pulcre appar-
entes in formis visibilium non comprehenduntur similiter a visu
nisi propter spissitudinem et umbram.
255 [3.218] Et umbra facit apparere pulcritudinem, quoniam in
multis formis visibilium sunt macule et pori subtiles redentes
eas turpes, et cum fuerint in luce solis, apparebunt macule in
eis, quare latebit pulcritudo eorum. Et cum fuerint in umbra
aut in luce debili, latebunt ille macule et ruge, quare apprehen-
260 ditur pulcritudo eorum. Et etiam tortuositates que apparent in
plumis avium et in panno qui dicitur alburalmon in umbra non
apparent et in luce debili.
[3.219] Et obscuritas facit pulcritudinem apparere, quoni-
am stelle non apparent nisi in obscuro. Et similiter non appar-
265 et pulcritudo earum nisi in nigredine noctis et in locis obscuris,
et latet in luce diei. Et stelle in noctibus obscuris sunt pulcri-
ores quam in noctibus lune.
[3.220] Et similitudo facit pulcritudinem, quoniam membra
animalis eiusdem speciei, ut oculus oculo, non apparent pulcra
270 nisi quando fuerint consimilia, quoniam oculi, quando fuerint
diverse figure, scilicet quod unus sit rotundus et alter longus,
erunt in fine turpitudinis. Et similiter, si unus fuerit niger et
alter viridis, erunt etiam turpes, et similiter si unus fuerit maior
altero. Et similiter si una gena fuerit profunda et altera promi-

245 etiam: et P1; om. C1EL3P3R 246 pulcra inter. a. m. S/post pulcra add. villositas
EErL3P3R (ante villositas add. ut EP3R)/in inter. a. m. C1 247 etiam om. C1EL3P3R
248 post pannis add. sericis C1 250 apparent: apparet P3/de: in C1/post diafoni add.
lapides C1 252 figure: figura R 254 et umbram om. P3 255 facit apparere
transp. C1L3 257 eas: eos ErL3; corr. ex oris a. m. C1/post eas add. res C1/fuerint:
fiunt E/solis inter. E 258 pulcritudo corr. ex pulcritudini S/eorum: earum R/
fuerint: fuerit P1 259 in om. EP3/ille: iste P1/apprehenditur (260): comprehenditur
C1L3; apprehendit Er; comprehendetur R 260 eorum: earum P3R 261 qui:
quod C1ErL3S/alburalmon: almuellen P3; amilialmon R; corr. ex almuellen a. m. E;
corr. ex elmuellen a. m. L3 262 et om. L3 264 post obscuro scr. et del. et similiter
non apparent in obscuro P1 265 in¹ om. Er/in locis corr. ex villosis a. m. C1
267 lune: luce P1 268 similitudo: consimilitudo EP1P3/membra: umbra S
269 eiusdem corr. ex eius C1L3 (a. m. C1)/ut oculus: in oculis Er/oculus corr. ex
oculis S 270 consimilia corr. ex similia a. m. C1/quando² om. Er 271 unus
om. C1 272 similiter: etiam EErL3P3R; om. C1 273 maior: minor P1
274 una om. Er

275 nens, erit in fine turpitudinis, et similiter quando unum super-
ciliorum fuerit grossum et alterum subtile, aut unum illorum
grossum et alterum breve, erunt turpia. Omnia ergo animalium
membra huiusmodi et dupla non erunt pulcra nisi cum fuerint
consimilia. Et similiter picture et littere non apparent pulcre
280 nisi quando fuerint littere que sunt uniusmodi et partes illarum
que sunt huiusmodi consimiles.

[3.221] Et diversitas facit pulcritudinem, quoniam figure
membrorum animalis sunt diversarum partium, et non sunt
pulcre nisi propter illam diversitatem. Quoniam si nasus totus
285 esset equalis grossitudinis, esset in fine turpitudinis, et pulcri-
tudo eius non est nisi propter diversitatem duorum extremo-
rum eius et eius pyramidalitatem. Et similiter pulcritudo su-
perciliorum non est nisi quando extrema eorum fuerint sub-
tiliora residuis anterioribus. Et similiter omnia membra ani-
290 malis, quando quidem intuentur, invenitur quod pulcritudo
eorum non est nisi ex diversitate figurarum partium eorum. Et
similiter scripture, quoniam, si partes eius scripture essent
equalis grossitudinis, non apparerent pulcre, quoniam extrema
litterarum non apparent pulcra nisi quando fuerint subtiliora
295 residuo, quoniam et, si extrema litterarum, et media earum, et
continuatio earum essent uniusmodi spissitudinis, esset scrip-
tura in fine turpitudinis. Diversitas ergo facit pulcritudinem in
multis formis visibilibus.

[3.222] Iam ergo declaratum est ex eo quod diximus quod
300 unaqueque intentionum particularium, quando comprehendun-
tur per sensum visus, aliquando facit pulcritudinem per se. Et
cum sermo fuerit factus de multis corporibus inductive per se,
cum inducentur omnia corpora, invenietur quod quolibet ista-
rum intentionum facit pulcritudinem in multis locis. Et non

275 erit: erunt P1R 277 grossum: longum EP3R/turpia corr. ex turpes a. m. C1/
animalium membra (278) transp. EP3R 278 membra om. Er; corr. ex umbra L3/
huiusmodi: uniusmodi C1EErL3P3R/et dupla om. R/cum om. C1L3/fuerint: sunt C1;
fiunt L3 279 picture et littere: littere et picture EP3R 280 post nisi scr. et del. nis
C1/fuerint om. C1L3/fuerint littere transp. EP3R/littere que sunt: que sunt littere C1
281 huiusmodi: uniusmodi C1EErL3P3R/post consimiles scr. et del. et P1 285 equa-
lis: eiusdem EP3R/esset²: esse P3 287 pyramidalitatem corr. ex pyramidat P3
289 et om. C1/similiter: super S/animalis (290): animalium R 290 quidem: qui Er;
om. R; corr. ex qui L3/intuentur: aspiciuntur R/invenitur: inveniet S 292 similiter:
universaliter P3; corr. ex universaliter a. m. E/quoniam . . . scripture inter. L3/eius om.
EP3R/scripture² om. C1 293 apparerent: appareant C1L3; apparent P1; corr. ex
apparent a. m. P3/pulcre om. P1 294 ante non add. et de media earum et continuatio
earum S 295 et¹ om. R 296 uniusmodi: unius R/ante esset scr. et del. esset S
299 ergo rep. P3 300 comprehenduntur (1): comprehenditur EP3R; alter. in
comprehenditur L3 1 aliquando: a natura P1 3 cum inter. a. m. E 4 ante
intentionum add. formarum vel EP3/post multis scr. et del. formis visibilibus P1

- 5 diximus ea que diximus ex eis nisi gratia exempli et ut possent
adquiri alia exempla per illa. Sed tamen iste intentiones non
faciunt pulcritudinem in omnibus locis, nec una istarum inten-
tionum facit pulcritudinem in qualibet forma in qua pervenit
illa intentio; sed in quibusdam formis, et in quibusdam non.
10 Verbi gratia, quod non quelibet magnitudo facit pulcritudinem
in quolibet corpore alicuius magnitudinis, et similiter non qui-
libet color facit pulcritudinem, nec inde color facit pulcritudi-
nem in quolibet corpore in quod pervenit ille color. Et similiter
non quelibet figura facit pulcritudinem. Sed quelibet illarum
15 intentionum quas diximus facit pulcritudinem per se; sed in
quibusdam locis, in quibusdam non, et secundum quosdam
modos, et secundum alios non.

[3.223] Et etiam iste intentiones faciunt pulcritudinem per
coniugationem illarum adinvicem, quoniam scriptura pulcra est
20 illa cum figure litterarum sunt pulcre et compositio illarum ad-
invicem est compositio pulcra, quoniam scriptura in qua adun-
antur iste due intentiones est pulcior scriptura in qua est una
istarum duarum intentionum tantum. Finis ergo pulcritudinis
scripture non est nisi ex coniugatione figure et situs.

- 25 [3.224] Et similiter, quando colores scintillantes et picture
fuerint ordinata ordinatione consimili ordinata, sunt pulciores
coloribus et picturis carentibus ordinatione consimili. Et simi-
liter pulcritudo apparet in forma hominum et animalium ex
coniunctione vel ex coniugatione (quod idem est) intentionum
30 particularium que sunt in eis. Quoniam magnitudo oculorum
mediocris cum figura eius amigdalata est pulcior oculo qui
non habet nisi magnitudinem tantum aut figuram amigdalatam
tantum. Et similiter rotunditas faciei cum tenuitate et sub-

5 ea om. P3/ex: de C1L3/ex eis om. R 6 illa: ista EP3R 7 post nec add. in EP3
8 forma om. S/qua: quam R 9 post et scr. et del. non L3 10 quod om. P1RS/non
quelibet om. C1EErL3P3/ante facit mg. non P3 11 corpore om. P1 12 inde:
viridis EP3R; indus P1; alter. in viridis a. m. C1; corr. ex indus a. m. S/post color² add. vel
indus EP3 13 quod: quo P1/illem color transp. Er/et similiter transp. P3 14 sed:
et C1EErL3P3R 15 intentionum corr. ex pulcritudinem S 16 quibusdam¹:
quibus P3/post locis add. et EP3R 18 etiam iste transp. P1/iste om. S 19 con-
iugationem: coniunctionem C1EL3P3R/illarum corr. ex earum P1/adinvicem: inter se
R/pulcra om. L3; corr. ex pulcra P3 20 adinvicem (21): inter se R 23 duarum
intentionum transp. P1/ergo: igitur P1 24 coniugatione: coniunctione C1
26 fuerint corr. ex fuerunt Er/ordinata²: ordinate EP3/pulciores: pulciora P1S/
pulciores coloribus (27) scr. et del. C1 27 et¹ . . . consimili mg. a. m. C1 (ante et add.
pulciora coloribus)/et² om. P1S 29 coniunctione vel ex om. R/ex om. EEerP3/
coniugatione corr. ex coniunctione P1/quod . . . est om. R/post quod scr. et del. lo P1/est
mg. S/post intentionum scr. et del. est S 31 ante est add. quod P1 33 similiter:
simiter S/rotunditas corr. ex rotunditat P3

tilitate coloris est pulcrrior quam unum sine altero. Et similiter
 35 parvitas oris cum gracilitate labiorum et mediocritate eorum
 est etiam pulcrrior parvitate oris cum grossitudine labiorum et
 pulcrrior gracilitate labiorum cum amplitudine oris. Et ista in-
 tentio est multe diversitatis et multorum modorum.

[3.225] Et cum feceris inductionem in formas pulcras omni
 40 modorum visibilium, invenies quod coniunctio intentionum
 particularium que sunt in formis faciunt in eis modos pulcri-
 tudinis quos non facit una intentionum per se. Et pulcritudo in
 maiori parte non fit nisi ex coniunctione istarum intentionum
 adinvicem, quoniam intentiones particulares quas diximus
 45 faciunt pulcritudinem per se, et faciunt pulcritudinem per
 coniunctionem earum adinvicem.

[3.226] Et etiam pulcritudo fit ex alia intentione preter is-
 tas duas intentiones quas prediximus, et est proportionalitas
 et consonoritas. Quoniam forme composite ex membris diver-
 50 sis et partibus diversis habent figuras diversas, et magnitudi-
 nes diversas, et situs diversos, et continuationem et coniunc-
 tionem, et perveniunt in quamlibet illarum multe intentiones
 particulares. Tamen omnes non sunt proportionales, quoniam
 non quelibet figura est pulcra cum qualibet figura, nec quelibet
 55 magnitudo est pulcra cum qualibet magnitudine, nec quilibet
 situs est pulcer cum quolibet situ, nec quelibet figura cum
 qualibet magnitudine, nec quelibet magnitudo cum quolibet
 situ. Sed quelibet intentionum particularium habet propor-
 tionem cum quibusdam intentionum, et est assimetra quibus-
 60 dam. Verbi gratia, simitas nasi cum profunditate oculorum
 non est pulcra. Et similiter magnitudo nasi cum maxima mag-
 nitudine oculorum non est pulcra, et similiter prominentia
 frontis cum profunditate oculorum non est pulcra, et similiter
 frontis planities cum prominentia oculorum non est pulcrum.

34 ante coloris add. cutis et EP1P3R (et inter. P1)/quam unum om. P1 35 oris: horis
 P1/gracilitate: subtilitate EP3R/eorum om. P3R; inter. a. m. E 36 etiam om.
 C1EErL3P3R/parvitate corr. ex gracilitate P1/post parvitate add. eorum L3 39 form-
 as: formis R; corr. ex formis P3/pulcras: pulcris P3R/omni: omnium C1EP1R
 41 faciunt: facit R 42 quos: quas C1ErL3/intentionum: intentio P1 44 adin-
 vicem: inter se R 46 earum: istarum P1S/adinvicem: inter se R 47 post alia scr.
 et del. parte P1 48 duas intentiones transp. C1L3/prediximus: diximus P3/et alter.
 in id est L3/est: etiam Er; om. L3 49 et consonoritas om. Er/composite corr. ex
 compose Er 50 et... diversis om. P1 52 qualibet: quamlibet P1RS 53 non
 om. Er 54 figura¹: forma P3 56 situ om. P1S/nec... situ (58) om. C1L3
 59 intentionum: intentionibus R/post assimetra scr. et del. in proportio C1 61 pul-
 cra corr. ex pulcrum EP3 (a. m. E)/maxima: magna EP3; om. R 62 pulcra: pulcrum
 C1EErL3P3/et... pulcra (63) mg. a. m. E 63 pulcra: pulcrum C1EErL3P3
 64: pulcrum: pulcra R

- 65 Quodlibet ergo membrorum habet figuram que facit formam
eius pulcram, et cum hoc quolibet figura cuiuslibet membri non
habet proportionem nisi cum quibusdam figuris residuorum
membrorum, et cum aliis non. Et forma fit pulcra per congrega-
tionem figurarum proportionalium.
- 70 [3.227] Et similiter magnitudines, et situs, et ordinatio
eorum, quoniam magnitudo oculorum cum pulcritudine figure
eorum, et cum mediocritate similitatis nasi, et cum magnitudine
proportionali ad magnitudinem oculorum est pulcra. Et simili-
ter amigdaleitas oculorum, et dulcedo et tenuitas figure eius,
75 etsi fuerint parvi, cum subtilitate nasi, et mediocritate figure et
quantitatis eius, erunt pulcri. Et similiter gracilitas labiorum
cum subtilitate oris est pulcra quando subtilitas oris eius fuerit
proportionalis ad gracilitatem labiorum—scilicet quod labia
non sint in fine gracilitatis et os non sit in fine parvitas, sed
80 erit parvitas oris mediocris et labia gracilia et cum hoc propor-
tionalia ad quantitatem oris. Et similiter amplitudo faciei,
quando fuerit proportionalis ad quantitates membrorum faciei,
erit pulcra—scilicet cum facies non sit in fine amplitudinis, et
membra faciei sunt proportionalia ad quantitates totius faciei.
- 85 Quoniam, quando facies fuerit ampla maxime amplitudinis, et
membra que sunt in ea sunt parva non proportionalia ad
quantitatem eius, non erit facies pulcra, quamvis quantitates
membrorum sint proportionales, et figure eorum sunt pulcre.
Et similiter, quando fuerit parva facies et stricta, et membra
90 eius fuerint magna (membra dico faciei), erit facies turpis. Et
cum membra fuerint proportionalia inter se et proportionalia
ad quantitatem amplitudinis faciei, erit forma pulcra, quamvis
membra per se non sint pulcra.

65 quodlibet ergo *transp.* C1L3/ergo membrorum *transp.* P3/membrorum: mem-
brum L3 66 cum hoc: etiam R 67 quibusdam *corr. ex* quibus P3 68 pulcra
corr. ex forma P3/congregationem (69): cognationem P1 71 *post* eorum *add.* facit
hoc C1 73 *post* magnitudinem *scr. et del.* eorum P1 74 amigdaleitas: amigdalitas
C1L3R; amigdalinitas E; amigdalinitatis P3/*post* et¹ *scr. et del.* ducta P3/et²: nec S
75 et² *om.* C1EL3P3R 76 *post* eius *scr. et del.* et L3 77 subtilitas: gracilitas R/oris²
om. P3/eius *om.* R/*post* eius *scr. et del.* su P3/*post* fuerit *inter.* debite P3 78 labia
om. P1 79 *sint:* sunt C1P3/gracilitatis ... fine *mg.* L3/et ... parvitas *mg. a. m.* C1/
post non² *scr. et del.* non P3/sit: erit L3/*om.* EP1P3S 80 parvitas *corr. ex* parvitas P3/
cum hoc: praeterea R/hoc: hec L3 81 *post* et *add.* tunc fiet pulcritudo et C1/*post*
faciei *scr. et del.* non Er 82 quando fuerit *transp.* Er 83 scilicet: sed L3/cum:
quando P3; quod R 84 *sunt:* sint R/quantitates: quantitatem R/totius faciei
transp. C1EERL3P3 87 quantitatem: quantitates EP3/*post* quamvis *scr. et del.* facies
C1/quantitates membrorum (88) *transp.* C1 88 proportionales *corr. ex* proportiones
P3/sunt: sint EERP3R; *alter. in* sint C1 90 fuerint: fiunt L3P1 91 fuerint: sint EP3
92 *post* quantitatem *scr. et del.* illius p P1/quamvis: quam P1 93 *sint:* sunt C1;
fuerint P1S

- [3.228] Sed proportionalitas tantum facit pulcritudinem.
- 95 Cum ergo in forma congregabitur pulcritudo figure cuiuslibet partis eius, erit pulcritudo quantitatis et compositionis earum, et proportionalitas membrorum secundum figuras, et magnitudines, et situs, et fuerint cum hoc proportionalia ad totam figuram faciei et quantitatem eius, erit in fine pulcritudinis.
- 100 [3.229] Et similiter scriptura non erit pulcra nisi quando littere eius fuerint proportionales in figura, et quantitate, et situ, et ordine. Et similiter de omnibus modis visibilium cum quibus congregantur partes diverse.
- [3.230] Et cum consideraveris formas pulcras de omnibus
- 105 modis visibilium, invenies quod proportionalitas facit pulcritudinem magis quam aliqua alia intentio, vel etiam aliquae coniuncte per se. Et cum considerabuntur intentiones pulcre quas faciunt intentiones particulares per coniunctionem earum adinvicem, invenietur quod pulcritudo que apparet ex coniunctione
- 110 illarum non apparet nisi propter proportionalitatem illarum intentionum coniunctarum inter se. Quoniam non quandocumque adunabuntur ille intentiones fit pulcritudo; sed in quibusdam formis, et in aliis non. Et est propter proportionalitatem que contingit inter illas intentiones. Pulcritudo ergo non est
- 115 nisi ex intentionibus particularibus, et perfectio eius est ex proportionalitate et consonantia que fit inter intentiones particulares.
- [3.231] Iam ergo declaratum est ex omni quod diximus quod forme pulcre comprehense a visu non sunt pulcre nisi ex
- 120 intentionibus particularibus que comprehenduntur per sensum visus, et ex coniunctione earum adinvicem, et ex proportionalitate earum adinvicem. Et visus comprehendit intentiones particulares predictas simplices et compositas. Cum ergo visus

94 tantum: tantummodo EP3R 95 ergo: igitur P1/in inter. ErL3 (a. m. Er)
 96 post eius scr. et del. eit P1/compositionis: compositio EEr; corr. ex compositio L3P3/
 earum om. R; corr. ex eorum P1 97 proportionalitas: proportionalitatis C1/post
 figuras add. tantum P1/et² om. S 98 post situs scr. et del. fu S/cum hoc: praeterea R
 99 et: ad S; inter. L3/quantitatem: quantitatum Er; alter. in quantitatum L3
 100 quando corr. ex cum P1 101 littere eius fuerint: fuerint . . . eius C1EL3P3R/in
 corr. ex et a. m. C1 102 de: est cum R/post visibilium scr. et del. invenies S
 104 consideraveris: consideraverit L3 107 cum inter. E 108 adinvicem (109):
 inter se R 110 post illarum¹ add. inter se R/post propter scr. et del. proportionem
 alicem P1/ante illarum² scr. et del. eorum P1/post illarum² add. coniunctionum vel EP3
 111 intentionum: coniunctionum P1; corr. ex coniunctionum ErL3S (a. m. ErS)/quoniam
 corr. ex quando a. m. C1 113 post formis add. fit EP1P3R/post et² add. hoc EP3R/post
 propter add. proportionem vel C1EL3P3 115 post eius add. non EP3R/est mg. a. m.
 C1/post est add. nisi EP3R 118 est om. S 121 adinvicem: inter se R/et² inter. L3
 122 earum: eorum ErL3/adinvicem: inter se R/intentiones corr. ex intentione P3
 123 post ergo scr. et del. videret P1

comprehenderit aliquam rem visam, et fuerit aliqua intentio in
 125 illa re visa particularis faciens pulcritudinem per se, et intueatur
 visus illam intentionem per se, pervenit forma illius intentionis
 post intuitum apud sentientem. Et comprehendet virtus
 distinctiva pulcritudinem rei vise in qua est illa intentio, quoniam
 forma cuiuslibet rei vise est composita ex multis intentionibus
 130 intentionum quarum divisionem prediximus. Cum ergo visus
 comprehenderit rem visam et non distinxit intentiones que sunt in ea,
 non comprehendet pulcritudinem eius. Et cum distinxit intentiones
 que sunt in ea, et fuerit aliqua intentio earum secundum modum
 facientem pulcritudinem in anima,
 135 statim visus apud intuitionem illius intentionis comprehendet
 illam intentionem per se. Et cum comprehenderit illam intentionem
 per se, perveniet illa comprehensio apud sentientem, et sic virtus
 distinctiva comprehendet pulcritudinem que est in ea. Et per istam
 comprehensionem comprehendet pulcritudinem illius rei vise.
 140 Cum ergo visus comprehenderit aliquam rem visam, et in illa re
 visa fuerit pulcritudo composita ex intentionibus coniunctis,
 et intuens fuerit visus illam rem visam, et distinxit intentiones
 que sunt in ea, et comprehenderit intentiones que faciunt pulcritudinem
 per coniunctionem earum adinvicem aut proportionalitatem earum
 145 adinvicem, et pervenerit illa comprehensio apud sentientem, et comparaverit
 virtus distinctiva illas intentiones adinvicem, comprehendet pulcritudinem
 illius rei vise composite ex coniunctione intentionum que sunt in ea.
 150 Visus ergo comprehendet pulcritudinem illius rei vise composite
 ex coniunctione intentionum que sunt in ea. Visus ergo comprehendet
 pulcritudinem que est in visi-

124 comprehendit *corr. ex* comprehenderet P1 125 particularis: particulari EP3;
corr. ex particulare C1/post faciens *add.* aliquam EP3/post se *add.* aliquam R/intueatur
 (126): intuatur P3 126 visus *corr. ex* vir a. m. C1/intentionis (127): intuitionis EL3P3
 127 intuitum *corr. ex* intuitionem P1/sentientem: membrum sentiens R 128 pul-
 critudinem . . . intentio *om.* P1 129 ante forma *add.* vero R 130 ante intentionum
add. earum R 132 non . . . ea (133) *mg. a. m. E* 134 post earum *add.* que sunt in
 ea EP3R/facientem *corr. ex* faciendum L3 135 intuitionem: intentionem EP1P3
 136 et *om.* P3/comprehenderit *corr. ex* comprehenderet Er 137 sentientem: mem-
 brum sentiens R 138 ante que *mg.* eius a. m. C1 139 istam: illam C1/
 comprehendet: comprehenditur C1/pulcritudinem (140): pulcritudo C1 140 ergo:
 igitur P1 142 intuens: intuitus R/intuens . . . visus: fuerit . . . intuens EP3R/visus
om. S 145 earum¹: illarum P1S/adinvicem¹²: inter se R/earum² *om.* P3 146 per-
 venerit: pervenit EP3/sentientem: membrum sentiens R/post et *add.* cum EP3
 147 adinvicem: inter se R 148 composite: compositam P1R; *corr. ex* composita a. m.
 S; *alter. in* compositione a. m. E; *alter. in* compositam L3/ex inter. a. m. E 149 visus
 . . . ea (151) *om.* EErP3R; *scr. et del.* C1 (post composite *add.* vel comparatione illarum
 composite) 151 comprehendet: comprehendit L3

bilibus ex comparatione illarum intentionum adinvicem secundum modum quem declaravimus.

[3.232] Turpitudine vero est forma carens qualibet intentione
 155 pulcra. Quoniam iam predictum est quod intentiones particu-
 lares faciunt pulcritudinem, sed non in omnibus locis nec in
 omnibus formis; sed in quibusdam, et in aliis non. Et similiter
 proportionalitas non est in omnibus formis; sed in quibusdam
 formis, et in aliis non. Forme ergo in quibus non faciunt inten-
 160 tiones particulares aliquam pulcritudinem per se nec per suam
 coniunctionem, et in quibus non est aliqua proportionalitas
 inter partes earum carent omni pulcritudine, et sic sunt turpes,
 quoniam turpitudine formarum est privatio pulcritudinis in eis.
 Et forte congregantur in eadem forma intentiones pulcre et
 165 turpes, sed visus comprehendet pulcritudinem ex pulcro et
 turpitudinem ex turpibus quando distinxit et fuerit intuens
 intentiones que sunt in ea. Turpitudine ergo comprehenditur a
 visu in formis carentibus omnibus pulcritudinibus ex privati-
 one pulcritudinis ab eo apud comprehensionem.

170 [3.233] Consimilitudo autem est equalitas duarum forma-
 rum aut duarum intentionum in re in qua sunt consimiles. Cum
 ergo visus comprehenderit duas formas aut duas intentiones
 consimiles in simul, comprehendet consimilitudinem illarum ex
 comprehensione cuiuslibet duarum formarum vel intentionum
 175 et ex comparatione alterius illarum ad alteram. Visus ergo
 comprehendet consimilitudinem in formis et intentionibus con-
 similibus ex comprehensione cuiuslibet formarum et intentio-
 num secundum suum esse et ex comparatione illarum adin-
 vicem.

152 comparatione: compositionem P1; compositione R; corr. ex comprehensione a. m.
 C1/post comparatione scr. et del. a Er/adinvicem: inter se R 154 qualibet intentione
 transp. EP3R 155 quoniam iam corr. ex iam quoniam L3/post quoniam add. enim R/
 post iam add. quidem C1 156 in¹ rep. P1 157 in quibusdam om. E/quibusdam:
 aliis C1EErL3P3R 159 formis . . . aliis inter. L3/aliis: quibusdam C1EL3P3R/post
 forme scr. et del. r C1/post ergo scr. et del. visibilium P1/intentiones (160): intentio P1
 160 aliquam pulcritudinem transp. EP3R/nec: non P3 161 et om. C1EErL3P3/post
 et scr. et del. nec E/non om. EP3 162 omni pulcritudine: pulcritudinem P3
 164 congregantur: aggregantur EP3R 165 comprehendet: comprehen-
 dit C1EErL3P3R/ex . . . turpitudinem (166) om. P1 166 turpibus: turpi R/intuens:
 intuitus R 167 comprehenditur corr. ex comprehenderunt P1/a visu (168) om.
 EErL3P3; inter. a. m. C1 169 ab eo om. R/post apud scr. et del. privationem
 comprehensione P1 173 consimiles inter. a. m. E/in om. R/illarum ex transp. R/post
 ex scr. et del. consimil P1 174 comprehensione: comparatione P1S/vel: et C1EL3P3
 175 comparatione: comprehensione P1S/illarum: earum C1L3; om. S 176 com-
 prehendet: comprehendit C1EL3P3R/formis: forma P3/et: vel R/consimilibus (177)
 om. S 177 ante ex add. et S/comprehensione: comparatione P1S/et: vel R
 178 comparatione: comprehensione EErL3P1S/adinvicem (179): inter se R

180 [3.234] Diversitas autem comprehenditur a visu in formis
diversis ex comprehensione cuiuslibet formarum diversarum, et
ex comparatione alterius illarum ad alteram, et ex comprehen-
sione privationis equalitatis in eis. Diversitas ergo comprehen-
ditur per sensum visus ex comprehensione cuiuslibet formarum
185 et intentionum per se, et ex comparatione eorum adinvicem, et
ex sensu privationis equalitatis a sentiente.

[3.235] Iam ergo complevimus et declaravimus declaratio-
nem qualitatis comprehensionis cuiuslibet intentionum particu-
larium que comprehenduntur per sensum visus. Et declaratum
190 est ex omnibus hoc quod quedam intentiones particulares
comprehenduntur solo sensu, et quedam comprehenduntur per
cognitionem, et quedam per argumentationem et significatio-
nem secundum vias quarum declarationem prediximus. Et iste
sunt intentiones quarum declarationem intendimus in isto
195 opere.

[CAPITULUM 4]

[4.1] Iam declaratum est quomodo visus comprehendit
quamlibet intentionum particularium que comprehenduntur
per sensum visus, et visus non comprehendit nisi formas visibili-
um, que sunt corpora. Sed forme visibilium sunt composite ex
5 intentionibus particularibus predictis, sicut figura, et magni-
tudine, et colore, et situ, et ordine, et sibi similibus. Visus ergo
non comprehendit quamlibet intentionum nisi ex comprehen-
sione formarum visibilium compositarum ex intentionibus par-
ticularibus, et visus comprehendet quamlibet formarum visi-
10 bilium secundum omnes intentiones particulares que sunt in
forma in simul. Et nichil comprehendit visus ex intentionibus
particularibus per se, quoniam nulla intentionum particularium
predictarum est sola per se, nam omnes iste intentiones par-

181 ex: cum C1/post et add. etiam C1 182 ex comparatione *inter. a. m. S/* compara-
tione: comprehensione *Er; corr. ex* comprehensione L3 183 ante in add. id est
similitudinis EP3; add. similitudinis P1; add. id est consimilitudinis R 184 cuiuslibet:
cuius P3/post cuiuslibet add. illarum *Er* 185 eorum: earum C1R/adinvicem: inter
se R 190 est om. C1EL3P3/hoc: his R 192 significationem (193) om. C1L3
193 vias: visas P1P3 194 sunt intentiones *transp. C1L3/isto: hoc ER* 2 inten-
tionum: intentionem C1L3P1/comprehenduntur: comprehenditur L3 3 formas om.
P1/formas visibilium (4) *transp. S* 4 post visibilium *scr. et del. non E* 6 sibi om.
R/post similibus *scr. et del. et P3* 9 et . . . particularibus (12) *mg. a. m. E/* formarum:
formam P1S 10 omnes om. EP3R 11 forma: formis R/in simul: visibilis P3R;
corr. ex visibilis E/comprehendit: comprehendet C1 12 particularium om. R
13 intentiones particulares (14) *transp. EP3R*

15 ticulars non inveniuntur nisi in corporibus, et nullum corpus
est in quo est aliqua istarum intentionum sola sine alia. Visus
ergo non comprehendit nisi formas visibilium, sed quelibet
formarum visibilium est composita ex multis intentionibus
particularibus. Ergo visus comprehendit in qualibet formarum
visibilium multas intentiones particulares, et distinguuntur in
20 ymaginatione. Visus ergo comprehendit quamlibet intentionum
particularium apud visionem rei vise coniunctam cum aliqua
intentionum particularium, et ex distinctione eius inter inten-
tiones que sunt in forma comprehendit quamlibet intentionum
per se.

25 [4.2] Et iam declaratum est, et etiam determinatum, quali-
ter visus comprehendit formas visibilium que componuntur ex
intentionibus particularibus. Et quedam intentiones particu-
lares ex quibus componuntur forme visibilium apparent apud
aspectum rei vise, et quedam non apparent nisi post intuitio-
nem et considerationem subtilem, sicut scriptura subtilis, et
30 lineatio subtilis, et diversitas colorum consimilium fere. Et
generaliter omnes intentiones subtiles non apparent visui apud
aspectum rei vise, sed post intuitionem et considerationem. Et
forma rei vise comprehensa per sensum visus est illa que com-
ponitur ex omnibus intentionibus particularibus que sunt ex
35 forma rei vise quas possibile est visum comprehendere. Et
visus non comprehendit veram formam rei vise nisi per com-
prehensionem omnium intentionum particularium que sunt in
forma rei vise. Et cum ita est, forma ergo vera rei vise in qua
40 sunt intentiones subtiles non comprehenditur a visu nisi post
intuitionem.

[4.3] Et etiam cum visus non comprehenderit intentiones
subtiles nisi per intuitionem, et non apparent intentiones sub-

14 in: ex L3 15 est: erit P3 16 comprehendit: comprehendet C1/post visibilium
scr. et del. est composita S 17 formarum: forma EP3R 19 et: quae R/
distinguuntur: distinguuntur R 20 quamlibet: quemlibet L3 21 post cum scr.
et del. qualibet E/aliqua intentionum (22) transp. EP3R 22 intentionum: intentionem
L3/intentionum particularium: intentione particulari C1EErP3R/particularium corr. ex
particulari L3/et: deinde C1EErL3P3R 23 post forma add. et P1; add. etiam S/
comprehendit: comprehendet C1L3/quamlibet: qualibet ErP3/intentionum:
intentionem C1 25 est om. P3/etiam om. C1EL3P3R/post determinatum add. est S
26 comprehendit: comprehendat R 27 intentionibus corr. ex coniunctionibus
a. m. C1 29 vise om. P1 31 subtilis corr. ex sub visu L3 32 subtiles non
apparent corr. ex non . . . subtiles P3 33 ante et² scr. et del. et forma rei vise sed post
intentionem et considerationem L3 39 cum om. P3/ita est transp. P3/est: sit R
42 etiam om. EP3R/comprehenderit: comprehendit P1; comprehendat R 43 appar-
ent: appareant R/intentiones: intuitiones L3

45 tiles visui apud aspectum, quando visus comprehenderit aliquam rem visam, et comprehenderit formam eius, et fuerint in illa re visa intentiones subtiles, intentiones subtiles non apparent per aspectum, sed per intuitionem. Cum ergo visus comprehenderit aliquam rem visam, et non fuerit in ea aliqua intentio subtilis, etiam comprehendet veram eius formam, etsi
50 non certificabit quod illa forma est vera nisi postquam habuerit fortem intuitionem ad quamlibet partem illius rei vise. Et certificaverit quod nulla intentio subtilis est in ea, et tunc certificabit quod forma quam comprehendit est vera forma.

[4.4] Secundum ergo omnes dispositiones non certificat
55 visus formam rei vise nisi per considerationem omnium partium rei vise et per intuitionem omnium intentionum que possunt apparere in re visa.

[4.5] Et cum hoc est declaratum, dicamus quod comprehensio visibilium erit secundum duos modos, et sunt comprehensio superficialis et comprehensio per intuitionem que profundum aspicit. Quoniam, quando visus aspicit rem visam, comprehendet intentiones manifestas que sunt in ea apud aspectum. Deinde, si preter illud intuerit ipsum et consideraverit omnes partes eius, certificabit formam eius. Si autem non
60 intuerit partes eius, comprehendet formam non certificatam, et illa forma aut eius forma vera erit (sed ipse non certificat quod forma eius sit vera), aut non erit forma eius vera. Et cum ita est, comprehensio ergo visibilium a visu erit secundum duos modos: et comprehensio superficialis, que est in primo aspec-

44 visui corr. ex visu a. m. L3/post aspectum add. rei visae R/quando corr. ex quoniam P1/post quando add. autem C1EErL3P3; add. igitur R/aliquam . . . comprehenderit (45) om. S 45 post et¹ add. non EP3 (inter. a. m. E)/post et² add. non C1EErL3P3/fuerint: fuerit ErP1S 46 intentiones subtiles¹ transp. R/post subtiles¹ add. et ErL3/intentiones subtiles² om. C1EL3P1S/ante non add. que interius C1; add. que EP3 47 per² om. Er 49 etiam om. C1EErL3P3R/etsi: quamvis R 50 post illa add. eius L3/forma est vera: est vera forma C1; vera est forma L3 (est inter. a. m.)/post nisi scr. et del. si Er 51 ad: super C1EErL3P3R/quamlibet: qualibet S/post illius scr. et del. o C1 52 intentio corr. ex intentione P1/post subtilis scr. et del. est L3 56 post omnium add. partium C1/intentionum: partium EP3R 57 re visa transp. P3 58 est declaratum transp. P1S 59 et: qui EP3R; om. C1ErL3/sunt om. C1ErL3S 60 intuitionem: inductionem Er; corr. ex inductionem L3S (a. m. S) 61 quando visus transp. P1/post rem scr. et del. rem P1 62 comprehendet: comprehendit C1EL3P3R/intentiones: intuitiones P3/apud corr. ex asp P3 63 illud om. L3/intuerit: intuetur P3; inspexerit R; corr. ex intuetur a. m. E/ipsam: ipsam R 64 eius² om. P1 65 intuerit: intuetur EP3R/non rep. P1; om. R 66 post forma¹ add. que est in visu EP1P3R/eius: erit C1/eius . . . erit: erit vera eius forma EP3R/vera erit transp. C1ErL3/erit: eius C1 67 forma eius sit: sit . . . eius C1ErL3/forma¹ . . . vera¹: sit vera eius forma EP3R/sit corr. ex si a. m. P3 68 est: sit R/a visu om. R 69 post et add. est R

70 tu, et comprehensio per intuitionem. Comprehensio autem per
primum aspectum est comprehensio non certificata, et com-
prehensio per intuitionem est comprehensio per quam certifi-
cantur forme visibilium.

[4.6] Et cum hoc declaratum est, dicamus quod intuitio per
75 quam comprehenduntur forme vere visibilium erit per ipsum
visum, et erit per distinctionem. Quoniam iam declaratum est
in distinctione linearum radialium quod forme que a visu com-
prehenduntur ex axe radiali et ex illo quod est prope axem
sunt manifestiores et maioris certificationis formis que com-
80 prehenduntur ex residuis verticationibus. Cum ergo visus fue-
rit oppositus alicui rei vise, et illa res visa non fuerit in fine par-
vitatibus sed alicuius quantitatis, et visus fuerit fixus in opposi-
tione eius apud aspectum illud quod opponitur medio visus ex
illa re visa, et fuerit super axem aut prope axem, erit manifes-
85 tius partibus residuis rei vise. Et visus percipit istam disposi-
tionem, quoniam, quando comprehenderit rem visam totam,
inveniet locum oppositum medio eius cuius forma pervenit in
medio visus esse manifestiorem partibus residuis.

[4.7] Et superius declaratum est quod ista intentio apparet
90 sensui quando res visa fuerit magne quantitatis. Cum ergo
visus comprehenderit totam rem visam, inveniet quod forma
partis opposite medio eius est manifestior omnibus partibus
residuis, et cum voluerit certificare formam rei vise, movebitur
ita quod medium eius sit oppositum cuilibet parti partium rei
95 vise. Et sic comprehendet formam cuiuslibet partis partium rei
vise comprehensione manifesta certificata sicut comprehendit
partem oppositam medio eius apud aspectum rei vise. Cum
igitur sentiens voluerit certificare rem visam, movebitur visus
ita quod sit medium eius oppositum cuilibet parti partium rei
100 vise, et per istum modum comprehendet formam cuiuslibet

70 ante per¹ add. que est EP3R/comprehensio²... intuitionem (72) mg. a. m. E 74 est:
sit R/dicamus: dica ergo P1 75 comprehenduntur: comprehenditur Er/forme vere
transp. R 76 est om. ErL3 77 visu corr. ex visui L3 78 ex¹: ab C1L3/radiali
corr. ex radialium Er/quod: qui R/prope: proprie P1 79 manifestiores: manifestioris
L3; corr. ex manifestioris a. m. C1; corr. ex manifeste P3/et om. L3/maioris: maiores EP3/
certificationis: manifestationis C1EL3P3/comprehenduntur (80): comprehenditur Er
80 ergo: igitur EEerL3P3 81 et... visa om. P1/visa om. P3 82 fuerit om. P3/fixus
corr. ex fixi Er 83 apud om. P3 84 aut... axem inter. L3 86 quando
comprehenderit corr. ex comprehenderit quando S/comprehenderit: comprehendit EP3
87 post cuius mg. est a. m. C1/post forma add. que C1EEerL3P3 88 medio: forma P1S;
medium R/esse... residuis om. P1 92 partis rep. P1/post opposite add. in L3/post
eius scr. et del. quod P1/est inter. a. m. E 94 quod: ut R/oppositum: oppositionem
S/parti om. C1 96 post manifesta add. et R 97 eius om. P1S 98 igitur:
ergo C1L3 99 quod: ut R/oppositum: oppositionem S/cuilibet: cuiuslibet P3

partium rei vise valde manifeste.

[4.8] Et virtus distinctiva distinguet omnes formas venientes ad ipsam, et distinguet colores partium, et diversitatem colorum, et ordinationem partium adinvicem—et generaliter
 105 omnes intentiones rei vise que apparent per intuitionem et formam totius rei vise compositam ex illis partibus et ex illis intentionibus. Secundum ergo hunc modum erit certificatio cuiuslibet partium rei vise secundum suum esse et certificatio
 110 omnium intentionum rei vise. Et non certificatur forma cuiuslibet partium rei vise nisi post motum visus super omnes partes, et cum hoc natus est visus ad motum intuitionis et ad faciendum axem radialem transire super omnes partes rei vise. Cum ergo virtus distinctiva quesierit intueri rem visam, movebitur axis radialis super omnes partes rei vise. Et cum intentiones subtiles que sunt in re visa non apparent nisi per motum
 115 visus et pertransitum axis aut radialium linearum que sunt prope ipsum super quamlibet partium rei vise, non perveniet forma rei vise certificata apud sentientem (quando corpus eius fuerit alicuius quantitatis) nisi per motum visus et per oppositionem cuiuslibet partium rei vise medio visus.

[4.9] Et etiam, quando res visa fuerit in fine parvitatatis et non fuerit opposita medio visus etiam, non complebitur intuitio eius nisi postquam movebitur visus donec axis pertranseat in illam rem visam; et perveniet forma illius rei vise in medium
 125 visus, et appareat forma rei vise. Et cum ita est, intuitio per quam visus comprehendit veras formas visibilium forte erit per ipsum visum et forte per distinctionem in simul. Comprehensio ergo forme vere rei vise non erit nisi per intuitionem, et intuitio per quam certificatur forma rei vise non complebitur
 130 nisi per motum visus. Et cum corpus rei vise fuerit alicuius quantitatis, non complebitur intuitio eius nisi per motum axis

103 et¹ om. L3 104 adinvicem: inter se R/post generaliter add. distinguet R
 105 rei vise om. L3/intuitionem: intuitum EP3R 106 compositam: oppositam L3/
 partibus... illis om. EP3R 109 certificatur forma: certificatur formam P3 111 cum
 hoc: praeterea R/intuitionis: intentionis P1 112 post axem scr. et del. ro P1/
 radialem: radiale Er 113 ergo virtus corr. ex virtus ergo S 114 post cum add.
 omnes C1L3 115 post in add. illa EP3R/apparent: appareant R 116 pertransitum:
 per transitum R/radialium linearum transp. C1EL3P3R 117 ipsum: ipsam EErP3;
 corr. ex ipsam L3/quamlibet: qualibet P1/perveniet: pervenit Er; corr. ex pervenit S
 118 apud: ad R 120 cuiuslibet corr. ex cuius L3 121 post visa scr. et del.
 visus L3 122 etiam: et C1EErL3P3 (scr. et del. C1) 123 movebitur: motus fuerit
 R/pertranseat: transeat C1EErL3P3R 124 in¹ om. Er/perveniet: pervenit Er; per-
 veniat R 125 appareat: apparet EL3P3; corr. ex apparet a. m. C1/est: sit R/per:
 post P3 127 ante in add. visibilis P3/in om. R/in simul corr. ex visibilis a. m. E
 128 et intuitio (129) om. P3 129 certificatur: certificabitur EP3R/complebitur corr.
 ex comprehenditur P1 130 corpus: forma P3

radialis in omnes dyametros rei vise. Et istam intencionem
voluit dicere ille qui opinabatur quod visio non fuerit nisi per
motum et quod nulla res visa videbitur tota simul, quoniam
135 ipse intendebat dicere visionem certificatam que non potest
esse nisi per intuitionem, et per motum visus, et per motum
axis radialis super omnes diametros rei vise.

[4.10] Quomodo vero sentiens certificat per intuitionem et
motum formam rei vise est quia, quando visus fuerit oppositus
140 rei vise, sentiens etiam comprehendet totam formam apud
oppositionem comprehensione qualicumque, et comprehendet
partem que est apud extremum axis vera comprehensione in
fine veritatis. Et cum hoc, tunc comprehendet quamlibet
145 partium residuarum forme aliqua comprehensione. Deinde,
quando visus movebitur et mutabitur axis a parte in qua erat
ad aliam partem, comprehendet sentiens in ista dispositione
formam totius rei vise secunda comprehensione, et compre-
hendet partem eius que est apud extremum axis secunda
150 comprehensione etiam. Et cum hoc erit comprehensio istius
partis que est apud extremum axis in secunda dispositione
manifestior comprehensione eius in prima dispositione, et in
ista dispositione etiam comprehendet sentiens partes residuas
aliqua comprehensione. Et similiter, quando axis mutabitur
per motum ad tertiam partem, comprehendet sentiens in tertia
155 dispositione totam rem visam tertia comprehensione, et com-
prehendit partem que est apud extremum axis tertia compre-
hensione etiam, et erit comprehensio istius partis ab eo in ista
dispositione manifestior comprehensione in duabus primis
dispositionibus. Et cum hoc sentiens comprehendet in ista
160 dispositione etiam quamlibet partium residuarum aliqua com-
prehensione. Per motum ergo visus super partes rei vise ad-

133 voluit: voluerit *P1/post* qui *add.* quidem *P3/fuerit*: fieri *R* 134 videbitur:
videtur *EP3*; videretur *R/post* tota *add.* in *P1* 135 intendebat: intendebit *L3*
136 *post* esse *add.* certificata *P3* 138 certificat: certificet *R/post* et *add.* per *EP3R*
139 formam: forme *S* 140 etiam *om.* *C1EErL3P3R*/etiam comprehendet: compre-
hendit etiam *P1/apud om.* *P1* 141 oppositionem: oppositam *P1/comprehensione*:
comprehensionem *Er/post* et *scr. et del.* q *L3/comprehendet*: comprehendit *EP3*
142 partem *om.* *Er* 143 *post* fine *add.* axis *P3/cum hoc*: etiam *R/post hoc scr. et del.*
per axem *C1/comprehendet*: comprehendit *C1*; *om.* *EErP3R*; *inter.* *L3/post* quamlibet
add. partem *EP3R* 144 partium residuarum *transp.* *EP3R/post* partium *add.* forma-
rum *P1S* 145 erat: erit *P1S* 148 partem *om.* *P1/eius om.* *EErL3P1P3R*; *mg.*
a. m. *C1* 149 cum hoc *om.* *R* 152 etiam *om.* *P1/comprehendet* sentiens
transp. *EP3R* 156 partem *om.* *P3/extremum*: extremitatem *EP3R* 157 etiam
om. *P1S* 159 et *inter.* *a. m.* *E/cum hoc*: tunc *R/sentiens corr.* ex *senti* *L3*
160 *post* etiam *add.* in *P1/quamlibet*: qualicumque *P1* 161 super: suas *P1*

quirit sentiens duas dispositiones quarum altera est frequen-
tatio comprehensionis totius rei vise; et secunda est que com-
prehendit quamlibet partium rei vise per axem radialem aut
165 per illud quod est prope axem radialem manifesta compre-
hensione. Apparet ergo sensui omne quod est possibile
apparere ex illis partibus. Et cum sentiens sepe comprehen-
derit totam rem visam et quamlibet partium rei vise, compre-
hendet per istam dispositionem omne quod possibile est
170 comprehendi ex illa re vise.

[4.11] Et cum hoc comprehensione multotiens iterata et in
duabus duplicationibus et iterationibus comprehensionis totius
rei vise distinguit virtus distinctiva illud quod apparet ex
coloribus partium, et luce, et magnitudine, et remotione, et
175 figura, et situ earum, et equalitate illarum que sunt consimiles
in istis distinctionibus, et diversitate earum que sunt diverse in
omnibus istis intentionibus aut in quibusdam, et ex ordine par-
tium adinvicem. Et comprehendit ex distinctione omnium is-
tarum intentionum et comparatione istarum intentionum ad ea
180 que cognoscuntur ex similibus earum formam compositam ex
omnibus istis. Et sic signatur in ymaginatione forma composi-
ta ex omnibus similibus intentionibus, et sic certificatur forma
rei vise per quam appropriatur illa res visa apud sentientem.
Secundum ergo hunc modum certificatur sentiens per intuitionem
185 formas visibilium.

[4.12] Et etiam dicamus quod visus, quando comprehendit
aliquam rem visam, et fuerit certificata forma eius apud senti-
entem, forma illius rei vise remanet in anima, et figurabitur in
ymaginatione. Et iterabitur comprehensio rei vise, et erit forma
190 eius magis fixa in anima quam forma rei vise quam visus non
comprehendit nisi semel aut raro. Et dico quod visus, quando

162 altera corr. ex alter L3 163 post secunda add. que P3/comprehendit (164):
comprehendit L3 168 totam corr. ex motam L3/totam rem visam: rem . . . to-
tam C1EL3P3R 169 post quod add. est Er/possibile est transp. C1EL3P3R
170 ex: ab C1EL3P3R 171 hoc: hac C1P1R; om. S/et² om. C1ErL3P3R 172 dua-
bus om. C1EErL3P3R/comprehensionis: comprehensione Er/comprehensionis . . . vise
(173): totius rei vise comprehensionis L3 175 illarum corr. ex earum S 176 ea-
rum om. EL3P3; mg. a. m. C1 177 post omnibus add. etiam C1EL3P3/et om. L3/ex
inter. C1 178 adinvicem: inter se R 179 et: at C1/et . . . intentionum
om. EL3P1P3RS; mg. a. m. C1 180 cognoscuntur: cognoscunt EE; cognoscit P3/
similibus: consimilibus P3/formam: formarum S 181 istis om. R/post istis scr. et del.
intentionibus E/sic rep. E; inter. L3/signatur: figuratur C1; corr. ex figuratur L3
182 similibus: istis C1EL3P3R; illis Er 186 visus quando transp. R/comprehendit:
comprehenderit R 187 post rem scr. et del. suam P3 188 figurabitur: figuratur
R/in² om. S; inter. ErL3 189 iterabitur: iteratur R/comprehensio corr. ex
comprehensione Er 190 quam²: quia EErP1P3S; corr. ex quia C1L3 (a. m. C1)
191 dico om. C1EErL3P3R/post dico add. etiam C1/quod visus mg. a. m. C1/quando
om. P3

comprehenderit aliquod individuum, deinde comprehenderit
 alia individua illiusmodi individui, et iterabitur comprehensio
 individuorum frequenter, quiescet forma illiusmodi in anima, et
 195 perveniet forma universaliter figurata ymaginatione. Et signifi-
 catio super hoc quod forme visibilium remanent in anima et in
 ymaginatione est quia homo, quando meminit de aliquo homi-
 ne quem cognovit ante, et certificavit formam eius, et fuerit
 memorans tempus in quo vidit illum hominem et locum vera
 200 memorazione, statim ymaginabitur formam illius hominis, et
 figuram faciei eius, et situm eius in quo erat in illo tempore. Et
 ymaginabitur locum in quo vidit ipsum, et forte ymaginabitur
 alia visibilia que fuerunt presentia in illo loco in quo vidit
 ipsum. Et hec est significatio manifesta quod forma illius
 205 hominis et forma illius loci sunt fixa in anima et remanentia in
 ymaginatione. Et propter hoc, quando homo fuerit memorans
 de aliqua civitate quam vidit, ymaginabitur formam illius
 civitatis, et formas locorum in quibus fuit in illa civitate, et
 formas individuorum que cognovit in illa civitate. Et similiter
 210 omnia que homo vidit ex visibilibus, quando ei occurrunt ad
 memoriam, ymaginabitur formas eorum secundum modum et
 esse que percepit circa ea ante. Ymaginatio ergo formarum
 visibilium quas ante homo vidit et modo sciverit cum sunt
 absentes est significatio quod forme visibilium quas visus
 215 comprehendit perveniunt in anima et figurantur in
 ymaginatione.

[4.13] Quod vero forma rei vise cuius comprehensio iter-
 abitur a visu est magis fixa in anima et in ymaginatione quam
 forma rei vise cuius comprehensio non iterabitur est quia,

192 *post aliquod scr. et del. ad S* 193 *alia individua inter. a. m. E/post individua scr. et del. d P1/illiusmodi: eiusmodi R/iterabitur: iterata fuerit R* 195 *post figurata add. in C1EP1P3R/ymaginatione (196): ymaginatio S; corr. ex ymaginatio L3* 196 *remanent: remaneant R; remanet S* 197 *meminit: meminerit C1R* 198 *certificavit: certificaverit C1R/formam: forma S/fuerit memorans (199): meminerit R* 199 *tempus: ipse C1; hominem om. P1S* 200 *memorazione: rememorazione P1* 201 *eius²: illius EP3R/post quo scr. et del. ea C1* 202 *vidit corr. ex dividit P3* 203 *post fuerunt add. in C1EL3P3/in quo: quando P3R; corr. ex quando a. m. E* 204 *quod: quia Er* 205 *fixa: fixe EP3R/remanentia: remanentes P3; remanent R* 206 *post hoc add. cum hoc P3/fuerit memorans: meminerit R* 207 *quam corr. ex quod a. m. C1* 208 *formas: formam EP3R/post formas add. illorum C1L3/locorum om. L3/fuit: fuerit Er/et² . . . et (209) om. P3* 209 *et om. E* 210 *omnia: omnium R/homo om. P1R* 211 *eorum om. R* 212 *que: ut R/circa om. R/ante: antea C1L3R; aut S/post ante add. ea EP3/ergo corr. ex eorum Er* 213 *ante homo transp. EP3R/sciverit: scivit C1EErL3P3/cum: quod C1EErL3P3* 214 *est: et P3; inter. a. m. E/visus om. EP3R* 215 *comprehendit alter. in comprehendit deinde corr. ex comprehendit a. m. C1/perveniunt: perveniant C1; pervenerint P1/figurantur corr. ex figurabitur S* 217 *vero om. C1L3* 218 *est: sit R* 219 *cuius inter. L3/post est scr. et del. quia P3*

- 220 quando ad animam venit aliqua intentio, statim perveniet
forma illius intentionis in anima. Et cum tempus pertransierit
et prolongaverit, et non redierit iterum ad animam, forte trade-
tur illa intentio oblivioni ab anima aut aliqua intentionum que
sunt in illa intentione. Et si redierit ad animam ante oblivio-
nem, renovatur forma illius in anima, et rememorabit anima
225 per formam secundam formam primam. Et cum multotiens
iterabitur eventus illius intentionis super animam, erit anima
magis rememorans de illa intentione, et sic erit illa intentio
magis fixa in anima.
- 230 [4.14] Et etiam in prima vice in qua intentio venit ad ani-
mam aut in qua forma rei vise venit ad animam forte anima
non comprehendet omnes intentiones que sunt in illa forma nec
certificabit ipsas. Et comprehendet quasdam intentiones que
sunt in ea, et cum forma redierit secundo, comprehendet anima
235 ex ea aliquid quod in prima vice non comprehendit, et quan-
to magis forma iterabitur super animam, tanto magis manifes-
tabitur ex ea quod non prius apparebat. Et cum anima com-
prehenderit ex forma intentiones subtiles eius et certificaverit
formam eius, erit magis fixa in anima et magis fixa in ymagina-
240 tione quam forma ex qua vere non comprehendit mens omnes
intentiones que sunt in ea. Et cum anima comprehenderit ex
forma omnes intentiones que sunt in ea ex prima vice, deinde
iterabitur eventus forme super ipsam, et comprehenderit in
ipsa secundo intentionem, plus certificabit quod illud quod in
245 prima vice comprehendit est vera forma eius. Forma autem

220 venit: pervenit *R*/perveniet: pervenit *P1* 221 intentionis: iterationis *ErL3*; *alter.*
in iterationis *C1EP3* (*a. m. E*)/anima: animam *R*/tempus *alter.* *in* ipse *a. m. E*/post tem-
pus *add.* considerationis *C1*/pertransierit: transierit *P3* 222 prolongaverit: intra
multum tempus *R*/post forte *scr. et del.* de *L3*/tradetur (223): detrahetur *C1* 223 ab
anima *om.* *C1R*/anima *om.* *L3*/aut *corr.* ex ab *L3* 224 illa *corr.* ex alia *ErL3*
225 post *in scr. et del.* ali *C1*/post anima¹ *add.* et renovabit *C1L3*/rememorabit:
rememorabitur *P1*; *corr.* ex rememorabis *S* 226 per: et *Er* 227 eventus illius *corr.*
ex illius eventus *P3*/erit *om.* *R* 228 rememorans: meminerit *R*; *corr.* ex remorans *P3*
230 in¹ *om.* *R* 231 aut . . . animam *inter. L3*/forte *corr.* ex forme *Er* 232 que sunt
rep. P1 233 post comprehendit *add.* tantum *R* 234 ea: anima *L3*; *corr.* ex anima
C1/anima *om.* *P1* 235 comprehendit: comprehendit *EErP1P3RS* 236 forma
iterabitur *transp. EP3R* 237 non prius *transp. R*/prius apparebat *transp. C1L3*/
apparebat: apparebit *L3* 239 post erit *add.* forma *C1*/magis fixa² *om.* *EP3R*/fixa²
om. P1 240 vere *corr.* ex vera *L3*/vere non *transp. R*/non *om. P1*/comprehendit:
comprehendit *EP1* 241 et . . . ea (242) *mg. a. m. E*/cum: in *P3*/comprehenderit:
comprehendit *E*/ex forma (242) *om. P1* 242 post intentiones *add.* que sunt in ea
ex forma *P1* (*scr. et del.* que . . . ea) 243 eventus: perventus *R*/post et *add.* cum
C1EErL3P3/comprehenderit: comprehendit *ER*/in ipsa (244): inde ipsam *EErL3P3*
244 ipsa: ipsam *C1*; ea *P1R*/secundo: secundam *EP3L3*/intentionem: intentiones *R*/
ante in scr. et del. est *E* 245 comprehendit: comprehendit *EErL3P1P3RS*; *alter. in*
comprehendit *deinde corr.* ex comprehendit *a. m. C1*/eius: illius *EP3R*

vera verificata et certificata est magis fixa in anima et ymagi-
natione quam forma non certificata. Forma ergo rei vise, quan-
do multotiens iterabitur comprehensio eius, erit magis certifi-
cata apud animam et in ymaginatione. Et per fixationem forme
250 in anima et in ymaginatione erit memoratio illarum ab anima.

[4.15] Et significatio super hoc manifesta quod intentiones
et forme quando iterabuntur in anima erunt magis fixe quam
intentiones et forme non iterate est quia, quando homo voluerit
corde tenere aliquem sermonem vel versum aliquem, iterabit
255 sermonem illius intentionis multotiens, et sic figentur in sua
anima. Et quanto magis iterabit lectionem eius tanto magis erit
fixa in anima et remotioris oblivionis. Et si semel legerit ip-
sam, non remanebit versus ille fixus in anima. Et similiter si
bis legerit versum in anima forte non figetur in anima eius, et si
260 figatur, statim tradetur oblivioni. Et ex experimentatione ergo
istius intentionis patet quod forme venientes ad animam,
quanto magis iterabuntur tanto magis erunt fixa in anima et in
ymaginatione.

[4.16] Perventus autem formarum universalium modorum
265 visibilium in anima et figuratio earum in ymaginatione est quia
quolibet modorum visibilium, sicut forma et figura, sunt in
quibus equabuntur omnia individua illiusmodi, et illa indivi-
dua diversantur intentionibus particularibus comprehensis per
sensus visus. Et forte erit color in omnibus individuis illius-
270 modi unus; et forma, et figura, et color, et omnes intentiones ex
quibus componitur forma cuiuslibet individuorum speciei est
forma universalis illiusmodi. Et visus comprehendit illam for-
mam et illam figuram et comprehendit omnem intentionem in

246 verificata et certificata: certificata et verificata P3/post et² add. in EL3 247 ergo:
igitur P1 249 in inter. S/et² . . . ymaginatione (250) mg. a. m. C1 250 anima¹:
ymaginatione P1/anima et in om. S/post et add. per fixationem forme P1R/in om. C1/ab
anima: ad ipsa C1 251 post manifesta add. est EP3 (a. m. E) 252 fixe corr. ex
fixa L3 253 est om. EL3P3; mg. a. m. C1 254 vel . . . sermonem (255) om. Er/
versum aliquem transp. P3 255 figentur: figetur C1EP3R 256 quanto: quando
S/lectionem eius transp. C1L3 257 remotioris corr. ex remotionis L3/ipsam (258):
ipsum C1Er 258 ante non add. vel ipsum scilicet versum EP3R/post non scr. et del.
figetur P1 259 bis om. C1EErL3P3S/versum: ipsum EP3R/post versum add. antea
vel EP3/in anima¹ om. P1R/anima¹ alter. in antea C1/forte inter. P1 260 post figatur
scr. et del. et si figatur P1/tradetur: tradatur EP3/et om. C1EL3P3R/ex om. C1EP1P3R;
scr. et del. L3/ergo: igitur S/post ergo add. hac vel EP3 262 ante tanto add. ad
animam E/fixa: fixe EP3R 264 autem inter. a. m. Er 265 anima: animam Er/
earum: eorum R/ymaginatione corr. ex ymaginatio a. m. E 266 quolibet: quidlibet
C1; quodlibet ErP1RS/modorum: individuorum R/sicut . . . figura: habet formam et
figuram R/sunt om. C1EErL3P3R/post in add. anima P1 268 post diversantur add.
tantum R 269 sensum corr. ex ipsum P1 270 unus: unius C1/post ex scr. et del.
in P3 271 individuorum: individui R 273 ante illam add. universalem EP3R
(inter. a. m. E)

qua equabuntur individua speciei in omnibus individuis que
 275 comprehenduntur ex individuis illius speciei. Et comprehen-
 duntur ex individuis illius speciei etiam intentiones particu-
 lares per quas diversantur illa individua. Per intentionem ergo
 comprehensionis individuorum uniusmodi a visu iterabitur for-
 ma universalis que est in illa specie cum diversitate formarum
 280 particularium illorum individuorum. Et cum forma universalis
 iterabitur in anima, figetur in anima et quiescet, et ex diversita-
 te formarum particularium venientium cum formis universali-
 bus apud intuitionem comprehendit anima quod forma in qua
 equabuntur omnia individua illiusmodi est forma universalis
 285 illiusmodi. Secundum ergo hunc modum erit proventus forma-
 rum universalium quas visus comprehendit ex modis visibilium
 in anima et in ymaginatione.

[4.17] Forme ergo individuorum visibilium et forme modor-
 um visibilium quas visus comprehendit remanent in anima et
 290 figurantur in ymaginatione, et quanto magis iterabitur compre-
 hensio earum a visu tanto magis erunt fixa in anima et in
 ymaginatione. Et sustentatio sentientis in comprehensione
 quiditatis visibilium non est nisi super formas pervenientes in
 animam, quoniam comprehensio quiditatis visibilium non erit
 295 nisi per cognitionem. Et cognitio non est nisi ex comparatione
 forme quam visus comprehendit modo ad formam secundam
 que est in ymaginatione ex formis visibilium quas visus com-
 prehendit ante, et ex comprehensione considerationis forme
 comprehense modo ad aliam formarum pervenientium in
 300 ymaginatione. Comprehensio ergo quiditatis rei vise non est
 nisi ex comprehensione assimilationis forme rei vise alicui

274 *post equabuntur add. omnia EP3R* 275 *ante ex scr. et del. illius spe P1/post*
individuis add. omnibus C1EL3P3R/comprehenduntur (276) . . . speciei (276) om. P3
 276 *ex . . . speciei om. C1EErL3P1R/post etiam scr. et del. omnes L3; scr. et del. co P1/*
intentiones corr. ex intentionibus L3 277 *intentionem: intentionem vel per intuitionem*
C1 (scr. et del. intentionem vel per) 278 *post individuorum add. omnium EP3R/*
iterabitur: iteratur C1EErL3P3R 279 *post est add. manifesta C1/diversitate: consideret*
diversitatem C1 280 *post universalis scr. et del. et L3* 281 *figetur in anima*
om. C1Er 282 *particularium: universalium EP3/ante cum add. ad visum R/post*
formis scr. et del. et L3 283 *post apud add. illam P1/intuitionem: intentionem*
C1ErL3P1S/post intuitionem add. vel intentionem illam EP3 (intentionem corr. ex
intuitionem E)/comprehendit: comprehendet ER/qua: equa P1 284 *est . . . illiusmodi*
(285) inter. L3 285 *ergo hunc transp. P3/hunc mg. P3/post modum scr. et del. erit L3/*
proventus: perventus EErP3R 286 *visibilium: universalium P1* 288 *et . . .*
visibilium (289) om. R 289 *visus inter. a. m. Er/visus comprehendit transp. C1/*
remanent om. S 291 *fixa: fixe P3; corr. ex fixe a. m. E* 293 *super corr. ex per L3*
 295 *comparatione: comprehensione P1* 296 *forme om. EErL3P3; mg. a. m. C1*
 299 *comprehense alter. ex comprehensione in comprehensioni L3/aliam: aliquam*
C1ErL3/formarum corr. ex formam L3P3

formarum quiescentium in anima fixarum in ymaginatione. Sustentatio ergo sentientis in comprehensione quiditatum visibilium non est nisi super formam universalem pervenientem in
 5 animam modorum visibilium, et sustentatio eius in cognitione individuorum visibilium non est nisi super formas individuorum pervenientes in animam cuiuslibet individuorum que visus comprehendit ante, et fuerint forme eorum ymagnate ante et intellecte. Et virtus distinctiva naturaliter assimilatur formas
 10 visibilium apud visionem formis fixis in ymaginatione quas anima acquirit ex formis visibilium. Cum ergo visus comprehenderit aliquam rem visam, statim virtus distinctiva querit eius simile in formis existentibus in ymaginatione, et cum invenerit in ymaginatione aliquam similem forme illius rei vise,
 15 cognoscet illam rem visam et comprehendet quiditatem eius. Et si non invenerit ex formis existentibus in ymaginatione formam similem forme illius rei vise, non cognoscet illam rem visam nec comprehendet quiditatem eius. Et propter velocitatem assimilationis forme rei vise apud visionem a virtute distinctiva, forte accidet ei error ita quod assimilabit rem visam
 20 alii rei vise quando in re visa fuerit aliqua intentio que est in illa alia re. Deinde si consideraverit cum intuitionem illam rem visam post illam dispositionem et certificaverit formam eius, assimilabit ipsam forme simili illi in rei veritate, et manifestabitur illi secundo quod erraverat in prima assimilatione. Se-
 25 cundum ergo hunc modum comprehenduntur quiditates visibilium per sensum visus.

[4.18] Et cum omnes iste intentiones sint declarate, dicamus modo quod comprehensio visibilium per intuitionem erit
 30 duobus modis: comprehensio sola intuitionem et comprehensio per intuitionem cum scientia precedente. Comprehensio vero que est sola intuitionem est comprehensio visibilium extraneo-

3 quiditatum: quiditatis EP3R 5 modorum visibilium om. R 6 nisi inter. P3/
 super: secundum P1 8 comprehendit... ymagnate om. E/fuerint... ymagnate:
 quorum formae sunt conceptae imaginatione R 10 apud... visibilium (11) mg.
 a. m. S/post visionem add. modo C1/post formis add. visis EP3R 11 ante cum scr. et
 del. c P3/comprehenderit (12): comprehendit P3 12 post statim add. visus EP3
 13 eius om. P1/simile corr. ex summe L3 15 cognoscet: cognoscit S 17 forme mg.
 a. m. E 19 assimilationis mg. a. m. E 20 accidet: accidit P3 21 alii: alicui S/
 quando corr. ex quoniam C1/fuerit: fuit P3 22 re om. ErL3S/cum intuitionem corr. ex
 cum iteratione a. m. E/intuitionem: intentione P1; iteratione P3R 23 illam: istam
 EP3R; aliam Er/post eius scr. et del. eius L3 24 simili corr. ex simile S/illi: ei
 C1EErL3P3R/rei corr. ex re a. m. P3 28 omnes om. P1S/sint: sunt C1EL3P3
 29 modo: ergo C1L3/comprehensio: comprehensiones P1/per corr. ex ipsum Er
 30 post modis add. scilicet C1/et: vel P3 (inter.)/comprehensio per intuitionem (31)
 om. P3 31 cum inter. a. m. E/vero om. P1S

rum que visus non vidit ante aut visibilium que visus compre-
hendit ante sed non est rememoratus visionis illorum. Quo-
35 niam visus, quando comprehendit aliquam rem visam quam
ante non percepit videndo, nec rem visam huius speciei, et
voluerit aspiciens certificare formam huius rei vise, intuebitur
ipsam et considerabit per intuitionem omnes intentiones que
sunt in ea. Et comprehendet per intuitionem formam eius
40 veram, et cum ante non percepit illam rem visam nec aliquam
rem huius speciei, non cognoscet illam formam eius apud eius
comprehensionem. Et in talibus indigetur intuitionem ad ipsam
formam propriam. Erit ergo certificatio forme huiusmodi
visibilium non nisi per solam intuitionem tantum. Et similiter,
45 quando visus comprehenderit aliquam rem visam quam ante
percepit et non est rememorans ipsius, non cognoscet formam
eius secundo apud intuitionem, sed erit comprehensio huius-
modi visibilium per solam intuitionem.

[4.19] Comprehensio vero que est per intuitionem cum sci-
50 entia precedente est comprehensio omnium modorum visi-
bilium que visus comprehendit ante aut de quorum specie
aliquod comprehendit visus ante et pervenerint forme speci-
erum et individuorum eorum in anima. Cum ergo visus com-
prehenderit aliquam rem visam quam ante comprehendit aut
55 cuius speciei aliquam rem prius comprehenderit, statim apud
aspectum illius rei vise comprehendet totam formam eius.
Deinde modica intuitionem comprehendet totam formam eius

33 non . . . visus *om. P3* 34 est rememoratus: meminit *R*/rememoratus: rememo-
rans *EP3* 35 comprehendit: comprehenderit *C1EErL3P3R*/aliquam *corr. ex*
quam *C1L3 (a. m. C1)* 36 non *inter. L3*/huius: huiusmodi *C1EL3P3* 37 huius:
huiusmodi *EP1P3* 38 *post omnes scr. et del.* virtutes vel *C1*/intentiones: vir-
tutes *EErL3P1P3S* 39 in ea *corr. ex inter P1*/formam *om. EP3*/post eius *scr. et del.*
formam *S* 40 non *inter. L3*/percepit: perceperit *C1EL3P1P3R* 41 *post rem add.*
visam *C1L3*/huius: huiusmodi *C1EP3*/illam *om. C1EErL3P3R* 42 indiget: indiget
R/corr. ex *ing P3*/post indiget *add. visus R*/ipsam *om. R* 43 huiusmodi: huius *C1*
44 nisi *inter. L3* 45 visam *rep. P1*/post ante *add. comprehendit vel E*; *add.*
comprehendit vel *P3* 46 percepit: perceperit *P1*/est rememorans: meminit *R*/
formam: forma *EP3* 47 secundo: nisi *R*/post secundo *add. ab ipso visu EP3*/apud:
per *EP3R*/sed: ergo *C1EErL3P3R*/sed erit *transp. C1EErL3P3*/comprehensio *corr. ex*
comprehensionem *S* 49 comprehensio *corr. ex comprehensi L3* 50 modorum
om. R 51 aut: et *P3*; *corr. ex et a. m. E*/de *om. EErL3P3*; *inter. a. m. C1*/specie: speci-
ei *EErP3*; *corr. ex speciei C1*; *alter. in speciei L3* 52 aliquod: aliquid *C1P1RS*/
comprehendit: comprehendit *EErP1P3R*/pervenerint: pervenerunt *R* 53 ante et
add. eorum EP3R/et *om. L3*/anima: animam *R*/comprehenderit (54): compre-
hendit *C1L3R* 54 comprehendit: comprehendit *EErL3P1P3R* 55 cuius:
eius *E*; *om. S*/prius: ante *EP3R*/comprehenderit: comprehendit *EL3P3R*/ante statim
scr. et del. aut cuius speciei aliquam rem prius comprehendit *L3*/statim *corr. ex antea*
a. m. C1/apud aspectum (56) *om. P1* 56 comprehendet: comprehendit *C1*
57 deinde . . . eius *om. S*; *mg. a. m. E*; *rep. Er*

que est forma universalis sive speciei. Cum ergo ante compre-
 hendidit visibilia illiusmodi rei vise, et pervenerit forma speciei
 60 illius rei vise in sua anima, et fuerit rememorans ex forma uni-
 versali illiusmodi rei vise, cognoscet formam universalem quam
 comprehendit in illa re visa apud comprehensionem eius et
 apud cognitionem forme universalis quam comprehendit in illa
 re visa, et statim cognoscet illam rem visam specialiter. Dein-
 65 de quando intuerit intentiones residuas que sunt in illa re visa,
 certificabit formam eius particularem. Si autem non percepit
 ante illam rem visam aut forte percepit illam sed non meminit
 de perceptione illius, non cognoscet formam particularem. Et
 cum non cognoverit particularem, non cognoscet illam rem vi-
 70 sam, et sic erit cognitio illius rei vise ab eo secundum speciem
 tantum. Et acquirit ex intuitione et certificatione forme eius
 formam eius particularem que appropriatur suo individuo. Et
 si ante percepit illam rem visam, et non percepit alia individua
 huiusmodi speciei, et fuerit rememorans illius et forme quam
 75 ante comprehendidit ex illa re visa, quando comprehenderit
 formam eius particularem, cognoscet apud cognitionem for-
 mam particularem. Et apud cognitionem forme particularis
 comprehendet rem visam, et sic per comprehensionem forme
 eius particularis certificabit formam rei vise, et cum hoc cog-
 80 noscet ipsam rem visam. Et erit cognitio illius rei vise ab eo sic
 specialiter et secundum individuum in simul. Et si ante per-
 ceperit illam rem visam, sed non perceperit ex modo illius rei
 vise nisi individuum tantum, et non distinguitur ab eo forma
 universalis illiusmodi rei vise, quando comprehenderit illam
 85 rem visam et comprehendit intentiones universales que sunt in

58 forma universalis *transp.* R/sive: vel P1; sue S; *mg.* a. m. C1; *om.* R/ante *corr.* ex
 autem a. m. C1/comprehendit (59): comprehendit L3P1P3R; *corr.* ex comprehendit
 a. m. C1 59 et . . . vise (61) *mg.* a. m. E/speciei *om.* P1; *mg.* P3 60 rememorans:
 memor R/universali (61) *corr.* ex universalis C1; *corr.* ex universa a. m. S 63 ante
 forme *scr.* et *del.* eius P3 64 re *inter.* L3/et *om.* C1EErL3P3R 65 intuerit: intuitus
 fuerit R 66 si . . . non *alter.* in sive non L3 67 ante *inter.* L3/rem *inter.* a. m. Er/
 rem . . . illam *om.* L3/forte *om.* C1 69 cognoverit: cognovit EP3/post cognoverit *add.*
 formam C1L3R 71 acquirit: acquirit C1EErL3P3R/intuitione: intentione Er; *corr.*
 ex cognitione a. m. C1/forme eius *transp.* P1/eius *om.* S/post eius *scr.* et *del.* et L3; *scr.* et
del. particula P1 73 percepit¹: perceperit P1R/percepit²: perceperit R 74 huius-
 modi: huius C1E/rememorans: memor R/et² *om.* R/et forme *corr.* ex forme et S
 75 comprehendit: comprehendit P1P3R/re *corr.* ex rei P3/comprehenderit:
 comprehendit C1 76 cognoscet . . . particularem (77) *inter.* L3/apud: per P3R; *corr.*
 ex per a. m. E/formam (77) *om.* EP3 78 per *om.* P1 79 post particularis *scr.* et *del.*
 comprehendet rem visam P1/cum hoc: simul R 80 ipsam: illam C1; *om.* Er/illius
om. C1EL3P3R/sic *om.* P1 81 in *om.* R/et² . . . perceperit¹ (82) *rep.* P1/perceperit¹
 (82): percepit EL3P3 82 perceperit²: percepit L3P3S 83 post nisi *add.* illum
 C1EErL3P3; *add.* illud R/distinguitur: distinguatur R; *corr.* ex distinguuntur P1/eo:
 ea P1 85 comprehendit: comprehenderit C1EErL3P3R

illa re visa et in omnibus rebus illius speciei, non cognoscet
 illam rem visam nec comprehendet quiditatem eius ex compre-
 hensione forme universalis. Cum ergo comprehenderit inten-
 tiones residuas que sunt in illa re visa, et comprehenderit for-
 90 mam particularem eius, et fuerit rememorans forme particu-
 laris quam comprehendit in illa re visa, cognoscet formam particu-
 larem apud comprehensionem eius. Et cum cognoverit for-
 mam particularem, cognoscet eandem rem visam ipsam, et erit
 cognitio illius rei vise ab eo individualiter. Et nulla res visa
 95 comprehenditur per intuitionem nisi secundum aliquem isto-
 rum modorum. Comprehensio ergo omnium visibilium secun-
 dum intuitionem erit duobus modis: sola intuitionem et com-
 prehensio per intuitionem cum scientia antecedente. Cognitio
 autem talis et scientia quandoque erit secundum speciem tan-
 100 tum, quandoque secundum speciem et individuum in simul.

[4.20] Et etiam comprehensio per intuitionem non erit nisi
 in tempore. Quoniam intuitio non erit nisi per intuitionem et
 motum visus, sed distinctio et motus non erit nisi in tempore.
 Intuitio ergo non erit nisi in tempore. Et superius declaratum
 105 est etiam quod comprehensio per cognitionem et comprehensio
 per distinctionem non erit nisi in tempore. Et cum declaratum
 est quod comprehensio visibilium per intuitionem quandoque
 erit sola intuitionem et quandoque per intuitionem cum cogni-
 tione precedenti, et quod illud quod comprehenditur per intu-
 110 itionem et quod comprehenditur per cognitionem non compre-
 henditur nisi in tempore, dicemus quod comprehensio que erit
 per intuitionem cum cognitione precedenti erit in maiori parte

86 illa: ea C1L3/cognoscet: cognoscit EP3; cognovit L3 88 cum corr. ex co P3
 89 comprehenderit: comprehendit P3 90 rememorans: memor R 91 com-
 prehendit: comprehendit C1EErP3 93 visam ipsam transp. P1/ipsam om. EP3R
 95 comprehenditur: comprehendetur R 96 ergo omnium corr. ex omnium ergo Er
 97 comprehensio (98): comprehensione C1EErL3P1R; prehensione P3 98 ante-
 cedente: precedente EP3R/post antecedente add. illam P1S 99 et om. P3; corr. ex erit
 E/post scientia inter. talis L3; inter. est a. m. S 100 ante quandoque scr. et del.
 individuum simul C1/et om. L3/in om. EEerL3P3R 102 intuitionem: distinctionem
 C1EP3R; alter. in distinctionem L3S (a. m. S) 103 post distinctio add. non erit nisi in
 tempore C1ErL3/et . . . tempore (104) mg. a. m. C1/et motus om. S/erit: erunt EP3R
 104 intuitio . . . tempore om. S; mg. P1/et mg. P1 105 etiam om. EL3P1P3R
 106 post per scr. et del. cognition E/erit: est ER/cum: quia R 107 per corr. ex ad P3/
 quandoque om. C1ErL3/quandoque erit (108) transp. EP3R 108 intuitionem: inten-
 tione P1; corr. ex intuitionem Er/post intuitionem add. quandoque C1; scr. et del. et
 quandoque per intuitionem erit sola intuitionem L3/quandoque: quando E; corr. ex quando
 a. m. P3/cum: in P3 109 precedenti: precedente C1EL3P3R/et . . . precedenti (112)
 om. P1 110 ante et scr. et del. et quod comprehenditur per intuitionem S 111 ante
 nisi scr. et del. nisi P3/post dicemus add. ergo C1 112 ante cum add. vel EP3/post
 cognitionem add. vel scientia R/precedenti: precedente C1EP3R/post precedenti add.
 scientia precedente EP3/maiori corr. ex maiore P3

in minori tempore quam sit tempus in quo erit comprehensio
per solam intuitionem. Quoniam intentiones existentes in ani-
115 ma et presentes memorie non indigent ut cognoscantur omnes
intentiones que sunt in eis ex quibus componuntur in rei veri-
tate; sed sufficit in comprehensione earum comprehensio ali-
cuius intentionis proprie illis. Cum ergo virtus distinctiva
comprehendit in forma veniente ad ipsam aliquam intentionem
120 propriam illi forme et fuerit rememorans prime forme, cognos-
cet omnes formas venientes ad ipsam, quoniam omnis intentio
que appropriatur alicui forme est signum significans super illas
formas.

[4.21] Verbi gratia, quia, quando visus comprehenderit
125 individuum hominis et comprehenderit lineationem sue manus
tantum, statim comprehendet quod sit homo antequam com-
prehendat lineationem sue faciei, et antequam comprehendat
lineationem partium residuarum eius; et similiter si compre-
henderit lineationem faciei eius antequam comprehendat par-
130 tes residuas eius. Ex comprehensione ergo quarumdam inten-
tionum que appropriantur forme hominis comprehendet quod
illud visibile sit homo sine indigentia comprehensionis partium
residuarum. Quoniam comprehendet partes residuas per cog-
nitionem precedentem ex formis residentibus in anima, formis
135 dico hominum. Et similiter, quando visus comprehenderit ali-
quas intentiones que appropriantur forme particulari alicuius
individui quod ante visus percepit, sicut similitatem in naso,
aut viriditatem in oculo, aut arcualitatem in superciliis, com-
prehendit cum comprehensione totius sue forme illud indivi-
140 duum, et cognoscet ipsum. Et similiter cognoscet equum per

113 in¹: et *Er*/erit: erat *C1ErL3* 114 intentiones: intuitiones *ErL3P1S*; cognitiones
P3; formae *R*; *alter. ex* cognitiones in intuitiones *a. m. E* 115 ut: quod *EP3*
116 intentiones *corr. ex* intuitiones *L3* 117 earum: eorum *C1EL3P3* 118 *post*
intentionis *scr. et del.* in comprehensione earum *E* 119 comprehendit: comprehen-
derit *EErL3P1R* 120 rememorans: memorans *C1EL3P3*; memor *R*/forme²:
figure *P1* 121 formas *om. P1* 124 quia *om. C1*/quando *om. P1*/comprehenderit:
comprehendit *EP3* 125 *ante et scr. et del.* et comprehenderit *L3*/lineationem *om. Er*/
sue: sive *P1* 126 comprehendet: comprehendit *C1L3*/antequam ... et (127) *om. Er*/
comprehendat (127): comprehendet *S* 127 sue ... lineationem (128) *inter. L3*/sue
facie *transp. EP3R*/antequam: tamen non *P1*; *corr. ex* tamen non *a. m. S*/comprehendat:
comprehendit *C1*; comprehendit *P1S* 128 *post* eius *scr. et del.* et similiter si
comprehenderit lineationem partium residuorum eius *S*/comprehenderit (129):
comprehendit *Er* 129 eius: suae *R*/comprehendat: comprehendit *S* 130 resi-
duas eius *transp. P3*/ex comprehensione: et comprehensio *P3* 131 que *inter. L3*/
comprehendit: comprehendit *C1EErL3R* 132 comprehensionis *corr. ex*
comprehensione *Er* 134 residentibus: resistentibus *ErP1S* 135 quando: cum
EP3/aliquas (136): quasdam *C1ErL3* 137 individui *corr. ex* residui *E*/post visus *add.*
non *P1* 138 oculo *corr. ex* oleo *EP3 (a. m. E)*/comprehendit (139) *rep. P3*
139 cum *om. EP3*/sue forme *transp. Er* 140 ipsum: ipsam *P1S*/equum: eum *S*

aliquam maculam in fronte eius aut per diversitatem coloris.
Et similiter scriptor, quando comprehenderit formam alicuius
dictionis superficialiter, cognoscet eam antequam consideret
litteras particulares, et similiter omnes partes quas scriptor
145 frequenter et continue videt cognoscuntur ab eo apud comprehensionem ex comprehensione quarumdam litterarum.

[4.22] Visibilia ergo que visus ante comprehendit, et cognoscit modo formas illorum, et est rememorans illorum comprehenduntur a visu per signa. Visibilia autem extranea que
150 visus ante non percepit aut visibilia que ante percepit sed tamen non est rememorans illorum non sunt ita. Quoniam, quando visus comprehenderit aliquam rem visam quam ante non vidit et comprehenderit lineationem quarumdam partium, non comprehendet ex eo quiditatem illius rei vise, quoniam non
155 est apud ipsum forma quiescens partium residuarum. Visus ergo non comprehendit certitudinem rei vise quam ante non vidit nisi per considerationem omnium suarum partium et omnium intentionum que sunt in ea. Et similiter forma rei vise quam visus ante percepit sed non rememoratur non certificatur
160 ab eo nisi post considerationem omnium intentionum que sunt in ea. Sed comprehensio quarumdam intentionum que sunt in forma erit in minori tempore illo in quo comprehendit comprehensionem omnium intentionum que sunt in forma. Visio ergo que est per intuitionem cum cognitione precedenti erit in maiori
165 parte in breviori tempore tempore in quo erit visio sola intuitionem, et propter hoc visus comprehendit visibilia assueta comprehensione valde veloci in tempore latente sensum; et non erit inter oppositionem visus ad rem visam et inter comprehensio-

141 *post coloris add. eius P1* 142 *et om. P1S/comprehenderit: comprehendit C1*
143 *dictionis: distinctionis Er* 145 *cognoscuntur: cognoscantur C1ErL3; cognoscuntur EP3/apud comprehensionem (146) om. R* 147 *ante comprehendit transp. P1/comprehendit: comprehenderit EP3R/cognoscit modo (148) transp. C1EErL3P3R*
148 *rememorans: memor R/comprehenduntur (149): comprehenditur Er* 149 *post autem add. ante S* 151 *tamen om. C1EErL3P3R/rememorans: memor R* 154 *non est (155) om. R* 155 *ipsum: ipsam EEerL3P3/post ipsum add. non R/forma quiescens transp. EP3R/quiescens: quiescit R* 157 *post per scr. et del. refle P1/considerationem: consuetudinem ErP3; corr. ex consuetudinem C1L3 (a. m. C1); alter. ex consuetudinem in distinctionem a. m. E/omnium om. S/post partium add. adinvicem P1* 159 *post visus scr. et del. quando L3/percepit: percipit ErP3; perceperit S/rememoratur: meminit R; corr. ex remoratur P3* 162 *tempore: parte P3; corr. ex parte a. m. E/illo om. EEerL3P3; mg. a. m. C1/comprehensionem (163) om. C1EErL3P3R* 163 *omnium intentionum: omnes intentiones C1EErL3P3R/sunt: sun S* 164 *est inter. C1L3 (a. m. C1)/post est scr. et del. in intuitionem P3/precedenti: precedente C1R/in inter. a. m. C1*
165 *post tempore¹ add. illo R/tempore² om. L3; mg. a. m. C1/post tempore add. secundo scilicet C1/erit: erat C1EL3P3/intuitionem (166): intentionem ErP1; corr. ex intuio P3*
166 *comprehendit corr. ex comprehendet Er/assueta: consueta EP3R* 168 *oppositionem: oppositum P1S*

170 nem quiditatis rei vise assuete tempus sensibile in maiori parte. Quoniam homo ex pueritia et ex principio crementi comprehendit visibilia, et iterantur super eius aspectum individua visibilium et forme universales modorum visibilium. Et etiam declaratum est quod forme visibilium quas visus comprehendit perveniunt in anima et figurantur in ymaginatione, et quod forme
175 me que iterantur visui figurantur in anima, et quiescit figuratio earum in ymaginatione. Omnia ergo visibilia assueta et omnes modi assueti sunt existentes in anima, et quiescentes figurati in ymaginatione, et presentes memorie. Cum ergo visus comprehenderit aliquam rem visam assuetam, et comprehenderit totam
180 suam formam, et post illud comprehenderit aliquod signum proprium illi rei vise, comprehendet quiditatem illius rei vise apud comprehensionem illius signi, et erit comprehensio rei vise ab eo per comprehensionem precedentem et per modicam intuitionem. Visibilia ergo assueta comprehenduntur a
185 visu per signa et per cognitionem precedentem, quare ergo erit comprehensio quiditatum eorum in maiori parte in tempore insensibili.

[4.23] Et etiam quod comprehensio speciei rei vise est in minore tempore quam comprehenditur individuitas rei vise est
190 quoniam, quando visus comprehenderit aliquod individuum hominum, comprehendit ipsum esse hominem antequam com-

169 rei vise *transp.* P1 / sensibile *corr.* ex subtile a. m. L3 170 ex²: a P1 / principio *corr.* ex tempore EP3 (a. m. E) / crementi: incrementi R 172 visibilium¹: visibilia C1L3 / modorum om. R / etiam om. P1S 173 post est *add.* etiam P1 / post comprehendit *add.* quidem C1L3 174 anima: animam R / post anima *scr.* et *del.* et quiescit figuratio earum in ymaginatione et quod forme que iterantur visui figurantur in anima E / forme . . . iterantur (175): que . . . forme P1S 175 visui: in sui Er / post anima *add.* et quas visus comprehendit perveniunt in anima EL3P1P3R (anima: animam R); *scr.* et *del.* et quas visus comprehendit perveniunt in anima et figurantur in ymaginatione et quod forme que iterantur visui figurantur in anima C1 / figuratio: significatio Er 176 in ymaginatione *corr.* ex in anima P3 177 sunt existentes: existunt R / quiescentes: quiescunt R / figurati: in figura et C1EErL3P3 (*alter.* ex figura in figurazione a. m. C1) 179 visam *inter.* a. m. E / et *inter.* a. m. C1 / comprehenderit²: comprehendit L3 / totam suam (180) *transp.* C1 180 suam formam *transp.* EP3R / illud: illic EP3 181 illi: illius EP3R / illius om. C1EErL3P3R 182 signi om. EP3 / erit *corr.* ex exit a. m. E 183 ante rei *add.* illius P1 / comprehensionem: cognitionem R / precedentem om. P1 / per² om. R 184 intuitionem *corr.* ex intentionem a. m. E 185 ergo om. R 187 insensibili: sensibili P1 188 quod: quia EP3; om. R / speciei . . . vise: vise rei speciei Er / post vise *add.* in minori parte P1 / est om. S / post est *add.* in maiori parte EP3R / post in *add.* minori parte est in P1 189 minori: maiori P1S / tempore: parte ErL3P1 / comprehenditur: comprehendatur EL3R; *alter.* ex comprehendeatur in comprehendetur P3 / individuitas *corr.* ex individua P3 / post vise *add.* et EP1P3R 190 post quoniam *scr.* et *del.* non C1 / quando visus *mg.* a. m. C1 / visus om. EL3P3 / comprehenderit: comprehendit C1 191 post hominum *add.* primo EP3R / comprehendit: comprehendet C1ErL3R / antequam *corr.* ex quam E / antequam . . . hominem (193) *inter.* a. m. S / comprehendet (192): comprehendat EEerP3R

prehendet formam eius particularem. Et forte comprehendet
 ipsum esse hominem, quamvis non comprehendat lineationem
 faciei; sed ex erectione sui corporis et ordinatione membrorum
 195 corporis eius comprehendet ipsum esse hominem, quamvis non
 viderit faciem eius. Et similiter visus forte comprehendit
 quandoque specialitatem alicuius modorum visibilium assue-
 torum per quedam signa que appropriantur illi speciei. Et non
 est sic comprehensio individualitatis rei vise, quoniam indivi-
 200 dualitas rei vise non comprehendetur nisi ex comprehensione
 intentionum particularium que appropriantur illi individuo aut
 ex comprehensione quarumdam. Sed comprehensio quarum-
 dam intentionum particularium que appropriantur individuo
 non comprehenduntur nisi post comprehensionem intentionum
 205 universalium que sunt in illo individuo aut post comprehensio-
 nem quarumdam. Aut generaliter intentiones que sunt in for-
 mis universalibus modi illius individui sunt quedam intentio-
 nes que sunt in forma eius individuali, sed comprehensio par-
 tis est in minori tempore quam tempus in quo comprehenditur
 210 totum. Comprehensio ergo specialitatis rei vise a visu est in
 minori tempore quam tempus in quo comprehenditur indivi-
 dualitas illius rei vise.

[4.24] Et etiam comprehensionis specialitatis tempus visi-
 bilium (scilicet assuetorum) diversitatur, quoniam quedam
 215 specierum visibilium assuetorum assimilantur aliis speciebus
 et quedam non, ut species hominis et species equi, quoniam
 forme speciei hominis non assimilantur alii speciei animalium.
 Et non est ita equus, quoniam equus assimilatur multis ani-
 malibus in tota forma. Tempus ergo in quo visus comprehen-
 220 dit speciem individui hominis et comprehendit ipsum esse
 hominem non est sicut tempus in quo comprehendit speciem

193 ipsum: ipsam P3/hominem mg. a. m. E/ quamvis corr. ex quoniam L3/non inter. P3
 194 erectione corr. ex erectionem P3/sui om. P1 195 corporis: corporum P1
 196 comprehendit: comprehendet EP1P3R 197 alicuius modorum transp. EP3R/
 visibilium om. P1S 199 individualitatis: individuitatis C1EL3P3R/quoniam om.
 EP3R/individualitas (200): individuitas C1L3; corr. ex individualitatis S 200 ante rei
 add. enim EP3R/comprehendetur: comprehenditur R 202 sed . . . quarumdam
 (203) mg. a. m. E/comprehensio: comprehensiones P1 205 post inter. L3
 207 modi illius transp. L3P1R/post individui add. aut S; scr. et del. autem C1/quedam:
 ante EErl3P1P3R; mg. a. m. C1 209 minori: maiori EP3/post tempore scr. et del. in
 S/quam: quoniam P1 210 comprehensio rep. E; corr. ex comprehenditur to P1
 211 post quam scr. et del. temporis P1/individualitas (212) corr. ex individualitatis P3
 213 post etiam add. tempus EP3R/tempus om. EP3R 216 quedam om. Er; inter. EL3
 (a. m. E)/ut om. Er; inter. EL3 217 forme: forma EP3R/assimilantur: assimi-
 latur EP3 218 est om. C1ErL3S/post ita scr. et del. ita P1/equus¹: in equis EP3R/
 equus² om. P1/post equus² add. aliquis R 220 post et scr. et del. non C1/esse inter. L3

equi et comprehendit ipsum esse equum, et maxime quando
comprehenderit utrumque in remotione alicuius quantitatis.
Quoniam, quando visus comprehenderit individuum alicuius
225 hominis motum localiter, statim comprehendet ipsum esse ani-
mal ex motu, et ex erectione corporis comprehendet ipsum
esse hominem. Et non est ita quando comprehenderit equum,
quoniam, quando visus comprehenderit individuum equi mo-
vens se et comprehenderit cum hoc motum eius et numerum
230 pedum, non comprehendet ex hoc ipsum esse equum, quoniam
iste intentiones sunt in pluribus quadrupedum que assimulan-
tur equo in pluribus intentionibus, et maxime in mulo, quoniam
mulus assimilatur equo in multis dispositionibus. Quoniam
mulus non distinguitur ab equo nisi per intentiones fere non
235 manifestas, sicut lineationem faciei, et extensionem colli, et
velocitatem motus, et amplitudinem passuum. Si autem visus
non comprehenderit aliquam istarum intentionum per quas
comprehenditur equus cum comprehensione totius sue forme,
non comprehendet ipsum esse equum. Et tempus in quo visus
240 comprehendit erectionem corporis hominis non est sicut tem-
pus in quo comprehendit formam equi cum intentionibus par-
ticularibus per quas distinguitur equus ab alio. Comprehensio
igitur speciei hominis est in minori tempore quam tempus in
quo comprehenditur species equi. Quamvis enim duo tempora
245 sint parva, tamen unum eorum secundum omnes dispositiones
eius est maius altero.

[4.25] Et similiter, quando visus comprehenderit colorem
roseum in floribus cuiusdam orti, statim comprehendet quod
substantie illorum colorum sunt rose propter colorem proprium
250 rosarum, et cum hoc quod ille color est in rebus existentibus in
orto, ante comprehensionem rotunditatis, et ante rotunditatem

222 comprehendit: comprehendet C1EErL3P3 223 comprehenderit: comprehendit P3R/remotione: rememoratione P3 224 comprehenderit: comprehendit P3/alicius hominis (225) transp. R 225 comprehendet: comprehendit P1S 226 post animal add. et C1/ex² om. C1L3S/comprehendet: comprehendit C1 229 cum hoc: simul R 230 post pedum scr. et del. eius P3 231 iste: illae R/quadrupedum: quadrupedibus EP3R 232 et maxime: ut P1S 233 post equo add. et C1Er; add. etiam L3 234 distinguitur: distinguit P3/intentiones corr. ex intuitiones a. m. C1 235 extensionem: extensione P3 236 et corr. ex ad C1 237 non om. EP3/istarum intentionum transp. R 238 sue om. P1 239 visus om. EP3 243 igitur: ergo R/est mg. a. m. C1/tempore corr. ex parte S/quam om. C1ErL3/tempus: tempore C1ErL3; om. EP3 244 enim om. EErL3P3R; mg. a. m. C1 245 sint: sunt C1S 246 eius om. C1EErL3P3R 247 comprehenderit: comprehendit EL3P3 249 substantie . . . colorum: illorum . . . substantie C1/colorum om. L3/rose: rosee C1Er; corr. ex rosee L3/post colorem add. roseum C1 250 est om. Er/in rebus rep. Er 251 orto corr. ex ordo P1/post orto add. comprehenditur R/post ante¹ add. comprehendit P1/ante² om. C1EErL3P3

foliorum eius et applicationem foliorum eius unius super alterum, et ante comprehensionem omnium intentionum eius ex quibus componitur forma rose. Et non est ita quando comprehendit viriditatem mirti in orto. Quoniam, quando visus
 255 comprehendit viriditatem mirti tantum in orto, non comprehendet ipsam esse mirtum ex comprehensione viriditatis tantum, quoniam plures plantarum sunt virides, et cum hoc plures plante assimilantur mirto in viriditate et in figura. Si ergo non
 260 comprehendit figuram foliorum eius, et spissitudinem eorum, et intentionem propriam mirti, non comprehendet ipsam esse mirtum. Et tempus in quo visus comprehendit figuram foliorum mirti et intentiones secundum quas appropriatur mirtus cum comprehensione viriditatis non est sicut tempus in quo
 265 comprehendit colorem roseaceum tantum. Et similiter quiditates omnium specierum que possunt assimilari aliis non comprehenduntur a visu nisi per magnam intuitionem. Quiditas autem visibilium pauce assimilationis ad alia comprehenditur a visu pauca intuitionem. Et similiter de individuis,
 270 quoniam individuum quod non assimilatur alii individuo comprehenditur a visu per modicam intuitionem et per signa, et individuum quod visus cognoscit et assimilatur alii individuo quod visus cognoscit comprehenditur a visu per magnam intuitionem.

275 [4.26] Species ergo et individuum omnium visibilium assuetorum comprehenditur a visu per modicam intuitionem cum cognitione precedenti, et erit comprehensio eorum in maiori parte in tempore insensibili. Tamen diversatur tempus com-

252 et . . . eius *mg. a. m. C1*/applicationem: applicatione *Er*; applicationum *R*; *corr. ex* applicationum *P1* 254 est *om. EP3* 255 viriditatem . . . mirti (256) *mg. L3*/mirti: mirte *P1S*/in . . . mirti (256) *om. Er*/quoniam . . . orto (256) *mg. a. m. E* 256 comprehendit: comprehendet *EP3*/viriditatem mirti *transp. C1*/viriditatem . . . tantum: tantum . . . mirti *EP3R*/mirti: mirte *P1S*; *alter. in* mirte *a. m. C1*/tantum *om. EP1*/post orto *add. quoniam* (255) . . . orto (256) *P1* (mirti: mirte)/comprehendit (257): comprehendit *P1S* 257 mirtum: mirtam *C1L3P1S*/ex *mg. a. m. C1*/viriditatis *corr. ex* miriditatis *Er* 258 plantarum: plantae *R* 259 assimilantur *corr. ex* dissimulantur *E*/mirto: mirte *P1S*/in¹ *mg. a. m. C1*/in² *om. C1EL3P3R* 260 post figuram *scr. et del. fol P1*/et . . . eorum *om. C1L3* 261 mirti: mirte *ErL3P1S*/post mirti *add. et* spissitudinem eorum *C1L3*/ipsam . . . mirtum (262): mirtum . . . esse *S* 262 mirtum: mirtam *P1S*/visus *om. EP3R* 263 secundum: in *C1EErL3P3* 264 non est *om. P3* 265 colorem *om. P1*/roseaceum: rosaceum *EP3*; roseum *Er* 267 comprehenduntur: comprehenditur *Er*/post nisi *add. in P1* 268 visibilium *om. R*/alia: altera *P1S* 270 ante quoniam *add. similiter P3*/post quod *add. visu EP3R* (*inter. a. m. E*); *add. visu etiam C1ErL3*/post non *scr. et del. a P1* 271 et² *om. Er* 272 ante quod *scr. et del. et P1*/et . . . cognoscit (273) *om. Er*/post et *add. quod R*; *scr. et del. non E* 273 quod: quamvis *R*/visus *om. R*/post cognoscit *add. tamen R* 275 ergo: vero *L3P3*; *corr. ex* vero *a. m. C1* 276 modicam: modica *P1* 277 precedenti: precedente *C1L3R* 278 insensibili: sensibili *R*

prehensionis eorum secundum diversitatem specierum indi-
 280 viduorum eorum. Et erit comprehensio speciei velocior com-
 prehensione individui, et erit comprehensio speciei pauce
 assimulationis ad alia velocior comprehensione speciei multe
 assimulationis, et erit comprehensio individui pauce assimu-
 285 lationis ad alia velocior comprehensione individui multe as-
 simulationis.

[4.27] Similiter et tempus intuitionis diversatur secundum
 intentiones quas quisque intuetur in visibilibus. Verbi gratia,
 quia quando visus comprehenderit multipes animal parvorum
 pedum, et illud animal fuerit in motu, per modicam intuitio-
 290 nem comprehendet motum eius, et cum comprehenderit motum
 eius, comprehendet ipsum esse animal. Deinde per modicam
 intuitionem in pedibus comprehendet ipsum esse multipes ex
 comprehensione distantie inter pedes. Et cum hoc non cognos-
 cet statim numerum pedum, et si voluerit cognoscere numerum
 295 pedum, indigebit pluriori intuitionem et maiori tempore. Com-
 prehensio ergo animalitatis eius erit in tempore parvo. Deinde
 comprehensio multitudinis pedum erit in parvo tempore, et
 numerus pedum non comprehenditur nisi postquam fuerit
 visus intuens quemlibet pedum et numeraverit ipsos, quod non
 300 potest esse nisi in tempore alicuius quantitatis. Et erit quanti-
 tas temporis secundum multitudinem pedum et paucitatem
 eorum. Et similiter, quando visus comprehendit figuram ro-
 tundam intra quam est figura multorum laterum, et fuerint
 latera illius figure parva, et cum hoc fuerit diversorum laterum
 5 non maxima diversitate, apud comprehensionem totalis figure
 comprehendet ipsam esse rotundam. Et non comprehendet

279 *post specierum add. et L3P1R (inter. L3)* 280 *velocior . . . speciei (281) om. P3*
 281 *erit om. P1* 282 *post alia add. erit P1/speciei: superficiei P3/speciei . . .*
assimulationis (283) corr. ex assimulationis . . . multe Er 283 *erit: similiter EP3R/*
pauce . . . individui (284) om. Er; inter. L3 284 *ad alia: erit EP3R* 286 *similiter*
om. C1EErL3P3R/intuitionis: intentionis EP3 287 *quisque om. S* 288 *quia:*
quoniam S/multipes animal transp. EP3R/animal parvorum corr. ex parvorum animal Er
 290 *comprehendet . . . eius (291) mg. a. m. E/post et scr. et del. con P3/*
comprehenderit: comprehendet C1EL3P3; comprehendit Er 293 *distantie alter. ex*
tantis in distantis a. m. S/cum hoc: sic R 294 *si om. Er* 295 *pluriori: pluri EP3;*
longiori R/intuitione: intentione Er; corr. ex intentione L3; alter. in intentione a. m. E/
maiori: maiore R 296 *ergo inter. E/tempore parvo transp. P1* 297 *multitudinis:*
multitudo L3; corr. ex multo Er/parvo tempore transp. EP3R/et: sed R 298 *com-*
prehenditur: comprehendetur EP3 299 *intuens: intuitus R* 1 *paucitatem corr.*
ex paucitatem a. m. S 2 *comprehendit: comprehenderit C1EP3R* 3 *intra: in terra*
P1; inter P3/est: erit P3; corr. ex erit E 4 *et inter. a. m. E/fuerit om. C1/post laterum*
scr. et del. et (3) . . . laterum (4) L3 5 *maxima corr. ex maxime P3/apud corr. ex aliud*
P1/post figure scr. et del. et C1 6 *esse: rem C1*

statim quod intra illam sit laterata figura quando latera illius fuerint in fine parvitas, et cum intuerit figuram rotundam profundiori intuitione, apparebit ei figura laterata que est intra rotundum. Erit ergo comprehensio rotunditatis figure velocior
 10 comprehensione figure laterate que est intra. Deinde apud comprehensionem istius non apparebit diversitas laterum istius figure, nec distinguitur ab eo sive sint equalia sive non, et non apparebit inequalitas laterum figure laterate nisi post
 15 magnam intuitionem et in tempore alicuius quantitatis.

[4.28] Et etiam sentiens, quando voluerit intueri figuram totius rei vise, sufficit ei ut transeat visus super superficiem rei vise tantum. Et similiter, quando voluerit intueri colorem rei vise, sufficit ei transire visum super ipsum tantum—et similiter
 20 intueri asperitatem superficiei rei vise, aut planitiem, aut diafonitatem, aut spissitudinem. Et non sunt ita intentiones occulte et subtiles que sunt in visibilibus, sicut figure que sunt in quibuslibet partibus visibilium, et consimilitudo figurarum, et quantitatis partium, et diversitas quantitatum et colorum, et
 25 consimilitudo eorum, et ordinatio partium parvarum adinvicem, quoniam iste intentiones non comprehenduntur per intuitionem nisi postquam fuerit visus fixus super quamlibet partem, et consideraverit figuras illarum partium, et comparaverit unam ad alteram. Et hoc non complebitur in tempore
 30 parvo et per motum velocem sed in tempore alicuius quantitatis. Tempus igitur intuitionis intentionum visibilium diversatur secundum diversitatem intentionum intuitarum.

[4.29] Et cum declaratum sit hoc, dicamus quod visio que est per cognitionem precedentem, et per signa, et per modicam
 35 intuitionem non est comprehensio certificata. Quoniam comprehensio rei vise per cognitionem precedentem et per signa non est nisi circa totalitatem et universalitatem rei vise in gros-

7 intra: inter L3/illam: ipsam EP3R/quando: quoniam P3R; corr. ex quoniam a. m. E/post quando scr. et del. a latera illius S/illius: eius C1EL3P3 8 fuerint: fiunt C1L3; fuerunt R/intuerit: intuitus fuerit R/post intuerit scr. et del. comprehensio rotunditatis figure velocior comprehensione Er 9 profundiori: profundiore R/ei om. EP3R/intra: inter P3 10 rotundum: rotundam P3R/post rotundum add. figuram C1 11 figure laterate: figura laterata Er/laterate corr. ex latente L3 13 distinguitur . . . eo: distinguetur a visu R/sive¹²: an R/sint: sunt C1 14 inequalitas: equalitas Er/post: per C1ErL3; alter. in per a. m. E 15 et om. P1S 16 sentiens quando transp. ErS 19 ipsum: eum P1/post similiter add. quando voluerit R/rei vise om. P1S 22 et om. EP3R 24 quantitatis: quantitas P1; alter. in quantitas C1/quantitatum corr. ex quantitatis P3/et³ om. P3 25 adinvicem (26): inter se R 26 quoniam corr. ex quando a. m. C1 27 super: supra EL3P3 29 hoc om. P3 31 igitur: ergo C1ErL3P3R 32 post intentionum add. intuitarum visus L3 (scr. et del. intuitarum) 33 declaratum sit hoc: hoc sit declaratum R/sit corr. ex est P1; corr. ex fuerit S 36 vise om. P1

so, et virtus distinctiva comprehendit intentiones particulares
 que sunt in illa re visa secundum modum quo cognovit illas res
 40 visas ex prima forma illius rei vise existente in anima. Sed iste
 intentiones particulares que sunt in visibilibus mutantur secun-
 dum transitum temporis, et cum hoc visus non comprehendit
 intentiones que sunt mutate in re visa per cognitionem prece-
 dentem. Et cum mutatio fuerit occulta, non bene manifesta,
 45 non comprehenditur a visu primo aspectu, et non comprehen-
 ditur quando non fuerit valde manifesta nisi per intuitionem.
 Verbi gratia quod, quando visus cognoscit aliquem hominem,
 et fuerit facies illius hominis munda, et certificaverit visus
 formam eius, deinde recesserit ille homo a visu longo tempore,
 50 et contingit in facie eius macula, et fuerit occulta illa macula, et
 comprehenderit ipsum post ipsam distinctionem, cognoscet
 ipsum apud comprehensionem. Sed tamen non propter com-
 prehensionem et cognitionem illius hominis comprehendet
 maculam in facie eius nisi sit manifesta, et si non intuerit ip-
 55 sam, comprehendet ipsum non secundum suum esse. Et si
 intuerit ipsum puriori intuitione, apparebit ei macula que est in
 facie eius, et tunc comprehendet formam eius secundum suum
 esse.

[4.30] Et similiter, quando visus comprehenderit aliquam
 60 arborem, et intuerit ipsam, et certificaverit formam eius, dein-
 de recessit ab ea diu dum crevit illa arbor, et augmentabatur,
 et mutabatur figura eius, et crevit et intendebatur aliquis rubor
 in ea (si forte aliquis esset in ea), et illa mutatio que contingit
 in arbore non fuerit modica, deinde si revertatur visus ad illam
 65 arborem et cognoscat eam, non comprehendet apud compre-
 hensionem et cognitionem illam modicam mutationem que
 contingit in ea. Si autem intuerit ipsam secundo et cum hoc

42 ante transitum scr. et del. divisio P1/cum hoc: sic R/comprehendit: comprehen-
 derit P3 43 in re visa mg. a. m. C1/post in add. illa EP3R 45 primo aspectu: post
 aspectum P3 46 non om. P3 47 quod om. R/post quando add. nunc E; add. non
 ErL3; add. homo P3/visus om. EErP3; inter. L3/cognoscit: cognoscet C1L3 49 reces-
 serit: recessit EP3/recesserit . . . illa (50) mg. L3 50 contingit: contingat R
 51 ipsam: istam EP3R/distinctionem: dispositionem C1ErR; alter. in dispositionem
 a. m. ES 54 si non inter. C1/intuerit: fuerit intuitus R/ipsam (55): ipsum ErP1S
 55 ante comprehendet add. non R/comprehendet: comprehendit C1L3/ipsam: ipsam
 EP3/non om. R 56 intuerit ipsum: intuitus fuerit ipsam R 60 intuerit: intuitus
 fuerit R 61 recessit: recesserit C1EP3R/ea: eadem EP3R/diu inter. a. m. E/crevit:
 creverit R/augmentabatur: auctae fuerit R 62 mutabatur: mutata R/figura eius
 transp. C1/crevit: cernit S/crevit . . . ea² (63): facta sit in ea aliqua mutatio R/et³ om. S
 63 contingit: fuerit EP3R 64 post si scr. et del. fuerit S 65 cognoscat: cognoscet
 EErL3P3; alter. ex cognoscet in cognoscit a. m. C1 66 ante et add. illam C1L3/et:
 per R 67 intuerit: intuitus fuerit R/cum hoc: simul R

fuerit rememorans vere forme quam habebat in prima vice,
comprehendet mutationem que contingit in ea et certificabit
70 formam eius secundo. Et si non intuerit ipsam, non erit illa
forma quam comprehendit ex illa arbore per cognitionem
antecedentem ipsa forma vera quam habet post secundam
comprehensionem.

[4.31] Et similiter, quando visus comprehenderit parietem
75 in quibusdam locis, et ille paries fuerit planus, et fuerint in eo
picture et sculpture, et intuerit visus illum parietem, et certifi-
caverit formam eius, deinde recesserit ab illo loco diu, et con-
tingit in illo pariete post mutatio ex asperitate superficiei aut
ex intentione quarundam picturarum, et non fuerit illa mutatio
80 valde manifesta, deinde si revertatur visus ad illum locum, et
aspexerit illum parietem, et fuerit rememorans forme prime,
igitur comprehendet ipsam apud primam visionem. Sed apud
comprehensionem et cognitionem non comprehendet mutatio-
nem occultam que in eo contingit, et ipse cognoscet formam
85 eius sine aliqua mutatione. Si ergo in eo contingit aliqua asper-
itas, existimabit ipsam esse lenem sicut assuevit esse, et si pic-
ture primo fuerint vere certificate et fuerint mutate, existimabit
eas quasi esse certificatas.

[4.32] Et omnia visibilia que sunt apud nos sunt recipientia
90 mutationem secundum colorem, et figuram, et magnitudinem,
et situm, et lenitatem, et asperitatem, et ordinationem partium
et secundum multas intentiones particulares. Quoniam nature
earum sunt mutabiles et preparate passioni ab eo quod accidit

68 rememorans: memor *R*/ vere forme *transp.* *P1S*/ post forme *add.* eius *C1EErL3P3R*/
in prima: primae *R* 69 post que *add.* non *P1*/ certificabit *corr.* ex certificabis *S*
70 intuerit: fuerit intuitus *R* 71 quam: quod *P3*/ quam comprehendit *corr.* ex
comprehendit quam *Er*/ comprehendit: comprehendet *ErS* 72 post: per *L3*; *om.*
EErP3R (*inter.*)/ post post *add.* ipsam *C1*/ secundam: secunda *ErP3R*; *inter.* *L3*
73 comprehensionem: comprehensio *ErP3*; comprehensione *R*; *corr.* ex comprehensio
EL3 (*a. m. E*) 74 comprehenderit: comprehendit *P1*; comprehendet *S* 75 planus:
planis *ErP3*/ fuerint: fuerit *Er* 76 intuerit: intuitus fuerit *R* 77 post loco *scr.* et
del. et *C1L3*/ contingit (78): contingat *R* 78 in . . . mutatio: post mutatio in illo
pariete *EP3*/ aut *om.* *P1* 79 ex intentione *alter.* in ex mutatione *a. m. C1*/ intentione:
imutatione *P1*; *corr.* ex mutatione *a. m. E*; *alter.* in mutatione *a. m. S* 81 rememorans:
memor *R*/ forme: forma *P3* 82 igitur *om.* *R*/ comprehendet ipsam: comprehendit
illam *C1* 83 et: per *R* 85 aliqua¹: quali *E*; *corr.* ex quali *P3*/ post aliqua¹ *add.*
comprehensione *L3*/ mutatione *alter.* in mutationis *L3*/ post mutatione *add.* absque
comprehensione mutationis *C1*/ post eo *scr.* et *del.* quod *P1*/ aliqua²: alia *E* 86 ipsam:
ipsum *P1*/ assuevit: consuevit *EP3R*/ post assuevit *add.* esse etiam *E* (*scr.* et *del.* esse)
87 vere certificate *transp.* *R*/ fuerint²: fiunt *L3* 88 quasi esse *transp.* *ERS*/ quasi . . .
certificatas *corr.* ex esse . . . quasi *P3* 89 omnia: anima *Er*/ sunt² *mg. a. m. E*/ sunt
recipientia *transp.* *EP3* 90 et² *inter.* *P1*/ magnitudinem *corr.* ex magnitudinis *P1*
91 lenitatem et asperitatem: asperitatem et lenitatem *EP3R*

95 eis ex extrinseco, et mutatio quam est possibile comprehendi a
 visu est possibile in omnibus illorum. Et quamvis in eis sit ali-
 qua mutatio quam non est possibile apparere visui, nichil est
 ex eis in quo non accidit ex extrinseco mutatio possibilis ap-
 parere visui. Et cum omnia visibilia sint preparata mutationi
 possibili comprehendi a visu, nullum ergo visibile quod visus
 100 comprehendit modo, et erat prius comprehensum et certifica-
 tum, est certificatum apud secundam comprehensionem a visu,
 scilicet quod visus sit securus secundo quod non fuerit muta-
 tum cum mutatio sit possibilis in omnibus visibilibus. Cum
 ergo visus comprehenderit aliquam rem visam quam ante com-
 105 prehenderit, et intuerit ipsam, et certificaverit formam eius, et
 fuerit rememorans sue forme apud comprehensionem, cognos-
 cet ipsam. Et si in illa re visa contingit mutatio manifesta,
 comprehendet illam mutationem apud visionem. Si autem non
 fuerit manifesta, cognoscet illam rem et existimabit illam esse
 110 apud cognitionem secundum modum primum. Et cum hoc, si
 non iteraverit intuitionem, non erit securus quod forma quam
 ante cognoscebat sit remanens secundum suum esse, cum sit
 possibile quod in ea contingerit mutatio occulta que non potest
 apparere nisi per intuitionem. Si ergo iteraverit intuitionem,
 115 certificabit formam eius, et si non iteraverit intuitionem, non
 erit comprehensio illius rei vise certificata. Comprehensio ergo
 visibilium per cognitionem precedentem, et per signa, et per
 modicam intuitionem non est vera comprehensio; et visus non
 comprehendit rem visam vera comprehensione nisi per intuitio-
 120 nem rei vise apud comprehensionem eius, et per consideratio-
 nem omnium intentionum que sunt in illa re visa, et per dis-
 tinctionem omnium apud comprehensionem illius rei vise.

[4.33] Visio ergo erit secundum duos modos: visio in pri-

94 *post eis scr. et del. et P1 / ex om. P1R; inter. L3 / extrinseco: extrinsecus R / et . . . extrinseco*
 (97) *mg. L3 / post et add. quia R / quam: quando EP3; om. R / post possibile add. in eis*
possibile est ipsam EP3R 95 *est possibile om. EP3R / illorum: illis EP3R / in eis sit:*
sit in eis EP3R 96 *quam: que EP3R / est possibile: potest R / possibile: impossibile*
ErP3; corr. ex impossibile E / post apparere scr. et del. a visu in omnibus illis et quamvis
sit P3 / post est² add. etiam L3; add. tamen R; scr. et del. eis P1 97 *accidit ex extrinseco:*
accidat extrinsecus R / possibilis: quae possit R 99 *possibili: quae possit R*
 100 *et² om. R* 101 *est certificatum mg. a. m. C1S; om. EL3P3 / certificatum om. P1R /*
secundam comprehensionem transp. R 102 *scilicet corr. ex secundum a. m. C1 / sit*
om. P1 104 *comprehenderit¹: comprehendit P1 / comprehenderit (105): compre-*
hendidit EP3R 105 *intuerit: intuebit C1L3; intuitus fuerit R* 106 *rememorans:*
memor R / sue forme: forme eius Er 109 *post rem add. visam L3 / illam esse transp.*
L3 / post illam add. rem P1S / esse om. S / post esse scr. et del. secundam P1 110 *cum*
hoc: sic R 112 *sit remanens: remaneat R* 113 *contingerit: contingit C1L3*
 117 *post et² add. non P1* 118 *non² inter. P3* 119 *post per scr. et del. motum P1*
 123 *duos corr. ex diversos a. m. E / post visio² add. ergo EP3 (scr. et del. E)*

- mo aspectu et visio que est per intuitionem. Et per visionem
 125 que est in primo aspectu comprehendet intentiones manifestas
 rei vise tantum, et non certificatur per huiusmodi aspectum
 forma rei vise. Et visio que est in primo aspectu quandoque
 est solum fantastica et quandoque cum cognitione precedente.
 Et visio talis que est secundum fantasiam est visio visibilium
 130 que visus non cognoscit apud aspectum, et cum hoc non intue-
 tur ipsa. Et visio que est secundum fantasiam cum cognitione
 precedente est visio visibilium que visus ante cognoscit, et cum
 hoc non intuerit intentionem eorum. Et secundum utriusque
 dispositiones eorum non comprehendit visus per fantasiam
 135 veritatem rei vise, sive precognoverit illam rem visam sive non.
 [4.34] Et visio per intuitionem erit secundum duos modos:
 visio sola intuitionem et visio per intuitionem cum cognitione
 precedente. Visio autem que est sola intuitionem est visibilium
 que ante visus non comprehendit aut non est rememorans
 140 comprehensionis eorum quando intuetur modo ipsa. Et visio
 per intuitionem cum precedenti cognitionem est visio omnium
 visibilium que visus comprehendit et est rememorans visionis
 eorum quando intuerit intuitionem eorum et consideraverit
 intentiones omnes que sunt in eis. Et ista visio dividitur in duo
 145 quorum unum est visio assueta visibilium assuetorum, et ista

124 *post aspectu scr. et del.* comprehendet intuitiones manifestas rei vise tantum C1/
 intuitionem: intuitionem P3 125 *post comprehendet add.* visus R; *scr. et del.* per P3/
 intentiones *corr. ex* intuitiones L3/manifestas: manifeste Er; *corr. ex* manifeste L3/
 manifestas rei vise (126): rei vise manifestas EP3R (manifestas: manifeste EP3)
 126 certificatur: certificabit P1S 127 forma: formam P1/et visio *inter. L3*
 130 cognoscit: cognovit R/intuetur (131): intuerit L3; intuetetur S 131 secundum
 fantasiam *corr. ex* fantasiam secundum Er/cognitionem *corr. ex* cognitionem P3
 132 ante est *scr. et del.* et C1L3/ante om. S/ante cognoscit *transp. EP3R/post ante inter.*
 vel non a. m. L3/cognoscit: cognovit EErP3R; precognoscit P1S; *alter. in* cognovit
 a. m. C1 133 intuerit: intuetur EP3R/intentionem: intuitionem ErS; intentiones R;
corr. ex intuitionem L3; *alter. in* intuitionem a. m. E/utriusque dispositiones (134) *transp.*
 EP3R/post utriusque *add.* usque S 134 dispositiones: dispositionem P1R/eorum:
 earum R/post visus *scr. et del.* dispositiones E 135 visam om. R 136 *post et add.*
 cum Er/post modos *add.* scilicet EP3R; *add.* etiam P1 137 intuitionem: *alter. ex*
 cognitionem in intentionem *deinde corr. ex* intentionem a. m. E/cum om. EP3/cognitionem:
 cognitionem P3; *corr. ex* scientia a. m. E/cognitionem precedente (138) *transp. R*
 138 precedente: scientia precedentem P3 139 ante visus *transp. EP3R/rememorans:*
 memor R 140 comprehensionis *corr. ex* comprehensiones a. m. C1/eorum om. P3/
 intuetur . . . ipsa *scr. et del.* P3 (modo: non); modo *inter. a. m. E* 141 precedenti:
 precedente EP3R/precedenti cognitionem *transp. EP3/cognitionem:* scientia P3R; *corr. ex*
 scientia a. m. E/post visio *scr. et del.* i P3 142 visus om. S/rememorans: memor R/
 visionis: comprehensionis EP3R 143 intuerit: intuitus fuerit R; *corr. ex* intuetur P1/
 intuitionem: intentionem EP3; intentiones R/intuitionem eorum *transp. EP3R*
 144 duo: duos modos EP3R 145 unum: unus EP3R; una P1S/post visio *add.*
 quidem C1EL3P3 *transp. P1*

pars erit per signa que comprehenduntur modica intuitione et
 per considerationem quarumdam intentionum que sunt in illa
 re visa cum cognitione precedente. Et ista visio in maiori parte
 est in tempore insensibili, et comprehensio illius quod compre-
 150 henditur secundum hunc modum non est comprehensio in fine
 certificationis. Pars autem secunda est que erit per finem intu-
 itionis et per considerationem omnium intentionum que sunt
 in re visa apud comprehensionem illius rei vise et cum cognitione
 precedente. Et erit in maiori parte in tempore sensibili, et di-
 155 versatur tempus secundum intentiones que sunt in re visa.

[4.35] Et visio que est per quam visibilia assueta compre-
 henduntur comprehensione in fine certificationis non est nisi
 per intuitionem omnium intentionum que sunt in re visa, et per
 considerationem omnium partium rei vise, et per distinctionem
 160 omnium intentionum que sunt in re visa apud comprehensio-
 nem rei vise, sive precognoverit illam rem visam sive non. Et
 ista certificatio que est respectu sensus est intentio certificata,
 et est dicere finem certificationis in istis locis finem illius quod
 possibile est comprehendi a sensu. Et cum omnibus istis com-
 165 prehensio visibilium a visu est secundum fortitudinem visus,
 quoniam sensus visuum oculorum diversatur secundum vigor-
 em et debilitatem.

[4.36] Secundum ergo istos modos erit comprehensio visi-
 bilium a visu, et isti sunt omnes modi visionum, et hoc est illud
 170 quod intedebamus ad declarandum in isto capitulo. Et iam
 complevimus divisionem omnium visibilium et divisionem om-
 nium intentionum visibilium, et declaravimus omnes intentio-
 nes per quas pervenit visus ad comprehensionem visibilium et

146 comprehenduntur: comprehenditur *Er*/intuitione: intentione *S* 148 *post*
 cognitione *scr. et del.* preceni predenti *P1*/precedente: precedenti *P1S*/ista:
 illa *EP3R*/post visio *add.* est *R* 149 est *om.* *R* 151 certificationis: certitudinis
EP3R/que erit *om.* *R*/erit: est *EP3*/intuitionis (152): intentionis *Er* 152 *post* in
add. illa *P1S* 154 in tempore *inter. L3*/sensibili: insensibili *EP3* 156 *post* est
add. secundum hunc modum *P1RS* (*post* modum *add.* est non *S*)/quam: quem *R*/com-
 prehenduntur comprehensione (157) *corr. ex* comprehensione comprehenduntur *E*
 157 comprehensione: apud comprehensionem *C1L3*/certificationis: certitudinis *EP3*/
 non est *om.* *S* 158 *post* visa *scr. et del.* apud comprehensionem rei vise *C1*
 160 intentionum: distinctionum *P1*/intentionum que *corr. ex* que intentionum *L3*
 161 visam *om.* *C1EL3P3R* 162 respectu: respectus *Er* 164 possibile est: potest
R/comprehendi: comprehendet *P1*/a sensu *inter. a. m.* *E* 166 visuum: visus
EP1P3R; *corr. ex* visum *a. m.* *S*/oculorum: occultorum *Er* 167 *ante* et *scr. et del.* d *Er*
 169 a visu *om.* *S*/sunt *om.* *P1S*/visionum: visibilium *P3R* 170 ad declarandum:
 declarare *EP3R*/iam: etiam *L3*; *corr. ex* etiam *a. m.* *C1* 171 divisionem¹: de visione
P1S; dictionem *P3*/et . . . omnium (172) *om.* *P1S*/et . . . visibilium (172) *mg. a. m.* *C1*
 172 visibilium *om.* *P1S* 173 pervenit: venit *EP3R*

intentionum visibilium, et distinximus omnes partes in quas
175 dividuntur omnes modi visionum. Iste sunt intentiones quas
intendebamus declarare in isto tractatu.

174 *post visibilium scr. et del. et intentionum visibilium S* 175 *post visionum add. et*
R/post iste add. ergo C1P3

TERTIUS TRACTATUS

Et est ex 7 capitulis.

- Primum capitulum est proemium;
Secundum de eis que debent proponi sermoni in deceptionibus
5 visus;
Tertium de causis quibus deceptio accidit visui;
Quartum in distinguendo deceptiones visus;
Quintum de qualitatibus deceptionum visus que fiunt solo
sensu;
10 Sextum de qualitatibus deceptionum visus que fiunt in cognitione;
Septimum de qualitatibus deceptionum visus que fiunt in ratione.

[CAPITULUM 1]

- [1.1] Declaratum est in primo tractatu et secundo quomodo visus comprehendit visibilia secundum quod sunt si comprehensio eius fuerit recte, et quomodo certificat formam visi, et quomodo comprehendit unamquamque intentionum
5 particularium secundum quod est, et quomodo certificat illam. Sed non omne comprehensibile a visu comprehenditur ab eo secundum quod est, nec omne quod videtur ab inspiciente ipsum comprehendi in rei veritate est recte comprehensum. Sed multotiens decipitur visus in multis eorum que comprehendit
10 ex visibilibus, et comprehendit illa alio modo ab eo quo sunt. Et forte percipit suam deceptionem etiam cum decipitur, et forte non, sed reputat se bene comprehendere. Cum enim

1 *post tractatus scr. et del. est P1* 2 *et om. EP3R/et est transp. L3/est om. S* 4 *secundum: secundo P1/eis: ijs R/que inter. a. m. E/proponi: praeponi R* 6 *causis corr. ex causas Er/post causis add. de Er/accidit: accidet P1* 7 *quartum: quarto P1/in om. P1S/deceptiones: deceptionem P1S* 12 *fiunt corr. ex sunt S* 1 *ante declaratum add. primum capitulum Er/post et add. in C1L3* 2 *comprehendit: comprehendat R/si: et Er; corr. ex et L3* 3 *certificat: certificet R* 4 *comprehendit: comprehendat R* 5 *certificat: certificet R* 6 *ab corr. ex a a. m. C1* 7 *post videtur scr. et del. abspi P1/insipiente: aspiciente EP3R* 8 *ipsum om. R* 9 *comprehendit (10): comprehenditur P1* 10 *ex: in P3/comprehendit: comprehendet P1/post eo scr. et del. quo S* 11 *etiam: et Er (scr. et del.); om. P1S*

visus comprehendit aliquod visum per spatium remotum, tunc
 mensura eius videbitur minor quam vera mensura, et quando
 15 illud visum fuerit forte propinquum visui, comprehendet men-
 suram eius maiorem vera. Et amplius quando visus compre-
 henderit quadratum aut poligonium a remoto, comprehendet
 eum rotundum, si fuerit equalium dyametrorum, aut longum, si
 fuerit inequalium dyametrorum, et si comprehenderit speram a
 20 remotissimo, comprehendet eam planam. Et talia sunt multa
 et multimoda, et omnia que sunt comprehensa a visu tali modo
 sunt fallibilia.

[1.2] Amplius quando visus inspexerit aliquam stellam,
 comprehendet eam quiescentem, licet stella tunc moveatur; et
 25 cum inspiciens revertatur ad scientiam sciet illam stellam mo-
 veri apud aspectum. Et cum inspiciens distinxerit illud, statim
 percipit se decipi in hoc quod comprehenderit de quiete stelle.
 Et cum aliquis inspexerit aliquod individuum super faciem ter-
 re a remotissimo, et illud individuum fuerit motum motu tar-
 30 dissimo et non diu duraverit aspectus, tunc in tali statu aspec-
 tus comprehendet ipsum quiescens. Et si aspiciens non per-
 ceperit ante motum illius individui, et non diu duraverit in eius
 oppositione, tunc non percipiet se esse deceptum in hoc quod
 comprehendit de quiete illius individui, et in comprehensione
 35 huiusmodi erit deceptus. Et cum hoc non percipiet se decipi.
 Accidet igitur visui deceptio in multis eorum que comprehen-
 dit, que forte percipitur ab eo, et forte non.

[1.3] Et cum in duobus tractatibus precedentibus sit de-
 claratum quomodo visus comprehendit visibilia secundum
 40 quod sunt, in hoc autem capitulo declaratum est ex eis que
 diximus quod multotiens accidit visui deceptio in multis eorum
 que comprehendit, remanet declarandum quare deceptio ac-

13 visus *om.* C1/comprehendit: comprehenderit R; *corr. ex* comprehendit S/visum per
 spatium *inter. a. m.* E/post remotum *add. et Er* 16 post visus *scr. et del.* certific P1
 17 poligonium: poligonum L3R; *corr. ex* pologonium P3 18 eum: illud R/fuerit: fuit
 P1/aut . . . dyametrorum (19) *om.* P3/longum *corr. ex* longium S 23 inspexerit:
 inspexit P1 24 moveatur: movetur C1; *corr. ex* removeatur P3 25 post inspiciens
scr. et del. moveatur et cum P1/revertatur: revertetur R/illam stellam *transp.* P1/illam
 . . . moveri (26) *corr. ex* stellam . . . illam S 26 distinxerit *alter. in* inspexerit *a. m.* E
 27 percipit: comprehendit EP3; comprehendet R/comprehenderit: comprehendit P1S
 29 ante et *add.* intervallo R/ante fuerit *scr. et del.* super faciem S/tardissimo (30): tradissimo
 S; *corr. ex* tradissimo *a. m.* Er 30 non: si P1/tali *om.* Er; *inter.* L3/tali statu *transp.* L3/
 statu: casu P1/aspectus (31): aspiciens P3R; *corr. ex* aspiciens *a. m.* E 31 si *inter. a. m.*
 E/perceperit (32): percepit C1S 33 se *om.* EP3 35 huiusmodi: huius R/cum hoc:
 tamen R 36 accidit: accidit L3P1RS; *inter.* L3/igitur: ergo EP3/in *mg. a. m.* C1/que:
 quod C1; *corr. ex* quod L3/comprehendit que (37) *om.* C1L3 37 que: et R; *alter. in*
 quod *a. m.* E 38 in *inter.* P1; sit *corr. ex* fuerit P3 39 comprehendit: comprehen-
 dat R 40 eis: hiis P1

cidit visui et quando et quomodo. Nos autem in hoc tractatu
 contenti sumus ex deceptionibus visus in eis que comprehendit
 45 recte, et declarabimus causam in hoc, et diversitates deceptio-
 num, et quomodo accidit unaqueque deceptio.

[CAPITULUM 2]

[2.1] Declaratum est in primo tractatu quod visus nichil
 comprehendit ex visibilibus nisi secundum verticationes line-
 arum radialium et quod ordo visibilium et partium eorum non
 comprehenditur nisi ex ordinatione linearum radialium. Et
 5 dictum est etiam quod unum visum quod comprehenditur duo-
 bus oculis in simul non comprehenditur unum nisi quando
 positio eius in respectu duorum oculorum fuerit positio con-
 similis; et quod si positio fuerit diversa, tunc unum compre-
 hendetur duo. Sed unumquodque visibilium assuetorum que
 10 semper comprehenduntur a duobus visibus semper compre-
 hendetur unum. Unde oportet nos declarare quomodo unum
 visum comprehenditur a duobus visibus unum in maiori parte
 temporis et in pluribus positionibus, et quomodo positio unius
 visi ab ambobus oculis in maiori parte temporis et in pluribus
 15 erit consimilis. Et declarabimus etiam quomodo positio unius
 visi ab ambobus visibus erit positio diversa et quando accidit
 hoc. Et iam diximus hoc in primo tractatu, et declaravimus
 ipsum universaliter non determinate.

[2.2] Dicamus quod quando inspiciens inspexerit aliquod
 20 visum, tunc uterque visus erit in oppositione illius visi, et cum

44 ex: de *E**Er**P*3/deceptionibus: exceptionibus *Er* 45 post et¹ add. etiam *C*15
 46 accidit: accidat *R*; corr. ex accidente *S*/post accidit add. in *P*1/unaqueque: unaqua-
 que *P*1 2 comprehendit: comprehendat *R*/nisi om. *P*3/post verticationes add. re-
 flexas *EP*1*P*3; add. refractas *R* 5 etiam om. *L*3/unum visum transp. *EP*3/visum
 mg. *C*1 6 in om. *R*/post simul scr. et del. et *Er*/non mg. a. m. *Er*/comprehenditur:
 comprehendit *EP*3; corr. ex comprehenduntur *S* 7 post eius add. fuerit *P*1/respectu:
 conspectu *Er*/fuerit om. *P*1 8 et om. *Er*; inter. a. m. *E*/unum comprehendetur (9)
 transp. *EP*3*R*/comprehendetur (9): comprehendet *E**Er**L*3*P*3 9 ante duo scr. et del. et
 oculi sunt *C*1 10 visibus: visibilibus *Er*; corr. ex visibilibus *L*3*S*/comprehendetur
 (11): comprehenduntur *E*; corr. ex comprehenditur *P*3 11 ante unde scr. et del. unde
 oportet nos declarare quomodo unum visum comprehenditur a duobus visibilibus sem-
 per comprehenditur unum *L*3 12 comprehenditur: comprehendetur *L*3;
 comprehendatur *R*/post a scr. et del. 2 *P*3/visibus corr. ex oculis *L*3/maiori: maiore *E*
 13 post pluribus scr. et del. erit consimilis *Er*/positionibus . . . pluribus (14) om. *P*3; mg. *L*3
 14 ab inter. a. m. *E* 15 etiam: et *Er* 16 visibus corr. ex oculis *Er*/quando:
 quomodo *EP*3*R*/accidit: accidat *R* 17 hoc² . . . declaravimus om. *P*3/declaravimus:
 declarabimus *Er* 18 post ipsum scr. et del. ipn *P*1/non inter. *E*/determinate:
 determinare *P*3/post determinate scr. et del. nec *E* 19 post dicamus inter. igitur *L*3;
 add. ergo *R*/quando: cum *EP*3*R*/inspexerit . . . inspiciens (21) mg. a. m. *S*

inspiciens direxerit pupillam ad illud visum, tunc uterque diriget pupillam ad illud visum directione equali, et cum visus fuerit motus super rem visam, tunc uterque visus movebitur super illud.

25 [2.3] Et cum inspiciens direxerit pupillam ad rem visam, tunc axes duorum visuum congregabuntur in illa re visa et coniunguntur in aliquo puncto illius superficiei, et si inspiciens moverit visum per illam rem visam, tunc illi duo axes movebuntur simul super superficiem illius visi et per omnes partes
30 eius. Et universaliter duo oculi sunt equales in omnibus suis dispositionibus, et virtus sensibilis que est in eis est eadem, et actio et passio eorum semper est equalis et consimilis. Et si alter visus fuerit motus ad videndum, statim reliquus movebitur ad illud visum illo eodem motu, et si alter visus quieverit,
35 reliquus quiescet; et impossibile est ut alter visus moveatur ad videndum et reliquus quiescat nisi impediatur.

[2.4] Et declaratum est in predictis quod inter quodlibet visum et centrum visus est piramis ymaginabilis apud visionem cuius conus est centrum visus et basis superficies visi
40 quod visus comprehendit. Sed ista piramis continet omnes verticationes ex quibus comprehendit illam rem visam. Cum igitur duo axes amborum visuum fuerint coniuncti in aliquo puncto superficiei visi, tunc superficies visi erit basis communis ambabus pyramidibus radialibus figuratis inter duo centra
45 amborum visuum et illud visum, et tunc positio puncti in quo duo axes sunt coniuncti apud ambos visus est positio consimilis, quia est oppositus duobus mediis amborum visuum, et duo axes qui sunt inter illud et duos visus sunt perpendiculares super superficiem duorum visuum. Quod autem remanet
50 ex superficie visi inter quodlibet punctum in eo et duo centra amborum visuum sunt due linee quarum positio in respectu duorum axium erit positio consimilis in parte—scilicet quoniam

21 *post inspiciens scr. et del. im P3/post visum scr. et del. du P1/post uterque add. visus R*
 23 *rem corr. ex partem L3* 25 *inspiciens: visus EP3R* 26 *visuum: visibilium Er*
 27 *coniunguntur: coniungentur R* 28 *per: super C1* 29 *super inter. L3*
 31 *in eis rep. Er* 32 *post et² add. omnino EP3R (inter. a. m. E)* 33 *post visus scr. et del. visus P1* 35 *quiescet: quiescit R* 36 *quiescat: quiescet P1* 37 *predictis: preteritis P1RS* 39 *conus: vertex R* 40 *sed: et R* 42 *igitur: ergo C1EP3R/amborum: duorum EP3* 43 *puncto corr. ex positione a. m. C1* 44 *ambabus: ambobus Er; corr. ex ambobus a. m. C1* 45 *amborum om. Er/et illud visum om. P1*
 47 *oppositus: oppositum R/post duobus add. centris C1* 48 *axes om. Er/duos: duo P1; ipsos P3/perpendiculares (49) corr. ex pendiculares S* 50 *ex: de R/visi: nisi Er/in eo: eius R/post et add. inter R/post centra add. duorum visuum et punctum superficiei visi in quo coniunguntur duo axes P1* 51 *amborum . . . centra (53) mg. a. m. E/post visuum scr. et del. f P1*

omnes due linee ymaginabiles inter duo centra duorum visuum
et punctum superficiei visi in quo coniunguntur duo axes am-
55 borum visuum ambe erunt declinabiles a duobus axibus ad
unam partem. Nam omnis punctus superficiei visi in quo duo
axes coniunguntur declinabitur a puncto coniunctionis ad ean-
dem partem; punctus autem coniunctionis est super utrumque
axem. Remotiones autem istarum linearum a duobus axibus
60 sunt equales, quoniam omnes due linee exeuntes a duobus cen-
tris duorum visuum ad quodlibet punctum punctorum valde
propinquorum puncto coniunctionis equaliter distant a duobus
axibus quantum ad sensum. Duo enim axes exeuntes ad
punctum coniunctionis erunt equales, aut non erit inter illas
65 diversitas sensibilis quando res visa non fuerit valde propin-
qua visui, et distantia eius a visu fuerit mediocris. Et similiter
est dispositio cuiuslibet puncti multum propinqui puncto con-
iunctionis—scilicet quod omnes due linee exeuntes a duobus
centris duorum visuum ad quodlibet punctum eorum fere non
70 differunt in longitudine quantum ad sensum, et forte erunt
equales. Quando autem due linee declinantes coniuncte fuerint
in superficie in qua sunt duo axes, erunt inequales, nam linea
que exit a puncto in quo duo axes coniunguntur ad punctum
declinans ab illo continet cum duobus axibus angulos inequal-
75 es. Et duo axes sunt equales, et linea copulans duo puncta est
communis, quapropter due linee declinantes erunt inequales.
Sed ista inequalitas non operatur in sensu si punctus declinans
fuerit propinquus puncto coniunctionis. Si autem due linee
declinantes fuerint sub axibus aut super illos, possunt esse
80 equales, duo enim anguli quos continent duo axes cum linea
continuante duo puncta possunt esse equales si punctus fuerit
sub axibus aut super eos. Et in positionibus que sunt inter has
duas positiones erit diversitas que est inter duas lineas declin-

54 visi: visae R/amborum (55): duorum R 55 ambe: ambo L3; om. R 56 visi om.
EP3; corr. ex visis L3 57 declinabitur: declinabit R 58 autem: vero R 59 ista-
rum linearum transp. P3 60 post equales scr. et del. quoniam omnes due linee
exeuntes a duobus axibus sunt equales C1/exeuntes corr. ex exeunte a. m. C1 63 ad²
corr. ex a L3 64 post inter scr. et del. duos P3/illas: eos EP3R; illos S; alter. in illos L3
70 et: sed R/forte: fere P3R; corr. ex fere a. m. E/post erunt scr. et del. erunt P3 71 au-
tem: vero R/due linee transp. EP3R/post linee add. equales Er/coniuncte fuerint
transp. EP3R 73 a: ex EP3R/post quo add. sunt C1L3 (scr. et del. C1) 74 post illo
scr. et del. ut nisi E 75 et . . . equales mg. a. m. E/est communis (76) transp. P1S
76 quapropter: quare P1S 77 sed . . . inequalitas rep. P1/sensu: sensum R/si corr.
ex sed L3 78 propinquus: propinquum R 81 continuante: continuata ErP1; corr.
ex continuata L3/continuante duo corr. ex continuata ad duo a. m. S/post continuante
add. ad ErP1 (mg. a. m. Er) 82 in positionibus: inter positiones P3; corr. ex inter
positiones a. m. E 83 lineas om. R

antes minor quam diversitas que est inter duas lineas primas
85 declinantes, et sic non erit inter eas differentia operans in sen-
sum.

[2.5] Ergo due linee exeuntes a duobus centris duorum
visuum ad puncta propinqua puncto in quo coniunguntur duo
axes non differunt fere in longitudine quantum ad sensum. Et
90 duo axes sunt equales, et linea que copulat punctum coniunc-
tionis cum puncto declinante ad quod exeunt due linee a duo-
bus centris est communis duobus triangulis factis ex istis lineis.
Ergo duo anguli qui sunt apud duo centra duorum visuum qui-
bus subtenditur apud superficiem visi linea communis erunt
95 equales, aut fere inter eas non erit diversitas sensibilis. Et isti
duo anguli semper erunt minimi quando punctus fuerit propin-
quissimus multum coniunctioni duorum axium.

[2.6] Et cum due linee que exeunt ad quodlibet punctum
propinquum puncto coniunctionis contineant cum duobus
100 axibus angulos equales, tunc remotio quarumlibet duarum
linearum exeuntium ad eundem punctum punctorum propin-
quorum puncto coniunctionis a duobus axibus duorum visuum
erit remotio equalis.

[2.7] Ergo positio cuiuslibet puncti superficiei visi in quo
105 coniunguntur duo axes visuum, si fuerit propinquus puncto
coniunctionis in respectu duorum visuum, est positio con-
similis in parte et in remotione a duobus axibus. Dispositio
autem in punctis remotis a puncto coniunctionis declinantibus
ad unam partem ab ambobus axibus est talis anguli qui sunt
110 inter duas lineas exeuntes ad aliquem punctum eorum et inter
duos axes fortasse differunt diversitate aliquanta, et positio
omnium huiusmodi punctorum remotorum a puncto coniunc-
tionis in respectu duorum visuum est positio consimilis in
parte tantum sed non in remotione a duobus axibus. Visum

84 ante minor scr. et del. et sic non erit inter eas differentia operans in sensum ergo due
linee C1/minor . . . declinantes (85) mg. a. m. S/lineas primas transp. EP3 88 visuum:
in suum Er 89 post axes scr. et del. sunt equales L3 90 duo om. R/sunt equales
transp. S 91 post cum add. ipso C1 92 post lineis add. et axibus C1 93 qui
sunt corr. ex sunt qui E 95 eas: ipsas EP3; eos R; corr. ex eos a. m. C1 96 minimi:
in unum L3/punctus: punctis E; punctum R/propinquissimus multum (97): valde
propinquum R 97 duorum om. EP3 99 post coniunctionis add. axium C1;
contineant: continent R 100 quarumlibet duarum: quamlibet duorum Er
101 eundem: idem R 105 propinquus: propinqua P3; propinquum R 106 est:
erit EP3 107 in² om. S/post axibus scr. et del. n C1 108 declinantibus: decli-
nans P1S 109 anguli corr. ex anoguli S 110 inter¹: in E; corr. ex in P3/aliquem:
aliquod EP3R/post eorum add. remotorum C1/et om. L3; inter. a. m. C1/et inter corr. ex
inter et Er/inter² corr. ex int a. m. C1 111 ante duos add. eos L3/fortasse: forte P1/
aliquanta: aliquantula C1ErL3 114 non inter. S/in om. Er/visum: visuum C1;
positio R

115 igitur comprehensum ambobus visibus, cum fuerit alicuius
quantitatis et propinquorum dyametrorum, positio cuiuslibet
puncti apud duos visus est positio consimilis in parte et in
remotione, quapropter forma eius statuetur in duobus visibus
in duobus locis consimilis positionis a duobus visibus. Et cum
120 visum comprehensum ambobus visibus fuerit maximorum dya-
metrorum, tunc positio eius puncti in quo coniunguntur duo
axes erit positio consimilis apud duos visus, et quanto magis
appropinquaverint illi puncta que sunt in superficie illius visi,
tanto magis positio illorum apud duos visus erit consimilis in
125 parte et in remotione in simul. Puncta autem que sunt in su-
perficie illius visi remota a puncto coniunctionis et declinantia
ab ambobus axibus ad unam partem habent positionem con-
similem in parte apud duos visus, et in remotione forte con-
similem et forte non. Forma igitur partis que est apud locum
130 coniunctionis huius visi et eius que continet punctum coniunc-
tionis et eius quod est illi propinquum, instituitur in duobus
locis duorum visuum consimilis positionis in omnibus disposi-
tionibus. Et instituentur forme partium residuarum remotarum
a puncto coniunctionis circumdantium partem consimilis posi-
135 tionis continue cum forma partis consimilis positionis. Et sic
universum duarum formarum instituitur in duobus locis duo-
rum visuum inter que non est maxima differentia in positione.
Sed si fuerit, erit inter extrema tantum, et erit modica propter
continuationem extremorum cum duobus mediis que sunt
140 consimilis positionis; et hoc erit dum duo visus fixi fuerint in
oppositione visi et duo axes fuerint fixi in uno puncto eius.
Cum autem duo visus fuerint moti super rem visam et duo

115 igitur: ergo C1L3/post igitur add. cuiuslibet puncti visi R/comprehensum:
comprehensi R/post comprehensum add. ab P1S/fuerit corr. ex fuerint P1 116 pro-
pinquorum: propinquarum R; alter. in parvorum L3; alter. ex propinquioris in
propinquiorum P1/positio . . . puncti (117) om. R 117 puncti: visi EP3/apud:
ante P1S 118 in: a L3; corr. ex a a. m. C1/in . . . visibus om. R 120 post
comprehensum add. ab P1/visibus om. L3; mg. a. m. C1/post fuerit scr. et del. o P3/
maximorum: maximarum R 121 positio eius transp. EP3 122 et om. L3
123 illi: isti EP3; illa Er/post illi add. duo L3R/illius: istius EP3/visi corr. ex visus L3
124 post magis add. erit C1L3/post apud scr. et del. nos P1/erit om. L3 125 in¹ om. C1/
in² om. R 126 remota inter. L3 127 habent: habet Er/positionem corr. ex
proportionem L3 128 post forte add. habent C1 129 igitur: ergo P1S/que corr.
ex qui P3/locum: punctum R 130 huius: huiusmodi Er/huius . . . coniunctionis
(131) om. P3/que: quod C1E/punctum: locum E 131 illi: ei P1S 133 instituentur:
constituentur L3/forme om. L3; mg. a. m. C1/remotarum corr. ex remortarum S
134 circumdantium: circumdanorum Er 135 continue: continue C1; alter. in
continue a. m. S/post consimilis add. parti P3 136 instituitur: instituetur EP3
137 que: quando Er 138 sed: et R/post modica add. differentia EP3 139 post
continuationem add. duorum EP1P3R 140 dum: cum C1L3R/visus: in P1/fixi
fuerint transp. P1S/fuerint corr. ex erunt P3 141 oppositione: operatione EP3

axes fuerint translati ab illo puncto et fuerint moti in simul per
superficiem illius visi, tunc positio cuiuslibet puncti illius visi
145 et positio punctorum propinquorum illi in respectu duorum
visuum apud coniunctionem duorum axium in ipso erit positio
consimilis valde, et forma cuiuslibet partis visi apud motum
duorum axium per superficiem erit in duobus locis positionis
consimilis apud duos visus. Et sic forma omnium partium visi
150 apud motum et intuitionem erit consimilis dispositionis apud
ambos visus.

[2.8] Et similiter etiam quando visus comprehendit visibilia
separata in eadem hora in simul, et duo axes fuerint coniuncti
in aliquo eorum, et illud visum in quo sunt coniuncti duo axes
155 fuerit propinquorum dyametrorum, tunc forma illius visi institu-
etur in duobus locis duorum visuum consimilis positionis. Et
etiam forma eius quod propinquum est illi viso, si fuerit parve
quantitatis, instituetur in duobus locis duorum visuum inter
quorum positiones non erit differentia sensibilis. Forma autem
160 visi remoti a viso in quo duo axes coniunguntur quando ambo
visus comprehendunt illud visum, dum duo axes sunt fixi in
illo viso, instituetur in duobus locis duorum visuum consimilis
positionis in parte tantum et non in remotione; aut non omnes
partes eorum erunt consimilis positionis in remotione a duobus
165 axibus, nec forma erit certificata. Deinde si duo visus fuerint
moti, et duo axes, et fuerint coniuncti in unoquoque visibilium
comprehensorum in simul, tunc forma uniuscuiusque eorum
instituetur in duobus locis consimilis positionis in respectu
duorum visuum in parte et in remotione; et tunc certificabitur
170 forma uniuscuiusque illorum visibilium.

[2.9] Et multotiens coniunguntur duo axes amborum visu-
um in aliquo viso, et cum hoc duo visus comprehendunt aliam
rem visam cuius positio in respectu duorum visuum erit diver-

143 *post puncto add. medio C1/in om. R/in simul: consimilis L3/per: super P1*
144 *illius¹ om. R/tunc . . . puncti mg. a. m. E/illius visi² om. EP3* 145 *in om. P1*
146 *post axium scr. et del. per superficiem C1* 147 *post cuiuslibet add. puncti vel EP3*
149 *sic corr. ex si L3* 152 *comprehendit: comprehenderit R* 153 *in² om. R*
155 *propinquorum: propinquarum R; alter. in parvorum L3/instituetur (156) corr. ex*
instituitur E 156 *consimilis . . . visuum (158) om. Er* 157 *eius inter. L3/est: fuerit*
EP3/viso corr. ex visio L3S 158 *instituetur corr. ex instituetuetur S/post visuum inter.*
sic scilicet L3; add. sic S 160 *viso corr. ex visu a. m. C1/ambo visus (161) transp. S*
161 *dum: deinde EP3* 163 *post aut add. si P1S* 165 *nec . . . certificata: erit non*
certificata forma eius P1S 166 *et¹ rep. P3/fuerint: sunt L3/in om. S* 167 *in om.*
R/uniuscuiusque: utriusque L3R 168 *instituetur: instituitur P1S* 169 *post*
visuum add. et C1 170 *uniuscuiusque inter. a. m. E/visibilium om. L3; mg. a. m. C1*
172 *viso corr. ex visu E/comprehendent: comprehendunt C1L3* 173 *duorum:*
amborum C1ErL3R/visuum corr. ex visibilium P1

sa in parte. Et hoc erit quando illud aliud visum fuerit propin-
 175 quius ambobus visibus viso in quo coniunguntur duo axes, et
 fuerit cum hoc inter duos axes aut fuerit remotius ab ambobus
 visibus viso in quo coniunguntur duo axes, et fuerit etiam inter
 duos axes cum fuerimus ymaginati extensos post coniunctio-
 nem, et visum in quo coniunguntur duo axes non cooperiet
 180 visum quod est remotius ipso aut cooperiet quoddam illius.

[2.10] Hiis igitur modis fit comprehensio visibilium ambo-
 bus visibus.

[2.11] Et etiam declaratum est in secundo tractatu quod axis
 radialis in utroque visu est eadem linea que non transmu-
 185 tatur, et quod pertransit centra omnium tunicarum visus et
 extenditur recte per centrum omnium tunicarum ad medium
 loci incurvationis ex concavo nervi super quem componitur
 oculus qui est apud foramen quod est in concavo ossis, et
 quod est inseparabilis ab omnibus centris, et quod positio eius
 190 apud omnes partes visus est positio semper eadem non trans-
 mutabilis apud motum visus nec apud quietem eius, et quod
 positio duorum axium apud duos visus est positio consimilis
 in respectu amborum visuum apud concavitatem nervi com-
 munis ex quo ultimum sentiens comprehendit formas visibi-
 195 lium. Ymaginemur igitur lineam rectam copulantes inter duo
 centra duorum foraminum que sunt in duabus concavitatibus
 duorum ossium continentium duos oculos, et ymaginemur duas
 lineas exeuntes a duobus centris duorum foraminum ossium
 extensas in duobus mediis duarum concavitatum nervorum.
 200 Hee igitur linee coniunguntur in medio concavitatis nervi com-

174 ante in add. pars EP1/post fuerit add. magis C1/propinquius (175): propinquum C1;
 propinquus P3; corr. ex propinquum L3 175 ambobus visibus transp. E/visibus inter.
 a. m. E/viso corr. ex visio L3/post viso add. illo C1/coniunguntur: adiunguntur Er;
 distinguuntur R; corr. ex adiunguntur L3/et . . . axes (177) mg. a. m. E 176 cum hoc:
 simul R 177 viso: visio S; corr. ex visos Er; corr. ex visio L3/fuerit: fuerint L3/etiam
 om. L3 178 post ymaginati add. axes C1P1S (mg. a. m. C1); add. eos R 179 co-
 operiet: cooperierit S 180 cooperiet: cooperierit ErL3P1S/quoddam: quiddam P1R;
 alter. ex quidam in quiddam S 181 hiis . . . visibus (182) mg. a. m. E/igitur: ergo
 C1L3R 182 visibus: visibilibus Er 184 que inter. a. m. E 186 per: super P1P3;
 corr. ex super a. m. E/centrum: centra R 187 quem: quod C1; quam EErL3
 188 in om. EP1; inter. a. m. S/ossis corr. ex omnis a. m. E 190 non inter. a. m. S
 191 apud¹ inter. L3/post nec scr. et del. est C1 192 duorum: duobus Er/post axium
 scr. et del. et L3/duos corr. ex duo L3/positio consimilis transp. C1L3 193 amborum:
 duorum EP3 194 post visibilium (195) add. est positio consimilis EErL3P3; scr. et del.
 est positio consimilis duorum axium C1 195 ymaginemur: ymaginetur C1;
 ymaginentur P1S; ymaginemus P3/igitur: ergo EP3R/post rectam scr. et del. rt P3; add. rt
 E (alter. in lk a. m.)/inter om. R 196 ante que scr. et del. un S 197 continentium
 corr. ex contingentium P1/duos om. ErP1S 198 ossium om. R 199 post
 concavitatum add. duorum EP3 200 nervi . . . concavitatis (201) om. ErP3/commu-
 nis (201) corr. ex consimilis L3

munis, quia positio duorum nervorum in respectu concavitate
communis nervi est positio consimilis; et positio harum dua-
rum linearum apud lineam copulantem inter duo centra duo-
rum foraminum erit positio consimilis, quia duorum nervorum
205 positiones in respectu duorum foraminum erit positio consimi-
lis. Et sic duo anguli qui sunt inter has duas lineas et lineam
copulantem inter duo centra duorum foraminum equales.

[2.12] Et ymaginemur etiam lineam copulantem inter duo
centra duorum foraminum divisam in duo equalia, et ymagine-
210 mur lineam exeuntem a puncto quod est in medio concavitate
nervi communis in quo due linee extense in concavitate
duorum nervorum sunt coniuncte extensam ad punctum divi-
dentem lineam copulantem duo centra duorum foraminum in
duo equalia. Hec igitur linea erit perpendicularis super lineam
215 copulantem duo centra duorum foraminum. Et ymaginemur
istam perpendicularem extensam recte in partem oppositam
visui; et sic ista linea erit fixa in eodem statu, et positio eius
non transmutabitur, quia punctus qui est in medio concavitate
nervi communis in quo due linee extense in duobus mediis
220 concavitatum duorum nervorum sunt coniuncte est unus non
transmutabilis. Et punctus etiam qui dividit lineam copulan-
tem duo centra duorum foraminum est etiam unus punctus non
transmutabilis, quapropter positio linee recte transeuntis per
illa est una positio non transmutabilis. Hec igitur linea vocetur
225 axis communis.

[2.13] Et ymaginemur apud punctum aliquem istius linee in

201 concavitate *om. R* 202 communis nervi *transp. EP3/est . . . consimilis scr. et del. P3/consimilis alter. in communis a. m. Er/harum mg. a. m. C1/harum duorum (203) transp. ErR/duorum linearum (203) transp. P1S* 203 copulantem: que copulatur *P1S/inter om. R* 204 erit . . . foraminum (207) *mg. L3/post consimilis add. et L3/quia . . . consimilis (205/206) mg. a. m. ES* 205 erit: est *P3R/positio corr. ex positionis P1* 206 ante et¹ *mg. HLK HKL a. m. S/has . . . lineas: duas . . . has P1* 207 inter *om. L3R/post foraminum add. erunt C1; mg. sunt P3/equales . . . foraminum (209) om. L3/post equales add. secus dissimilis esset positio nervorum R* 208 inter *inter. a. m. E/duo om. P3* 209 divisam: diviso *Er/equalia corr. ex eadem a. m. E* 210 ante lineam *add. etiam P1* 211 nervi communis *transp. ErP1S* 212 dividendum (213): dividens *R* 213 foraminum: foraminam *R* 214 hec: hic *P1* 215 centra *corr. ex extrema P1/ante et add. nam recta connectens centra duorum foraminum fit basis trianguli aequicruri cuius latera sunt rectae a medio nervi communis: itaque si recta sit a vertice in medium basis erit perpendicularis ad basim per 8p 10 d1 R* 217 post eodem *add. situ vel EP3* 218 punctus: punctum *R/qui: quod R; inter. a. m. S* 219 nervi communis *transp. EP3/extense om. P1* 220 concavitatum: concavitate *EP3/non om. C1L3* 221 transmutabilis: intranstrutabilis *C1L3; transmutabile R/punctus: punctum R/post punctus scr. et del. ea S/post etiam add. quid P1/qui: quod R* 222 etiam . . . transmutabilis (223): unum non transmutabile *R/non om. Er* 223 recte *om. L3R; mg. a. m. C1* 224 post est *add. etiam P1/post una add. etiam S/non om. P1* 226 ali-
quem: aliquod *R/istius linee transp. P1*

parte opposita visui aliquod visum, et ymaginemur duos visus
 aspicere illud visum et duos axes in simul coniungi in puncto
 superficiei visi in quo axis communis occurrerit superficiei illius
 230 visi, et hoc quidem possibile est in omni viso cuius situs ex
 duobus visibus est situs consimilis. Cum igitur duo axes fue-
 rint coniuncti in aliquo puncto axis communis, tunc duo axes, et
 axis communis, et linea que copulat duo centra foraminum
 duorum ossium, et due lineae extense in concavitatibus duorum
 235 nervorum omnia erunt in una superficie. Duo enim axes tran-
 seunt per centra duorum foraminum, transeunt enim per duo
 media concavitationum duorum nervorum in loco pyramidationis
 duorum nervorum. Cum igitur duo axes fuerint coniuncti in
 axe communi, erunt omnes in superficie in qua est axis com-
 240 munis, et linea secans ipsum que copulat centra foraminum
 duorum ossium. Et duo axes de loco centrorum duorum fora-
 minum usque ad punctum coniunctionis qui est in axe commu-
 ni erunt equales. Et positio eorum apud axem communem erit
 positio consimilis, et due partes duorum axium que sunt de
 245 centris duorum visuum usque ad punctum coniunctionis erunt
 equales, et remotio centrorum duorum visuum a foraminibus
 duorum ossium et a centris duorum foraminum est remotio
 equalis. Et etiam due partes duorum axium que sunt de su-
 perficiebus duorum visuum usque ad punctum coniunctionis
 250 etiam erunt equales. Nam due medietates dyametrorum sper-
 arum duorum visuum sunt equales, et quia ita est, positio
 puncti superficiei visi in quo coniuncti sunt duo axes apud duo
 puncta per que transeunt duo axes erit positio consimilis, et
 remotio eius ab eis erit equalis. Et hec duo puncta superficie-
 255 rum visuum sunt illa in quibus infigitur forma puncti in quo
 coniuncti sunt duo axes.

[2.14] Et etiam positio utriusque duorum punctorum que

227 *post visui scr. et del. o Er* 228 *aspicere: inspicere C1ErL3R* 229 *occurrerit:*
occurrat C1; occurrent Er 230 *visi inter. a. m. E/post et scr. et del. sic P1* 231 *igitur:*
ergo C1RS/fuerint (232): fiunt L3 234 *duorum¹ corr. ex duo a. m. Er/lineae inter.*
a. m. S 235 *omnia mg. a. m. C1* 236 *duorum rep. P1/duo om. EP3* 237 *con-*
cavitationum: concavitatem P1 238 *fuerint: fiunt L3; corr. ex fiunt a. m. C1* 239 *post*
communi scr. et del. e P1/axis corr. ex axa L3 240 *post et add. similiter R/ipsum:*
ipsam R/post ipsum add. axem EP3/foraminum duorum (241) transp. C1L3 241 *post*
ossium add. et duae lineae extensae in concavitatibus duorum nervorum R/loco corr. ex
locor L3 242 *coniunctionis corr. ex concavitatis L3/qui: que L3P1S; quod R*
 244 *que: qui P3/de: in P1* 245 *visuum: visibilium P3; corr. ex visibilium a. m. E*
 246 *post et inter. quia a. m. S/centrorum duorum transp. C1L3R* 250 *etiam om. R*
 251 *ita corr. ex ista P1* 252 *post puncti add. B scilicet EP3* 253 *post duo scr. et del.*
du P1/post et scr. et del. e Er 254 *post remotio scr. et del. ab S/equalis corr. ex ine-*
qualis L3 255 *quibus: que EP3/post forma scr. et del. in S/puncti corr. ex punctis*
a. m. E 256 *coniuncti sunt transp. P1S* 257 *que . . . punctorum (260) om. EP3*

sunt in duobus axibus superficierum duorum visuum apud
 260 concavitatem nervi communis erit positio consimilis, et positio
 istorum duorum punctorum apud quodlibet punctum in axe
 communi est positio consimilis. Ergo positio duorum puncto-
 rum que sunt in duobus axibus superficierum duorum visuum
 apud punctum axis communis qui est in medio concavitatis
 nervi communis in quo sunt coniuncte due linee exeuntes a
 265 centrīs duorum foraminum est positio valde consimilis et
 equalis. Et ambe forme que instituuntur in duobus punctis
 superficierum duorum visuum que sunt in duobus axibus, cum
 pervenerint ad concavitatem nervi communis, infiguntur in
 puncto qui est in axe communi quod est in medio concavitatis
 270 nervi communis in quo linee sunt coniuncte, et efficientur una
 forma.

[2.15] Et cum due forme que sunt in duobus punctis que
 sunt in duobus axibus superficierum duorum visuum figuntur
 in puncto quod est in axe communi quod est in medio concavi-
 275 tatis nervi communis, forme que sunt in punctis circumdan-
 tibus utrumque duorum punctorum que sunt in duobus axibus
 superficierum duorum visuum infiguntur in concavitate com-
 munis nervi in punctis circumdantibus punctum quod est in
 axe communi. Et positio quorumlibet duorum punctorum
 280 superficierum duorum visuum quorum positio apud duo puncta
 posita in medio in duobus axibus duorum visuum est positio
 consimilis in parte et in remotione apud eundem punctum
 concavitatis nervi communis est positio consimilis. Et puncta
 quorum positio apud ipsa est positio consimilis erunt decli-
 285 nantia a puncto quod est in axe communi quod est in loco
 coniunctionis linearum ex concavitate nervi communis in parte
 ad quam ambo puncta que sunt in superficiebus duorum visu-

259 *post communis scr. et del. communis L3* 260 *istorum duorum transp. C1 / duorum*
punctorum transp. P1 / quodlibet corr. ex quolibet a. m. C1 / post punctum scr. et del. in C1
 261 *duorum punctorum (262) transp. S* 262 *que: qui P3* 263 *punctum:*
positionem P3 (mg.) / qui: que C1 264 *nervi communis transp. ErP1S / coniuncte om.*
P1 / due . . . exeuntes om. EP3 265 *valde consimilis transp. EP3* 268 *pervenerint:*
perveniunt EP3 / nervi communis transp. C1ErL3RS / infiguntur corr. ex infigentur S
 269 *qui: quod R; corr. ex que S / in om. S* 270 *nervi communis transp. ErP1RS /*
efficientur: efficiuntur EP3; efficietur R 273 *superficierum duorum om. Er*
 276 *utrumque om. EP3 / post utrumque add. SBX LYZ unumquodque EP3 (SBX LYZ alter.*
in RG VZ a. m. E) / que: qui C1L3 277 *infiguntur: figuntur C1; om. P1 / communis*
nervi (278) transp. EP3 281 *posita om. R / in² mg. a. m. C1* 282 *eundem: idem R*
 284 *ipsa: ipsum P1; ipsam R / est rep. L3 / post est scr. et del. est C1 / erunt declinantia (285):*
declinabunt R / declinantia (285) corr. ex declinabiles P1 285 *post est¹ scr. et del. est S*
 286 *ex inter. L3 / post communis add. est positio consimilis EP1P3 / parte: partem P1RS*
 287 *quam: quem ErP1*

um sunt declinantia, et remotio eorum ab ipso erit secundum
remotiones eorum a duobus axibus. Et due forme que infigun-
290 tur in duobus punctis que sunt consimilis positionis apud
superficies duorum visuum perveniunt ad illum eundum punc-
tum concavitatis communis ipsius nervi, et superponentur sibi
apud illum punctum, et efficientur una forma; et positio unius-
cuiusque punctorum superficiei visi que sunt in circuitu puncti
295 quod est in axe communi apud duos axes duorum visuum est
positio consimilis. Ergo forma cuiuslibet puncti eorum infige-
tur in duobus visibus in duobus locis consimilis positionis in
respectu duorum punctorum que sunt in duobus axibus super-
ficierum duorum visuum. Due igitur forme visi in quo coniuncti
300 sunt tres axes infiguntur in duobus mediis duarum superficie-
rum duorum visuum, et due forme puncti in quo sunt coniuncti
tres axes infiguntur in duobus punctis que sunt in duobus axi-
bus superficierum duorum visuum, et quilibet punctus duarum
formarum infigetur in duobus locis consimilis positionis de
5 duobus visibus. Deinde due forme vise perveniunt ad concavi-
tatem communis nervi, et perveniunt due forme que sunt in
puncto quod est in duobus axibus ad punctum quod est in
communi axe, et efficientur una forma. Et quilibet due forme
que sunt in duobus punctis consimilis positionis a duobus
10 visibus perveniunt ad idem punctum punctorum circumdan-
tium punctum qui est in axe communi, et sic due forme totius
visi superponentur sibi et efficientur una forma, et sic visum
comprehendetur unum.

[2.16] Secundum ergo hunc modum due forme que infigen-
15 tur duobus visibus ab uno viso cuius positio in respectu duo-
rum visuum est consimilis efficiuntur una forma, et sic sentiens

288 sunt declinantia: declinant R/post ipso scr. et del. erin P1 289 duobus: duo-
rum Er 291 superficies: superficiem EP3/perveniunt: pervenerint P1; perveniunt
R/illum: illud P1RS; corr. ex illud P3/eundum: idem R 292 communis . . . nervi:
nervi communis EP3/superponentur: supponentur P1S/sibi: illi R 293 illum: illud
R/efficientur: efficietur R/uniuscuiusque (294): cuiusque unius C1; corr. ex uniusque
a. m. S; alter. ex unius cuius in unius cuiuslibet a. m. P3 294 circuitu corr. ex circui-
tui E 299 igitur: ergo P1P3RS/visi corr. ex vise C1/coniuncti corr. ex coniuncte C1
300 tres: duo P3; mg. a. m. C1/post axes add. scilicet ab KLDB EP3 (DB: OB P3)/infiguntur
alter. ex finguntur in figuntur C1 1 post puncti add. sunt C1/sunt om. C1/sunt
coniuncti transp. EP3 2 tres: duo P3/post axes add. scilicet ab KB LB EP3 (KB: KL P3)
3 quilibet: quodlibet R; corr. ex quamlibet S/punctus: punctum R 4 infigetur:
infigitur P1; alter. in infigitur S/de: a P1S 5 perveniunt: perveniunt EP3 6 com-
munis nervi transp. C1L3R/que sunt inter. L3/post que add. etiam Er 7 puncto . . .
est¹: punctis que sunt C1 8 efficiuntur: efficietur R/due forme transp. EP3
11 qui: quod R 12 superponentur: supponentur P1/sibi: simul EP3/efficientur:
efficietur R/visum: unum R 13 comprehendetur: comprehenditur EP3/unum:
visum S 14 ergo: igitur C1ErL3 15 viso: visu L3 16 efficiuntur: efficien-
tur C1

comprehendit unum visum, licet due forme infigantur ab eo in duobus visibus.

[2.17] Et cum due forme que sunt in duobus punctis que
 20 sunt in duobus mediis superficierum duorum visuum que sunt
 in duobus axibus pervenerint ad punctum quod est in axe
 communi, tunc quelibet due forme infixe in duabus superficie-
 bus duorum visuum infigentur in duobus punctis que sunt in
 duobus axibus, et pervenient semper ad illud idem punctum
 25 concavitatis nervi communis, quod est in communi axe. Nam
 duo puncta per que transeunt duo axes duorum visuum non
 mutantur, quoniam positio duorum axium apud duos visus
 semper est eadem positio non transmutabilis. Ergo punctus
 concavitatis communis nervi ad quem pervenient due forme
 30 que infiguntur in duobus punctis que sunt in duobus axibus
 superficierum duorum visuum semper est idem punctus, et est
 punctus qui est in communi axe in quo concurrunt due linee
 exeuntes a duobus centris foraminum duorum ossium exten-
 sorum in duobus mediis concavitatum duorum nervorum.
 35 Istud igitur punctum quod est in concavitate communis nervi
 quod est in communi axe vocetur centrum.

[2.18] Hoc igitur declarato, declaratum est quod forma
 cuiuslibet comprehensi quod comprehenditur ambobus visibus
 in cuius superficiei puncto concurrunt axes duorum visuum
 40 infigitur in duobus locis superficierum duorum visuum que sunt
 duo media superficierum duorum visuum. Deinde iste due
 forme perveniunt a duobus visibus ad concavitatem communis
 nervi ad eundem locum, et superponuntur sibi, et efficiuntur
 una forma. Et due forme puncti in quo concurrunt duo axes ex
 45 viso infigentur in duobus punctis que sunt in duobus axibus
 superficierum duorum visuum, et ibunt ab istis duobus punctis

18 *post duobus add. vi P3* 20 *mediis corr. ex visibus L3* 21 *duobus: duabus P3/*
pervenerint: perveniunt EP3/pervenerint . . . et (24) om. Er 22 *tunc alter. in item*
a. m. E 23 *infigentur om. C1EL3P3R* 24 *et om. C1EL3P3R/semper: super Er/post*
illud scr. et del. et E/idem: commune P1S 26 *post puncta add. concavitatis axis EP1P3*
(axis: ossis P1)/transeunt: pertranseunt C1 27 *mutantur: mutatur P3/post visus add.*
non EP3 28 *punctus: punctum R* 29 *communis nervi transp. C1L3/quem: quod*
R/pervenient: perveniunt R 31 *punctus: punctum R/et est punctus (32) om. L3*
 32 *punctus: punctum R/qui: quod RS* 33 *duobus om. P1* 36 *centrum corr. ex*
commune a. m. C1 37 *igitur: ergo EP3* 39 *post visuum scr. et del. mihi P1; add.*
pervenit C1EL3P3 (inter. L3) 40 *infigitur: in figura ErL3 (in scr. et del. L3); figura*
C1EP3; alter. in pervenit figura a. m. S 41 *visuum corr. ex visibilium a. m. L3/post*
visuum scr. et del. que sunt duo media superficierum duorum S 42 *perveniunt:*
proveniunt P1S/visibus mg. a. m. C1/communis nervi (43) transp. EP1P3 43 *super-*
ponuntur: supponuntur P1S/efficiuntur: efficiunt P3; efficitur R 45 *que . . . punctis*
 (46) *mg. a. m. S*

ad punctum centri concavitatis communis nervi, et indifferen-
ter sive punctus in quo concurrunt duo axes fuerit in axe com-
muni sive extra. Sed tamen cum visum fuerit in axe communi
50 et duo axes concurrunt in puncto ipsius quod est in axe com-
muni, tunc due forme istius puncti erunt magis consimiles.
Remotiones enim istius puncti a duobus punctis in quibus
figuntur due forme istius puncti superficierum duorum visuum
(et sunt illa que sunt super axes) erunt equales, quoniam duo
55 axes in hac dispositione erunt equales in longitudine. Et simi-
liter quilibet punctus propinquus isti puncto cuius remotiones
a duobus punctis in quibus infiguntur sue forme sunt equales
quantum ad sensum, forme eius erunt magis consimiles quam
due forme visi quod est extra communem axem, quapropter
60 forma visi quod est in communi axe, cum fuerit fixa in con-
cavitate communis nervi, erit magis verificata. Sed cum visum
fuerit extra communem axem et remotio eius non fuerit maxi-
ma, tunc sue due forme que infiguntur in duobus visibus non
maxime differunt, quapropter forme eius que infiguntur in
65 concavitate nervi communis non erunt due.

[2.19] Cum autem visum fuerit extra communem axem et
maxime fuerit remotum ab ipso, et cum hoc axes duorum visu-
um concurrunt in aliquo puncto ipsius, tunc forma eius infige-
tur in concavitate communis nervi una forma, et forma puncti
70 eius in quo duo axes concurrunt infigetur in puncto centri. Sed
tamen forma eius non erit verificata sed dubitabilis. Forma
igitur puncti visi in quo duo axes concurrunt infigetur in omni-
bus dispositionibus in puncto centri concavitatis communis
nervi, sive punctus concursus fuerit in communi axe, sive extra

47 communis nervi *transp.* EP3/et om. C1 48 punctus: punctum R/fuerit: fuerint
C1EErL3P3 50 concurrunt: concurrerint ErRS; concurrent P1/post puncto *scr. et del.*
in puncto P3 52 istius: huius EP3 53 istius: illius P1S 55 dispositione *corr.*
ex positione Er 56 quilibet . . . propinquus: formae cuiuslibet puncti propinqui R
57 infiguntur: figuntur EP3/sue: due EP3/sue forme *transp.* C1L3R 58 forme eius
om. R/eius: cuiusmodi EP3/post consimiles *scr. et del.* forme cuius erunt magis consimi-
les E 59 post forme *scr. et del.* erunt consimiles c P1/visi . . . forma (60) om. P1/
communem axem *transp.* EP3 60 fixa: infixa C1EP3R 61 communis nervi *transp.*
P1/verificata: certificata C1L3R/sed: et P1S 62 communem axem *transp.* EP3/eius
om. L3R; *mg. a. m.* C1 63 sue *mg. a. m.* C1/que: qui P3/post duobus *scr. et del.* non
ma P1 64 differunt: different R 65 erunt om. P3 66 autem: vero R/visum
corr. ex visus S 67 cum hoc om. R/axes: axis C1Er 68 concurrunt: concurrerint
L3P1P3R; *alter. in* concurrerint a. m. E/ipsius: illius C1/infigetur (69) om. EP3
69 communis nervi *transp.* EP3 70 infigetur: infiguntur EP3; infiguntur ErL3; *corr.*
ex infiguntur C1/post puncto add. communis C1R/post centri add. communis EP3 (mg.
a. m. E) 71 eius non *transp.* P3/erit om. P3/verificata *corr. ex verificata Er* 72 igitur:
ergo S/duo om. C1; *mg. a. m.* L3/duo axes concurrunt: concurrunt duo axes EP3
74 punctus: punctum R/concursus: occursus C1; communis P1; *corr. ex occursus L3*

75 illum. Quod autem remanet de forma visi infigetur in circuitu
puncti centri. Si autem visum fuerit minimi corporis et propin-
quorum dyametrorum et fuerit in communi axe vel prope, tunc
forma eius infigetur in concavitate communis nervi una forma;
et cum hoc est verificata, et positio cuiuslibet puncti eius apud
80 duos visus est positio consimilis, ut prius declaravimus. Si
vero visum fuerit magni corporis et remotorum dyametrorum, et
cum hoc fuerit in communi axe, tunc forma illius partis que est
apud locum coniunctionis duorum axium que circumdat punc-
tum coniunctionis infigetur in communi nervo una forma, et
85 verificata. Et forma residuarum partium infigetur continua
cum forma istius partis, quapropter forma totius visi figetur
una in omnibus dispositionibus; sed forma extremorum et illo-
rum que remota sunt a puncto concursus erit non certificata,
quoniam non omnes puncti remoti a puncto concursus figentur
90 sue forme in duobus punctis consimilis positionis in respectu
amborum visuum in fine consimilitudinis. Sed forma cuiuslibet
puncti remoti a puncto concursus figetur in duobus punctis
amborum visuum quorum positio apud duos visus est positio
consimilis in parte, et forte consimilis in remotione a duobus
95 axibus et forte non consimilis in remotione a duobus axibus.
Forme autem eorum quorum remotio non est consimilis figentur
in concavitate communis nervi in duobus punctis obliquis a
centro in una parte, sed erunt due; et si visum fuerit unius col-
oris, tunc illud fere nichil operabitur in ipsum propter consimi-
100 litudinem coloris et ydemptitatem forme. Si autem visum
habuerit diversos colores, aut fuerit in eo lineatio, aut pictura,
aut subtiles intentiones, tunc illud operatur in ipsum, qua-

75 autem om. P1/post forma add. a P1S (scr. et del. P1)/visi: visu S; corr. ex visu P1
76 propinquorum (77): propinquarum R; propinquiorum S 78 forma¹ om. P1/
communis nervi transp. C1L3 79 cum hoc om. R/est: etiam EP3; om. ErRS; inter. L3/
post est scr. et del. verfic P1/verificata corr. ex verificata Er/et² om. Er; inter. L3/post positio
add. eius Er/puncti om. P3 81 remotorum: remotiorum EP3; remotarum R
82 cum hoc: etiam R; corr. ex hoc cum L3 83 que: qui E 85 verificata corr. ex
verificata Er 86 istius: illius EP3/totius corr. ex istius S/figetur: infigetur P1P3RS
87 in om. EEerL3P3; inter. a. m. C1/post sed add. tamen P1RS/et: etiam EP3/illorum (88):
illo Er 88 erit . . . concursus (89) mg. a. m. E 89 non om. EP3R; inter. L3/omnes:
omnis ErP1RS/puncti remoti: punctus remotus P1S/post remoti scr. et del. p P1/figentur:
infigentur P3; alter. in infigentur a. m. E 90 sue: duae R; corr. ex due Er 93 quorum
corr. ex quo P3/est om. P3/post est scr. et del. positio E 96 autem: aut P3/figentur:
figetur P3 97 communis nervi transp. C1L3 98 sed: et R 99 illud: istud
C1L3R/fere om. P1/operabitur: operabatur C1L3; operatur EP3 100 coloris om. P3;
inter. a. m. E/ydemptitatem: ydemptitate L3/ante forme scr. et del. for L3/visum om. P1
101 habuerit: fuerit habens EP3/diversos: duos P1S/eo: ea C1ErL3; ipso EP3/aut²:
apud L3 102 tunc: inter P3/illud: istud C1ErL3R/operatur: operabitur C1; operatuatur
Er/quapropter (103): quoniam L3; corr. ex quoniam a. m. C1

propter forma extremorum erit dubitabilis, non certificata.

[2.20] Et cum visum fuerit magni corporis et remotorum
 105 dyametrorum, et axes amborum visuum fuerint fixi in aliquo
 puncto eius et immobiles, tunc forma eius apparet una, et lo-
 cus concursus eius et illud quod ei vicinatur erunt certificata et
 indubitabilia. Extrema autem et illa que eis vicinantur erunt
 non certificata propter duas causas: quarum una est quia
 110 extrema comprehenduntur per radios remotos ab axe, qua-
 propter non bene erunt manifesta; secunda autem est quia non
 forma cuiuslibet puncti eius constituitur in concavitate com-
 muni nervi in uno puncto, sed quedam sunt quorum forma
 constituitur in duobus punctis non in uno. Cum igitur duo axes
 115 fuerint moti super omnes partes huius visi, tunc verificabitur
 forma eius. Si autem visum fuerit extra axem communem et
 remotum ab ipso, tunc forma eius non erit certificata, positio
 enim cuiuslibet puncti illius apud ambos visus non est positio
 consimilis propter inequalitatem remotionum puncti huius visi
 120 a duobus punctis superficierum duorum visuum in quibus in-
 stituuntur due forme eius et a duobus axibus. Cum igitur ambo
 visus obliquabuntur ad huiusmodi visum adeo quod axis
 communis veniat ad istud visum aut prope, tunc certificabitur
 forma eius.

[2.21] Et similiter cum ambo visus comprehenderint multa
 125 visa in simul et axes amborum visuum simul concurrerint in
 aliquod unum visorum illorum et fixi fuerint in illo, residua
 autem visa fuerint extra duos axes, et visum in quo concur-
 rentes sunt duo axes fuerint minimi corporis, tunc forma visi in
 130 quo concurrentes sunt duo axes in concavitate nervi communis

103 forma extremorum *transp.* C1ErL3R/*post* forma *add.* exterior P3/*non om.* P3/
 certificata: certificata *Er* 104 corporis *corr.* ex coloris *a. m.* E/remotorum: remota-
 rum R 106 *post* et¹ *add.* fuerint EP3 107 vicinatur: propinquum est R
 108 autem: aut P3/illa: illud L3; *corr.* ex illud C1/eis vicinantur *transp.* ErP1RS: vicinantur:
 vicina sunt R 109 propter *inter.* E/una: unum C1L3/quia: quod C1L3R
 110 comprehenduntur: comprehendantur R/quapropter (111): que propter *Er*
 111 autem *om.* R/*post* autem *scr.* et *del.* non L3 112 constituitur: instituitur R
 114 constituitur: instituitur C1ErL3R; *alter.* in instituitur *a. m.* S/in¹ *corr.* ex *a. m.* C1/
 igitur: ergo C1R 115 huius: huiusmodi C1L3/verificabitur: certificabitur R
 116 eius *om.* P3 117 eius *om.* S/positio: propter P1 118 enim: autem EP3/illius:
 eius P1S 119 huius: huiusmodi C1 120 punctis *corr.* ex visibus P1/duorum *om.*
 P3/instituuntur (121): constituuntur L3 121 due... eius: forme... due C1L3/igitur:
 ergo C1 122 quod: ut R 123 istud: istum C1L3; illud EP3/certificabitur... eius
 (124): forma... certificabitur EP3 126 in¹ *om.* R/et... simul *om.* L3/*post* amborum
scr. et *del.* in P1/simul² *om.* C1P1/concurrerint: concurrerent L3 127 visorum *corr.* ex
 visu S/visorum illorum *transp.* EP3/fixi fuerint *transp.* P1RS 128 concurrentes sunt
 (129): concurrunt R 129 fuerit: sit C1P1S; fuerint *EEr*; *corr.* ex fue-
 rint P3 130 concurrentes sunt: concurrunt R

erit una forma et certificata. Et si visum fuerit super axem communem, tunc forma eius erit magis certificata quam forma visi que est extra axem communem. Et si in ipso sunt concurrentes duo axes, visa autem que comprehenduntur a visu in illo statu que sunt propinqua viso in quo duo axes sunt concurrentes—sed cum hoc fuerint minimi corporis—forma eius instituitur in concavitate communis nervi una in qua non erit dubitatio maxima, nam forma eius erit propinqua centro. Quod autem illorum visorum que comprehenduntur a visu in illo statu fuerit remotum a viso in quo sunt concurrentes duo axes forma eius instituetur in concavitate istius nervi dubitabilis. Et tunc aut erunt due forme et erunt se adinvicem penetrantes, quia sunt in una parte, quapropter inequalitas que est inter suas positiones in remotione non erit maxima, unde due forme erunt se penetrantes, aut forma quarumdam partium erit duplex, et forma quarumdam erit una. Et sic forma huiusmodi visibilium erit dubitabilis in omnibus dispositionibus propter diversitatem positionis radiorum exeuntium ad illud et quia radii exeuntes ad illud erunt remoti a duobus axibus. Forma autem obliqui visi a duobus axibus remoti a loco concursus duorum axium erit non certificata, dum fuerit remota a concursu duorum axium. Cum autem duo axes fuerint remoti et concurrentes in ipso, tunc verificabitur forma eius.

[2.22] Cum axes duorum visuum concurrerint in aliquo viso, et cum hoc duo visus comprehenderint aliud visum propinquius duobus visibus in quo viso sunt concurrentes duo axes aut remotius, et fuerit cum hoc inter duos axes, tunc positio eius apud duos visus erit diversa in parte. Nam cum fuerit inter duos axes erit dextrum unius axis et sinistrum alterius, et

131 una forma *transp.* C1/visum *corr.* ex visus C1L3 (*a. m.* C1) 133 sunt: sint P1S/
sunt concurrentes (134): concurrunt R 134 visa: visorum R 135 sunt concurrentes
(136): concurrunt R 136 sed: si C1EL3P3R/cum hoc: etiam R/hoc *om.* P1/fuerint:
fuerit P3/post fuerint *add.* ipsa R/eius: cuiusque P1S; *om.* R 137 communis nervi
transp. C1L3/una in qua: in qua una P3 138 post centro *add.* communi C1/quod . . .
visorum (139): ex illis autem visibilibus R/autem illorum (139) *transp.* P3 139 illo:
isto R/post statu *add.* quod R 140 viso: visu *Er*/sunt concurrentes: concurrunt R/
forma eius *transp.* R 142 et erunt *om.* R/adinvicem: mutuo R/quia *corr.* ex quare
a. m. *Er* 143 positiones: dispositiones P1; *corr.* ex opiniones L3 144 erunt . . .
penetrantes (145): se mutuo penetrabunt R 145 partium . . . quarumdam (146) *inter.*
L3/erit *mg.* *a. m.* C1 146 visibilium *om.* P1 148 illud: illa R/et *om.* P3/radii:
illi P3 149 illud: illa R 150 a² *om.* P1 151 axium (152) *corr.* ex auxium P3
152 concurrentes: concurrerint R 153 verificabitur: vertificabitur S 154 post cum
add. autem *Er*P1RS; *add.* duo C1R (*mg.* *a. m.* C1)/concurrerint: concurrunt *E*ErP3
155 viso: visu *Er*; *corr.* ex visu P3/cum *om.* R/hoc: hi R/visus *corr.* ex axes L3/aliud:
alium P1 156 in . . . concurrentes: viso in quo concurrunt R 157 cum hoc: etiam
R; *transp.* P1/tunc . . . axes (159) *mg.* *a. m.* E 158 visus: axes P3/fuerit: fuerint C1

160 radii exeuntes ad ipsum ab altero viso erunt dextri ab axe, et
 qui exeunt ad ipsum a reliquo viso erunt sinistri; et sic positio
 eius apud duos visus erit positio diversa in parte. Et forma
 huiusmodi visorum instituitur in duobus visibus in duobus
 locis diverse positionis, et due forme eius que instituuntur in
 165 duobus visibus perveniunt ad duo loca diversa concavitatum
 communis nervi, et erunt a duobus lateribus centri, quapropter
 erunt due forme, et non superponentur sibi.

[2.23] Et similiter cum fuerit visum in altero axe et extra
 reliquum forma eius instituetur in concavitate communis nervi
 170 in duobus locis, una scilicet in centro et alia obliqua a centro,
 et non superponentur sibi.

[2.24] Secundum igitur hos modos instituetur forma visibi-
 lium in duobus visibus et in concavitate communis nervi.

[2.25] Omnia autem ea que diximus sic possunt experiri
 175 experimento cum quo veniet certificatio.

[2.26] Accipiat tabula lenis ligni cuius longitudo sit uni-
 us cubiti et cuius latitudo sit quattuor digitorum, et sit bene
 plana, et equalis, et lenis. Et sint fines sue longitudinis equidis-
 tantes et sue latitudines equidistantes, et sint in ipsa duo
 180 dyametri se secantes a quorum loco sectionis extrahatur linea
 recta equidistans duobus finibus longitudinis. Et extrahatur a
 loco sectionis etiam linea recta perpendicularis super lineam
 primam positam in medio, et intingantur iste linee tincturis
 lucidis diversorum colorum ut bene appareant, sed tamen duo
 185 dyametri sint unius coloris. Et concavetur in medio latitudinis
 tabule apud extremum linee recte posite in medio, et inter duos
 dyametros, concavitate rotunda, et cum hoc quasi pyramidali
 tantum quantum poterit intrare cornu nasi quando tabula su-

160 *post ab*¹ *scr. et del. ipso* P1 161 *post exeunt rep. ad* (160) . . . *exeunt* (161) L3/a
 reliquo: in aliquo P3/et . . . eius (162) *scr. et del. L3* 162 *post eius rep. erit* (158) . . . eius
 (162) EL3P3 (*scr. et del. L3*)/positio *om. R* 163 *post visorum scr. et del. instituitur* Er
 164 eius *om. R* 165 *perveniunt: pervenient* R 166 *et erunt om. P1/post centri*
add. communis C1 167 *superponentur: supponerentur P1; supponentur S*
 168 *et*² *om. P3* 170 *et om. P1/aliam . . . centro rep. P1/obliqua: aliqua Er* 171 *super-*
ponentur: supponentur P1S 172 *igitur: ergo R* 173 *communis nervi transp. P1*
 174 *ea om. R; inter. E/que om. S/experiri: experimentari R* 175 *ante cum scr. et del.*
cum S 176 *sit om. P1S* 177 *cubiti: cubi P1/cuius om. C1/sit inter. P1*
 178 *plana: plena P3/sint: ut S/sint . . . longitudinis: fines sue . . . sint L3/longitudinis:*
latitudinis Er 179 *et . . . equidistantes rep. L3/latitudines alter. in latitudinis a. m. C1/*
ipsa: ipso C1L3 180 *se rep. C1/quorum: quarum R* 181 *ante a add. etiam R*
 182 *etiam om. R/post linea add. sectionis P3/lineam primam (183) transp. ErP1S*
 183 *positam: posita C1* 184 *colorum om. P1/duo: duae R* 185 *concavetur: fiat*
cavatura R/post latitudinis add. et L3 186 *et om. C1/duos: duas R* 187 *cum hoc*
om. R/quasi om. P3/pyramidali: pyramidaliter P1RS 188 *quantum poterit: sicut*
possit R/cornu: conus EP3; corr. ex conu L3/superponetur (189): supponitur P1;
supponetur S

perponetur illi quousque tangent duo anguli tabule fere duo
 190 media superficierum duorum visuum, tamen non tangent.

[2.27] Sit igitur tabula in figura **ABCD** et dyametri **AD** [et]
BC, et punctus sectionis sit **Q**; et linea extensa in medio longi-
 tudinis sit **HQZ**, et linea secans hanc lineam secundum angulos
 rectos sit **KQT**. Et concavitas que est in medio latitudinis ta-
 195 bule sit illa que continetur a linea **MHN**.

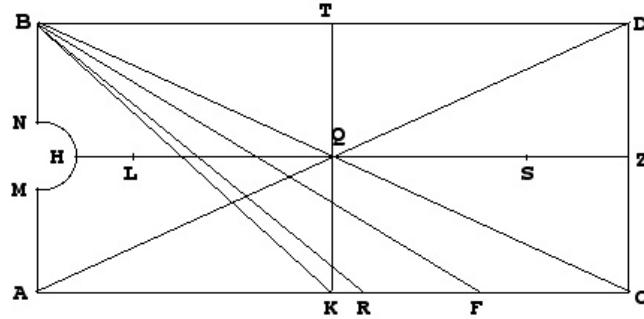


figure 3.8

[2.28] Hac igitur tabula facta hoc modo, accipiat¹⁸⁹ur cera alba
 ex qua fiant tria individua parva columpnata, et intin-
 gantur diversis coloribus; et erigatur unum individuorum in
 medio tabule in puncto **Q**, et applicetur tabule adeo quod non
 200 possit auferri a suo loco, et sit stans super tabulam statu
 equali. Duo autem individua reliqua erigantur super extrema
 lineae late in duobus punctis **K**, **T**, et sic tria individua erunt in
 una verticatione. Et hoc quidem facto, eleve¹⁹⁰t experimentator
 hanc tabulam, et superponat concavitatem que est in medio
 205 longitudinis cornu nasi et inter oculos adeo quod cornu nasi
 intret concavitatem et applicetur cum tabula, et fient duo an-
 guli tabule apud duo media superficierum duorum visuum et
 propinqui ut tangent ipsa fere. Deinde experimentator debet
 inspicere individuum propositum in medio tabule et pupillam
 210 super ipsum tenere fortiter. Cum igitur experimentator inspex-

189 tangent: tangent R 190 post visuum scr. et del. tangent P1/tamen: quamvis R
 191 sit: si P1/post dyametri add. sint ErP1S 192 BC transp. L3/punctus: puncta P1S
 193 ante sit scr. et del. i P1/HQZ: HQ P3/post linea scr. et del. i P3/hanc corr. ex habent
 a. m. Er 194 sit om. Er/concavitas: cavitas P1S/latitudinis: longitudinis P1S
 197 tria om. P1S/parva rep. Er/ante et add. vel columpnaria C1/intingantur (198) corr. ex
 infigantur EP3 (a. m. E) 199 quod: ut R 200 a: in P1 202 post lineae add.
 latitudinis C1; scr. et del. in duobus p P1 203 post facto scr. et del. quidam C1
 204 hanc om. P1/concavitatem: concavitate P3 205 quod: ut R 207 et scr. et
 del. C1 208 ipsa fere transp. L3/post ipsa scr. et del. re C1/fere om. P1; mg. a. m. C1;
 inter. ErL3S (a. m. ErS) 209 post individuum scr. et del. duum P1/propositum:
 positum C1 210 ipsum: ipsam P1S

erit individuum positum in medio hoc modo, axes duorum visuum concurrent in hoc individuo et superponentur duobus dyametris aut erunt equidistantes illis. Et erit axis communis, quem prius determinavimus, superpositus lineae extense in medio longitudinis tabulae quae est linea **HZ**.

[2.29] Deinde experimentator in hac dispositione debet intueri omnia quae sunt in superficie tabulae. Tunc autem inveniet unumquodque trium individuorum quae sunt in punctis **K**, **Q**, **T** unum, et inveniet lineam **KQT** etiam unam. Linea autem **HZ** extensa in longitudine tabulae invenietur due se secantes apud individuum positum in medio. Et similiter duo dyametri etiam, cum experimentator intuetur eos in hoc statu, invenientur quattuor, utrumque eorum scilicet duo.

[2.30] Deinde experimentator debet ponere pupillam circa alterum individuorum quae sunt in duobus punctis **K**, **T** ut duo axes concurrant in individuo posito in extremo. Deinde intueatur etiam in hac dispositione, et inveniet trium individuorum unumquodque unum et lineam positam in latitudine etiam unam, et inveniet lineam mediam extensam in longitudine tabulae duas et utrumque dyametrorum duos.

[2.31] Cum igitur experimentator comprehenderit has lineas et individua posita super tabulam, et auferet duo individua quae sunt in duobus punctis **K**, **T**, et ponat ea super lineam **HZ** extensam in longitudine, unum scilicet in puncto **L**, quod sequitur visum, et reliquum in puncto **S**, quod est ultra individuum positum in medio. Deinde revertat tabulam ad suam primam positionem et dirigat pupillam ad individuum positum in medio. Tunc autem inveniet duo individua quattuor et obliqua

211 positum: propositum *P1S/post modo add. inter. C1EErL3P3/axes alter. in inter axes a. m. S* 212 ante in *add. axes C1; inter. axes duorum visuum L3/duobus: duabus R* 213 illis *om. P1S* 214 quem: quam *P3* 217 omnia . . . sunt *corr. ex que . . . omnia S* 218 individuorum *corr. ex individuum L3* 219 etiam: et *Er; scr. et del. E; om. P3/post unam add. lineam C1/linea corr. ex lineam L3* 220 invenietur: invenientur *P1R; corr. ex invenientur L3P3/post due scr. et del. tabulae P3* 221 duo: duae *R* 222 eos: eas *R/invenientur (223): apparebunt R; corr. ex inveniento L3* 223 utrumque: uterque *E; utraque R/eorum: earum R/eorum scilicet transp. ErP1S/duo: duorum P1; duplex R* 224 deinde . . . individuorum (225) *om. P1/experimentator om. Er/circa alter. in contra a. m. C1* 225 *KT corr. ex ET a. m. E* 226 axes *corr. ex axes L3/in om. S/in individuo corr. ex individuum L3* 227 etiam: et *L3; om. P1* 228 unumquodque: unumquodquod *S/unum mg. L3* 230 ante duas *scr. et del. ta Er/utrumque: utramque R; corr. ex utrum a. m. C1/duos: duas R* 232 et² *mg. a. m. C1; inter. L3; om. EP3R/auferet: auferat R* 233 *K corr. ex Q Er/KT corr. ex ET a. m. E/lineam: lineas L3* 234 longitudine *corr. ex longitudinem E/L inter. L3/post L add. secundum L3* 236 revertat: revertatur *C1; vertet P1; vertat R* 237 post pupillam *add. etiam Er* 238 post quattuor *scr. et del. et obliqua in dextro et duo C1*

a medio, duo scilicet in dextro et duo in sinistro, et inveniet ea
 240 super duas lineas que in rei veritate sunt una linea in medio,
 sed apparent due; et inveniet quelibet duorum quattuor super
 alteram duarum linearum.

[2.32] Et similiter si abstulerit duo individua ab hac linea
 et posuerit ea super alterum duorum dyametrorum, unum in
 245 parte visus et reliquum ultra individuum positum in medio,
 inveniet illa quattuor. Nam uterque dyametrorum apparebit
 duo, quapropter apparebunt super utramque linearum que
 sunt unius dyametri in rei veritate duo individua unum in parte
 visus et aliud ultra individuum positum in medio. Et similiter
 250 si posuerit duo individua super ambos dyametros, utrumque
 super alterum dyametrum, et posuerit ea in parte visus, inveni-
 et illa quattuor, duo propinqua et duo remota.

[2.33] Deinde experimentator debet auferre duo individua
 a tabula et ponere alterum eorum super marginem tabule ultra
 255 punctum **K** et prope ipsum valde, ut super punctum **R**, et re-
 vertatur tabula ad suam primam positionem, et dirigat pupil-
 lam ad individuum positum in medio. Tunc quidem inveniet
 individuum positum in puncto **R** unum. Deinde auferat indi-
 viduum a puncto **R**, et ponat ipsum in margine tabule etiam
 260 ultra punctum **K** super punctum remotum a puncto **K**, ut
 super punctum **F**, et dirigat pupillam ad individuum positum
 in medio, quoniam tunc inveniet individuum positum apud
 punctum **F** duo.

[2.34] Experimentator autem inveniet omnia que diximus
 265 cum direxerit pupillam ad individuum positum in medio, aut
 ad individuum positum in linea recta in latitudine, aut ad
 punctum illius lineae, quodcumque punctum sit, et dum duo
 axes sunt concurrentes in individuo posito in medio aut in

239 scilicet . . . duo *mg. a. m. C1* 240 rei *om. P1S* 241 inveniet *corr. ex invenient*
C1/duorum: duo horum P1RS/super . . . ea (244) mg. a. m. E 244 ea: illa *ErP1S/*
alterum: alteram P3R/duorum: duarum R/duorum dyametrorum transp. C1EL3R
 245 reliquum *corr. ex reliqua L3/individuum corr. ex dividuum L3* 246 inveniet:
invenit E/post illa scr. et del. qua C1/uterque: utraque R 247 duo: duplex *R*
 250 ambos: ambas *R/post utrumque add. scilicet Er* 251 alterum: alteram *R/posuerit*
om. P1S/ea in transp. R/post visus add. posuerit P1S 253 duo: due *P3* 254 mar-
ginem: ymaginem P3 255 *K corr. ex E a. m. E/R: K EP3* 257 in medio *om. P3/*
quidem om. R 258 puncto: punctum *EP3/R: K EP3; X P1/deinde auferat transp.*
C1L3/auferat corr. ex auferant P1 259 *R: K C1EP3/margine: ymagine P3* 260 *K¹:*
R ErL3S; X P1 261 *post super scr. et del. ipsum P3/punctum F transp. P1S*
 262 quoniam: quia *P1S/apud: aliud P1: in R; ad S* 263 punctum: puncto *R*
 264 inveniet: inveniat *ErL3* 265 in . . . positum (266) *om. P1; mg. a. m. C1* 266 ad¹
om. L3 267 illius: unius *R/quodcumque: quocumque P1/punctum² om. R/post sit*
scr. et del. aut individuum positum C1 268 sunt concurrentes: concurrunt *R/in¹*
om. C1Er

270 aliquo puncto linee posite in latitudine. Si ergo experimentator
direxerit pupillam in illo statu ad individuum positum extra
lineam positam in latitudine aut ad punctum positum extra
illam lineam, et concurrerint duo axes in aliquo puncto extra
lineam positam in latitudine, tunc individuum positum in
medio videbitur duo. Et si reliqua individua fuerint in duobus
275 punctis **K**, **T**, tunc uterque eorum etiam videbitur duo. Deinde
cum experimentator direxerit pupillam ad medium individuum
aut ad aliquem locum linee posite in latitudine, statim disposi-
tio revertetur, ut in prima figura.

[2.35] Igitur a puncto **B** extrahantur linee **BK**, **BR**, **BF**. Li-
280 nea igitur **KB** est maior linea **BT**, et linea **KQ** est equalis **QT**.
Sic angulus **TBQ** est maior angulo **QBK**.

[2.36] Et angulus **TBQ** est equalis angulo **KAQ**. Ergo an-
gulus **KAQ** est maior angulo **KBQ**.

[2.37] Ergo remotio lineae **AK** ab axe **AQ** est maior quam
285 remotio lineae **BK** ab axe **BQ**. Sed differentia inter has duas
remotiones est modica, differentia enim inter duos angulos
KAQ, **KBQ** est parva.

[2.38] Et individuum quod est apud punctum **K** semper
videtur ambobus visibus unum quando duo axes fuerint con-
290 currentes in individuo quod est apud punctum **Q**. Et due lineae
AK, **BK** sunt equidistantes duobus radiis exeuntibus ad indi-
viduum quod est apud punctum **K**, dum duo axes concurrerint
in individuum quod est apud punctum **Q**.

[2.39] Et similiter dispositio individui quod est apud
295 punctum **R** scitur, quoniam radii exeuntes ad ipsum erunt in

269 ergo om. P3 270 direxerit: dixit Er; direxerat P1/statu: situ R 271 ante aut
scr. et del. ad P1 272 illam lineam transp. P1R/concurrerint: concurrent Er;
concurrerunt P3 274 post et si inter (??). L3/fuerint: sunt C1L3 275 tunc om. P3/
uterque: utrumque R 276 cum: si P1S 277 aut corr. ex aliud L3/ad om. S/
dispositio (278) corr. ex positio P3 278 ut om. ErS 279 a: ab S/puncto om. P1;
inter. a. m. S/B om. S/BR: BT P1; corr. ex RB Er 280 igitur: ergo P1S/est maior rep.
P3/KQ corr. ex KI P1/post equalis add. lineae P1S 281 post sic add. igitur R/angulus
corr. ex angulos a. m. Er/QBK: KBQ C1/post QBK add. per 4p geometriae Jordani. In
triangulo enim BTK ab angulo TBK, inaequalibus lateribus BT, BK comprehenso, recta
BQ est in medium basis TK: itaque angulus QBK ab ipsa BQ et maiore latere BK
comprehensus, minor est angulo TBQ, ab eadem BQ et minore latere BT compre-
henso R 282 angulus (283) om. C1 283 KAQ corr. ex KAC P1/post KAQ inter.
que est equalis angulo QBT L3 284 post ergo scr. et del. t S 285 BQ corr. ex BK
P1/has inter. P1 286 modica: in media P1 288 est om. P1 289 duo om. R;
inter. C1L3/axes fuerint transp. P3/fuerint concurrentes (290): concurrerint R 290 in
inter. ErS 291 post AK add. et C1/sunt alter. in sint S 292 apud punctum corr. ex
punctum apud L3/punctum om. P1S/post K scr. et del. Q S/dum: cum C1ErL3
293 individuum: individuo R/punctum om. R/punctum Q transp. P1S 294 et om.
R/dispositio rep. Er/post individui scr. et del. quod est P3 295 punctum om. P3/ad:
apud ErP1

verticatione duarum linearum **AR**, **BR**, et videbitur unum.

[2.40] Et duo anguli **RAQ**, **RBQ** non maxime differunt, et angulus **KBR** non habet sensibilem quantitatem quando punctus **R** fuerit valde propinquus puncto **K**.

300 [2.41] Declarabitur igitur ex hac dispositione quod visum cuius positio apud duos axes est una positio in parte et remotio radiorum exeuntium ad ipsum a duobus visibus non est maxime differentie, illud visum videbitur duobus visibus unum.

5 [2.42] Anguli autem **FAQ**, **FBQ** sunt diversi diversitate maxima, et individuum quod est apud punctum **F** videbitur duo quando duo axes concurrerint in individuo quod est apud punctum **Q**.

10 [2.43] Declarabitur igitur ex hac dispositione quod visum ad quod positio radiorum exeuntium a duobus visibus est diversa in remotione a duobus axibus maxima diversitate videtur duo, etsi positio eius in respectu duorum axium est eadem positio in parte.

15 [2.44] Positio autem lineae **HQZ** in respectu axium duorum visuum est positio diversa in parte, radii etenim exeuntes ad partem **HQ** a dextro visu sunt sinistri ab axe **AQ**, radii autem exeuntes ad hanc partem a sinistro visu sunt dextri ab axe **BQ**. Radii vero exeuntes ad partem **QZ** a dextro visu sunt dextri ab axe **AQ**, et radii exeuntes ad ipsam a sinistro visu sunt sinistri
20 ab axe **BQ**, et radii qui exeunt ad ipsam sunt diverse positionis in parte. Et omnis punctus istius lineae remotio duorum radiorum exeuntium ad ipsum a duobus visibus a duobus axibus est equalis; et ista linea et omnia posita super ipsam preter individuum positum in medio semper videntur duo cum

296 **AR**, **BR**: **AT**, **BT** *P1/post AR add. et C1* 297 **RAQ**: **RA** que *P1/post RAQ add. et C1/*
et²: etiam *ErL3; alter. ex etiam in cum a. m. C1* 298 **KBR**: **KBT** *P1/quando: quoniam*
L3/punctus (299): punctum R 299 **R**: **T** *P1/propinquus: propinquum R* 300 igitur
corr. ex ergo *S* 1 positio¹: dispositio *R; om. P3/remotio (2): remotiones P1S*
2 est om. *ErP1S* 3 differentie: differunt *ErP1; differens R; alter. ex differant in*
differunt S 5 autem om. *P3* 6 maxima: magna *Er/apud corr. ex a a. m. S/post*
apud scr. et del. F P3 7 quando: quoniam *R/concurrerint: concurrent R/in om. Er*
9 igitur om. *P3* 10 visibus... duobus (11) *inter. L3* 11 maxima diversitate *transp.*
P3/diversitate corr. ex diversa P3 12 videtur: videbitur *C1L3/etsi: licet R/est om.*
L3/est eadem transp. EP3R 14 **HQZ** corr. ex **HQR** *L3/axium... visuum (15) corr. ex*
duorum... axium C1 16 partem corr. ex partes *C1/post AQ add. et C1P1S/autem*
om. C1P1S 17 ad: ante *C1/post partem add. HQ C1P1S/BQ... axe (19) mg. a. m. E*
18 vero: autem *P3/QZ corr. ex ZQ P1* 19 ante et scr. et del. ve *S/post ipsam add. QZ*
C1/sunt inter. a. m. Er 20 qui: que *L3/ipsam: ipsum R* 21 omnis... lineae om.
R/post omnis scr. et del. omnis P3/istius: illius P1S 22 post ad *add. quodlibet*
punctum illius lineae R/ipsam: ipsam P3; om. R 24 positum: positionum *S*

25 duo axes concurrerint in individuo posito in medio.

[2.45] Declaratum est igitur ex hac dispositione quod visum cuius positio in respectu duorum axium est diversa in parte semper videtur duo, etsi remotiones radiorum exeuntium ad ipsum a duobus visibus a duobus axibus sunt equales. Remotiones enim quorumlibet duorum radiorum exeuntium a
30 duobus visibus ad aliquod punctum eius erunt in duabus partibus diversis, quapropter due forme cuiuslibet puncti eius instituentur in duobus punctis concavitatis communis nervi a duobus lateribus centri.

[2.46] Et similiter etiam est dispositio utriusque dyametrorum, scilicet quoniam radii exeuntes ad utrumlibet eorum a visu sequente ipsum erunt a medio visus, et propinqui axi, et sub axe, et supra axem; et radii exeuntes ad ipsum a reliquo visu erunt declinantes a reliquo axe. Qui vero a dextro visu ad
40 sinistrum dyametrum erunt sinistri ab axe; qui autem exeunt a sinistro visu ad dextrum erunt dextri ab axe. Forme quidem dyametrorum istorum et omnia etiam posita super ipsos videntur duo preter individuum positum in medio quando duo axes concurrerint in medio individuo.

[2.47] Declarabitur igitur ex hoc quod visum quod in respectu alterius visus est oppositum medio eius, in respectu autem reliqui est obliquum a medio, videtur duo. Nam forma puncti que instituitur in medio alterius visus venit ad centrum. Forma autem puncti obliqui a medio reliqui visus veniet ad
50 punctum aliud a centro et obliquum a centro secundum obliquationem puncti superficiei visus.

[2.48] Ex hac igitur experimentatione et expositione declaratur bene quod visum in quo currunt duo axes semper

25 concurrerint: concurrunt C1/in¹ om. S 26 est om. P3/est igitur transp. R
27 est om. P3 28 videtur corr. ex videntur C1/etsi: quamvis R 29 ipsum: ipsam
P1S/sunt: sint Er 30 enim: eorum P1 34 post centri add. communis C1
35 etiam inter. P1/dyametrorum (36) inter. a. m. Er 36 scilicet om. R/utrumlibet:
utrumque P3; utramlibet R/eorum: earum P1RS 37 ipsum: ipsam R/propinqui:
propinqua S 38 ipsum: ipsam R 39 qui: que EEerL3P1P3S 40 sinistrum:
sinistram R/erunt... dextrum (41) om. Er/ab axe: sub axes P1/qui: que P1S 41 visu
corr. ex visuo P1/dextrum: dextram R/post dextrum add. dyametrum C1P1S (mg. a. m.
C1)/post axe add. et R/forme quidem om. C1EEerL3P3/quidem om. R/post quidem add.
eruntque C1EEerL3P3 (corr. ex erunt a. m. C1) 42 istorum: istarum R/post istorum
add. et R/ante et add. omnia puncta C1EEerL3P3R/etiam om. C1EEerL3P3R 43 in...
concurrerint (44) om. L3/quando: quomodo C1Er/quando... medio (44) mg. a. m. C1
45 igitur: ergo Er; etiam P1S 46 post visus scr. et del. est C1 47 a inter. E/forma:
formae R 48 que: quod ErP1S/venit: veniet R 49 autem: vero R 50 et
... centro mg. a. m. C1/obliquationem (51): obliquitatem C1 51 ante puncti scr. et del.
in P3 52 igitur: ergo P1S/et inter. S/declaratur (53): declarabitur C1L3 53 cur-
runt: concurrunt C1L3R/duo: duos P3

videtur unum; et quod unumquodque visorum etiam in quibus
 55 concurrunt radii qui sunt consimilis positionis in parte inter
 quos non est maxima diversitas in remotione a duobus axibus
 videtur etiam unum; et quod visum in quo concurrunt radii
 consimilis positionis in parte et diverse positionis in remotione
 a duobus axibus maxima diversitate videtur duo; et quod
 60 visum quod comprehenditur per radios diverse positionis in
 parte videtur duo, etsi remotiones radiorum exeuntium ad
 ipsum a duobus axibus sunt equales; et quod omnia ista erunt
 sic dum duo axes concurrerint in uno viso.

[2.49] Et omnia visa assueta sunt opposita ambobus visi-
 65 bus, et ambo visus inspiciunt ad quodlibet eorum. Ergo duo
 axes duorum visuum semper concurrunt in eis, et positio radi-
 orum residuorum qui concurrunt communi puncto eorum est
 positio consimilis in parte, et non differunt in remotione a
 duobus axibus maxima differentia. Et ideo quodlibet visibili-
 70 um assuetorum visorum videtur ambobus visibus unum, et nul-
 lum visibilium videtur duo nisi raro. Nullum enim visibilium
 videtur duo nisi cum positio eius in respectu amborum visuum
 fuerit diversa maxima diversitate, aut in parte, aut in remotio-
 ne, aut in utraque; et positio unius visi apud duos visus non
 75 diversatur quidem maxima diversitate nisi raro.

[2.50] Causa igitur propter quam unumquodque visorum
 assuetorum videtur unum ambobus visibus declarata est ratio-
 ne et experientia.

[2.51] Et etiam, cum experimentator abstulerit individuum
 80 quod est in medio tabule, et inspexerit punctum sectionis quod
 est in medio tabule, et intuetur tunc lineas scriptas in tabula,
 inveniet duos dyametros quattuor. Et inveniet cum hoc duos
 illorum quattuor propinquos sibi et duos a se remotos, et cum
 hoc omnes se secantes super punctum medium qui est punctus
 85 sectionis duorum dyametrorum qui est super axem communem.

55 inter: in P1 56 quos corr. ex quod L3 58 remotione: parte remotio P1
 59 et . . . duo (61) mg. a. m. S 60 quod inter. L3 61 etsi: quamvis R 63 dum:
 cum P1 / concurrerint: concurrent EP3R; concurrunt P1S/viso: visu E 64 post visa
 scr. et del. sunt C1L3 65 post eorum scr. et del. cum P1 66 in eis mg. a. m. C1
 67 concurrunt: currunt C1/post concurrunt add. in C1P1RS 68 differunt:
 differt P1RS 70 assuetorum visorum transp. ErP1S/visorum om. R 72 positio:
 compositio R 74 utraque: utroque R/et: aut L3 75 quidem om. ErP1S
 80 punctum: medium EL3P3R; corr. ex medium a. m. C1 81 intuetur: intuitus fue-
 rit R 82 post dyametros add. etiam P1S/cum rep. P3/cum hoc: simul R/duos illorum
 (83): duas illarum R 83 propinquos: propinquas R/duos: duas R/remotos: remotas
 R/cum hoc (84): etiam R 84 se rep. C1/qui: quod R/punctus: punctum R
 85 duorum: duarum R/qui: quod R

Et inveniet utrumque illorum remotorum magis remotum a medio quam sit in rei veritate. Deinde cum experimentator cooperierit alterum visum, videbit duos dyametros, et videbit spatium inter eos maius quam in rei veritate secundum suam
 90 pyramidationem, quod autem est magis amplum de ipso est latitudo tabule. Et apparebit quod dyameter remotus a medio est dyameter qui sequitur visum coopertum.

[2.52] Ex quo declaratur quod duo dyametri qui videntur propinqui cum visio fuerit in utroque visu sunt illi quorum
 95 uterque videtur visu sequenti et quod duo dyametri remoti sunt illi quorum uterque videtur visu obliquo. Propinquitas autem duorum quattuor est quia, cum duo axes concurrerint in individuo posito in medio, tunc uterque dyametrorum comprehendetur a visu sequenti per radios valde propinquos axi, quapropter forme eorum propter hoc erunt in concavitate communis nervi valde propinqui centro. Et erit punctus sectionis eorum in ipso centro, unde videntur propinqui sibi et medio. Remotio autem duorum quattuor est quia uterque dyametrorum comprehendetur etiam alio visu obliquo ab ipso, quapropter
 100 comprehenditur per radios remotos ab axe. Et alterum comprehenditur per radios dextros ab axe, et reliquum per radios sinistros ab axe alio, quapropter forme eorum instituentur in concavitate communis nervi remote. Infiguntur enim in duabus partibus contrariis in respectu centri, et cum hoc remotis a centro, unde duo dyametri habent duas formas propinquas sibi et
 110 duas formas remotas a se. Quare vero comprehenditur remotio utriusque remotorum a medio maior quam sua remotio vera est quia remotio que est inter duos dyametros comprehenditur ab utroque visu maior quam sit in rei veritate. Et hoc apparet
 115 quando experimentator cooperit alterum visum et inspexerit

86 utrumque . . . remotorum: utramque illarum remotarum R/remotum: remotam R; corr. ex remotorum Er 88 cooperierit: cooperuerit R/visum rep. P3/duos: duas R/et inter. L3 89 eos: eas R/maius om. P1; corr. ex magis L3 90 autem om. EP3 91 remotus: remota R 92 qui: quae R 93 duo: duae R/qui: quae R 94 propinqui: propinquae R/visio corr. ex viso L3/illi . . . uterque (95): illae quarum utraque R 95 visu . . . videtur (96) mg. a. m. E/sequenti: sequente R/duo: duae R; om. P1S/remoti: remotae R 96 illi . . . uterque: illae quarum utraque R 97 duorum: duarum ex R/cum inter. E 98 uterque: utraque R 99 sequenti: sequente R 100 communis (101): communi S 101 propinqui: propinquae R 102 propinqui: propinquae R 103 duorum: duarum ex R/uterque: utraque R 104 comprehendetur: comprehenditur C1EErL3P3R/ante etiam scr. et del. p Er/post etiam inter. ab L3 105 et . . . alio (107) om. P1S/alterum: altera R 106 reliquum: reliqua R 107 eorum: earum R 108 infiguntur: infiguntur P1RS/enim: etiam P1S 109 contrariis om. P3/cum hoc: etiam R 110 duo: duae R 111 comprehenditur: comprehendatur R 112 utriusque: utrius P3/remotorum: remotarum R/post quam add. sit R 113 duos: duas R 115 cooperit: cooperuerit R

per reliquum. Quare vero, quando experimentator cooperit
alterum visum et inspexerit per reliquum tantum, inveniet spa-
tium inter duos dyametros magis amplum quam in rei veritate
est, quia spatium quod est inter duos dyametros comprehendi-
tur ab utroque visu valde propinquum visui, et omne quod est
valde propinquum visui videtur maius quam sit in rei veritate.
Et causa huius declarabitur post cum loquemur de deceptioni-
bus visus.

[2.53] Ex consideratione igitur dispositionum dyametrorum
que sunt in tabula et individuorum positorum super eos non in
medio, apparet quod omne visum positum super axem com-
munem et comprehensum a visu per axem radialem compre-
hendetur in suo loco, sive comprehendatur uno visu et per
unum axem axium duorum visuum, sive comprehendatur per
duos visus et per ambos axes. Et declaratur quod omne visum
comprehensum per unum visum et per axem radialem, quando
visum non est super axem communem, comprehendetur in loco
propinquiori communi axi quam suo loco vero. Et hoc etiam
sequitur in eis que comprehenduntur per residuos radios preter
axem. Quoniam, cum visus comprehenderit rem visam secun-
dum quod est, et instituetur forma in concavitate communis
nervi in uno loco et continua sibi invicem secundum continua-
tionem rei vise, et punctus visi qui est super axem radialem
cum non fuerit super axem communem, videatur in loco pro-
pinquiori communi axi quam suo loco vero, tunc puncta resi-
dua etiam videntur in loco propinquiori communi axi quam
suo loco vero, quia sunt continuata cum parte que est apud ex-
tremum axis.

[2.54] Et si axes duorum visuum concurrent in aliquo viso

116 cooperit: cooperuerit R 117 reliquum: unum *ErP1S*/inveniet: inveniat R
118 duos: duas R 119 est¹ *rep. ErL3*/duos: duas R 121 post visui *scr. et del.* et
omne quod est visui *S*/maius: magis *PIP3S*; *corr. ex magis Er* 122 huius: huiusmodi
C1/loquemur: loquetur *S*/de *om. P1* 124 consideratione: consideratio *P1*/igitur *om.*
C1; *inter. L3* 125 eos: eas *R*/post eos *inter. et a. m. C1* 126 visum *om. P1S*
128 ante uno *scr. et del.* per duos visus *Er* 130 per *om. R* 131 ante per¹ *scr. et del.*
non est super axem *L3*/quando: quod *C1EErL3P3R* 132 comprehendetur:
comprehenditur R 133 propinquiori: propinquiore *R*/etiam sequitur (134) *corr. ex*
sequitur etiam *Er* 134 comprehenduntur: comprehenduntur *C1L3*; comprehenditur
Er/preter *mg. a. m. E*; *corr. ex pre P3* 135 cum: quando *Er* 136 et *scr. et del. C1*/
instituetur: instituta fuerit R 137 post nervi *add. in concavitate P3*/secundum: scilicet
P1S; *alter. in propter a. m. E* 138 punctus: punctum *R*/qui: quod *C1* 139 cum:
et *P1S*/propinquiori (140): propinquiore R 140 communi: omnium *Er*/communi axi
corr. ex omnium axium L3/tunc *om. P1S*/ante puncta *add. et ErP1S*/post puncta *add.*
sua *C1EL3P3R* 141 propinquiori: propinquiore *R*/quam *om. EErL3P3R*; *mg. a. m. C1*
144 concurrent: concurrerent *EErL3P3R*/aliquo: alio *Er*

145 extra axem communem, sequitur etiam ista dispositio, scilicet
 quoniam videtur in loco propinquiore communi axi quam suo
 loco vero. Sed ista positio raro accidit, cum enim illi axes
 duorum visuum concurrerint in aliquo viso, tunc in pluribus
 dispositionibus axis communis transibit per illud visum. Et
 150 nunquam axes duorum visuum concurrent in aliquo viso extra
 axem communem nisi per laborem aut per impedimentum
 cogens visum ad hoc, et hec dispositio non apparet in visis
 assuetis. Nam cum accidit hoc in aliquo viso, continget in
 omnibus visis continuis cum illo visu, unde positio visorum
 155 apud se invicem non transmutabitur propter hoc. Et cum
 positio illius visi in respectu visorum vicinantium non fuerit
 transmutata, tunc non apparebit transmutatio sui loci cum
 acciderit in visis assuetis. Quando ergo consideratur hec via
 predicta, declarabitur ex illa experientia quod hoc sequitur in
 160 omnibus visis in quibus concurrunt axes duorum visuum que
 sunt extra axem communem.

[2.55] Et etiam oportet experimentatorem accipere tres
 scrotulas pargameni parvas equales, et scribet in una verbum
 aliquod scriptura manifesta. Et in residuis scribet illam ean-
 165 dem partem, et in illa quantitate, et in illa figura, et ponat
 individuum unum in medio tabule, ut prius, et ponat alterum
 individuum super punctum K. Deinde applicet unam scrotu-
 lam cum individuo quod est in medio tabule, et aliam in punc-
 to K, et servet se ut positio eius sit sicut positio prime scrotu-
 170 le. Et ponat tabulam, ut prius fecit, et dirigat pupillam ad
 scrotulam que est in medio individuo, et intueatur illam. Tunc
 quidem comprehendet partem scriptam super illam certa com-

145 sequitur: sequetur C1EErL3P3; sequeretur R/etiam corr. ex aliam a. m. S
 146 quoniam videtur: quod videretur R/videtur: videbitur C1EErL3P3/propinquiore:
 propinquoire R 147 ista inter. a. m. S/illi: isti P1S/illi axes transp. EP3 148 con-
 currerint: occurrerint P1; alter. ex occurrunt in occurrerint S/viso: visu P1 149 axis
 communis transp. S/post illud scr. et del. i S/et . . . visuum (150) mg. a. m. S 150 con-
 current: concurrerent Er; concurrant L3 152 et corr. ex ut a. m. C1/et hec om. Er/in
 om. EErL3P3 153 accidit: acciderit R/post viso add. assueto C1EErL3P3R (scr. et
 del. C1) 154 visu: viso L3R/unde: unum S 155 apud: inter R 156 visi om.
 P1S/visorum vicinantium transp. L3/vicinantium: incinantium Er/non: cum P1
 158 quando ergo: cum igitur C1EErL3P3/via: vita Er; una S 159 hoc sequitur
 transp. S 162 accipere inter. L3/post accipere add. scilicet EP3/tres . . . pargameni
 (163): pargameni tres scrotulas C1EErL3P3 163 scrotulas: schedulas R/pargameni:
 pargamenum EErP3/scribet: scribat R 164 scribet: tribus L3; scribat R
 165 quantitate: qualitate P1S/illa² om. Er/ponat: ponatur P1 166 unum om. P1S/
 post ponat add. etiam C1EErL3P3R 167 scrotulam (168): schedulam R 169 servet
 se: observet R/eius om. P1S/sit . . . positio mg. a. m. S/post positio add. eius P1S/scrotule
 (170): schedulae R 171 scrotulam: schedulam R 172 quidem om. P1R

prehensione. Et comprehendet cum hoc in illa dispositione ali-
am scrotulam et partem scriptam in ea, sed non bene declara-
tam sicut est pars consimilis illi que est scripta in media scro-
tula, licet sint consimiles in figura, forma, et quantitate.

[2.56] Deinde in hac dispositione oportet experimentator-
em accipere tertiam scrotulam manu sequenti punctum K, et
ponat illam in verticatione duarum scrotularum que sunt in
tabula et in rectitudine extensionis lineae que est in latitudine
tabule que est in superficie tabule quantum ad sensum, sed
tamen sit remota a tabula. Et huiusmodi verticatio vocetur
verticatio facialis. Et observet se experimentator ut positio
tertie scrotule et positio partis que est in illa, quando ponit
scrotulam, sit similis positioni duarum scrotularum que sunt in
tabula. Et tunc figat ambos visus in scrotula posita in medio, et
dirigat pupillam ad ipsam, et tunc quidem comprehendet
tertiam scrotulam, si non fuerit multum remota a tabula, sed
comprehendet formam partis que est in ea dubitabilem et non
intelligibilem. Et non inveniet illam sicut invenit formam partis
similis illi que est in medio tabule, nec sicut invenit formam partis
que est apud punctum K, dum ambo visus direxerint pupillam
ad scrotulam que est in medio.

[2.57] Deinde auferat experimentator individuum quod est
apud punctum K et scrotulam que est in illo, et appropinquet
tunc scrotulam quam tenet in manu quousque applicet eam ad
latus scrotule applicate cum individuo posito in medio, et pre-
servet se quod scrotula sit perpendicularis super lineam posi-
tam in latitudine. Et diriget pupillam, sicut prius, ad scrotu-
lam positam in medio. Tunc quidem in medio comprehendet

173 comprehendet cum hoc: cum hoc comprehendet P3/cum hoc: simul R/post
dispositione scr. et del. et comprehendet cum hoc in illa dispositione S 174 scrotulam:
schedulam R/in ea inter. a. m. S/non inter. a. m. S 175 consimilis: similis C1EErL3R/
scrotula (176): schedula R 178 scrotulam: schedulam R/sequenti: sequente R
179 scrotularum: schedularum R 181 que . . . tabule om. P1 182 huiusmodi:
huius R 183 facialis: facilis EP1P3; corr. ex facilis L3/se om. R 184 scrotule:
schedulae R 185 scrotulam: schedulam R/post scrotulam add. ut C1/similis: simul
P1; inter. EL3 (a. m. E)/scrotularum: schedularum R 186 scrotula posita: schedulam
positam R 188 scrotulam: schedulam R 189 dubitabilem: dubitabile Er; corr. ex
dubitabilis L3; alter. in dubitabitabilem S/et om. C1EErL3P3 190 intelligibilem:
intelligibile Er; corr. ex intelligibilis L3/illam: eam C1EL3P3/post sicut scr. et del. sicut S/
invenit: inveniet EP3 191 que: qui S/invenit: invenietur P3; alter. in inveniet a. m. E
192 K corr. ex E a. m. E 193 scrotulam: schedulam R 194 experimentator corr.
ex experimentatorem P1/est om. P1 195 punctum om. P3/scrotulam: schedulam R;
scrotula S/illo: eo EP3 196 tunc: ad ErL3; om. C1EP3R/scrotulam: schedulam R/
quam: que P3/ad: et Er; corr. ex et L3 197 scrotule: schedulae R/applicate corr. ex
applicata P3/posito: sito EP3 198 quod scrotula: ut schedula R 199 scrotulam
(200): secundam ErP1; schedulam R; corr. ex secundam L3S (a. m. S)

ambas partes que sunt in duabus scrotulis comprehensione manifesta et certificata, et non erit inter formas duarum partium in declaratione et certificatione differentia sensibilis.

[2.58] Deinde experimentator moveat scrotulam quam
 205 tenet in manu motu subtili super lineam positam in latitudine tabule, et preservet se ut situs eius sit sicut erat prius. Et intendat certificare scrotulam que est in medio, et intueatur bene duas scrotulas in hoc statu. Tunc quidem videbit scrotulam motam quod quanto magis removetur a medio, tanto di-
 210 minuitur declaratio partis que est in ea. Cum igitur venerit apud punctum K, tunc inveniet formam partis intelligibilem, sed non tanto quanto cum erat apud suam applicationem cum secunda que est in medio.

[2.59] Deinde experimentator moveat scrotulam etiam, et
 215 extrahat illam a tabula, et removeat illam paulatim et paulatim in verticatione lineae posite in latitudine. Et intueatur considerans optime, et dirigat pupillam ad scrotulam positam in medio. Quoniam tunc inveniet scrotulam motam quod quanto magis removetur a medio, tanto minus apparebit pars scripta
 220 in ea, adeo quod non erit intelligibilis omnino. Deinde cum moverit illam post hoc, videbit illam quod quanto magis removetur a medio, tanto magis latebit forma illius partis scripte in ea.

[2.60] Et etiam cooperiat experimentator visum qui sequi-
 225 tur punctum T, et figat tabulam in eadem dispositione, et dirigat pupillam unius visus qui sequitur punctum K ad scrotulam positam in medio. Et applicet aliam scrotulam ad latus scrotule posite in medio, sicut fecit prius. Tunc quidem inveniet partem que est in alia scrotula manifestam etiam, inter

201 duabus: duobus *Er*/scrotulis: schedulis *R* 202 *post inter add. duas C1EL3P3R*
 204 moveat: movea *P1*; *corr. ex movet a. m. C1E*/scrotulam: schedulam *R* 205 motu
om. P1 206 tabule *om. C1EL3P3* 207 scrotulam: schedulam *R*/in *inter. L3*
 208 scrotulas: schedulas *R*/scrotulam motam (209) *om. R* 209 *post magis add.*
schedula mota R/removetur corr. ex movetur L3/post tanto add. magis R 211 *K corr.*
ex E a. m. E 212 tanto quanto: tantum quantum *R*/erat: esset *R* 213 secunda:
 scrotula *C1EP3*; schedula *R* 214 moveat *corr. ex movet a. m. E*/scrotulam: schedulam
R/etiam et *transp. C1L3* 215 removeat *corr. ex removet C1; corr. ex removea P1*
 216 posite in latitudine: in . . . posite *P3* 217 ad scrotulam *om. P1*; scrotulam:
 schedulam *R* 218 inveniet: inveniat *C1L3*/scrotulam motam *om. R/post quod add.*
schedula mota R/quanto: quam P3 219 *ante a scr. et del. a movetur L3/a medio*
om. P1S 220 non *om. Er; inter. L3/non erit transp. EP3R* 221 hoc: hec *C1/post*
magis add. illa R 222 latebit *om. Er/post latebit scr. et del. pars scripta in ea adeo quod*
erit non intelligibilis omnino E/scripte: scriptis Er 225 figat *corr. ex fiat Er*
 226 scrotulam (227): schedulam *R* 227 scrotulam: schedulam *R* 228 scrotule:
 schedulae *R*/scrotule posite *transp. P3/prius om. P3* 229 scrotula: schedula *R*/
 manifestam: manifesta *Er*/etiam: et *EP3; om. P1RS*

230 quam et scrotulam positam in medio non est differentia sensibi-
lis. Deinde moveat secundam scrotulam, ut primo fecit, et
intendat scrotulam positam in medio, et dirigat pupillam ad
ipsam. Tunc quidem inveniet partem que est in secunda scro-
tula apud motum latere, et cum pervenerit ad punctum **K**, tunc
235 erit inter suam certificationem in hoc statu et suam certificatio-
nem apud applicationem suam cum ea que est in medio differ-
entia sensibilis. Deinde moveat hanc scrotulam, et extrahat
illam a tabula, ut primo fecit, et intueatur scrotulam positam
in medio. Tunc quidem inveniet quod scrotula mota quanto
240 magis removetur a medio, tanto magis diminuitur declaratio
que est in ea, adeo quod forma eius non erit intelligibilis; et
quanto magis post removetur a medio, tanto magis latebit.

[2.61] Apparet igitur ex hac consideratione quod manifes-
tissimum visibilium facialium visui que comprehenduntur
245 ambobus visibus est illud quod est apud concursum duorum
axium, et quod est propinquius concursui duorum axium est
manifestius remotiori, et quod forma remoti visi ad concursum
duorum axium est non certificata, etsi comprehendatur utro-
que visu. Amplius apparet ex hac consideratione quod mani-
250 festissimum visibilium facialium que comprehenduntur uno
visu est illud quod videtur per axem radialem, et illud quod
est propinquius illi est manifestius quam illud quod est remo-
tius, et quod remotum visum a radiali axe habet formam dubi-
tabilem non certificatam. Amplius apparet quod visus non
255 comprehendit rem visam que est remotorum dyametrorum vera

230 scrotulam: schedulam R 231 scrotulam: schedulam R/ut inter. L3; corr. ex in
a. m. Er 232 post intendat inter. in C1/scrotulam: schedulam R 233 inveniet:
invenient EL3P3/partem: per eam EErL3P3; corr. ex per eam a. m. C1/scrotula (234):
schedula R 234 latere corr. ex late C1 235 in . . . certificationem (236) inter. L3
236 post ea scr. et del. ea Er 237 moveat corr. ex movet a. m. C1/hanc inter. L3/
scrotulam: schedulam R 238 intueatur corr. ex intuetatur E/scrotulam: schedulam
R/positam in medio (239): in . . . positam R 239 scrotula: schedula R 240 magis¹:
minus R/magis²: minus EErL3P3R; corr. ex minus a. m. C1; alter. ex maius in minus
a. m. S 241 non: omnino R; om. Er; inter. L3; non erit transp. EL3P3S 242 post
om. P1R 243 igitur: ergo R/post igitur add. quod EP3/quod: cum Er/quod
manifestissimum (244) alter. in cum manifestissimo L3/manifestissimum (244):
manifestissimo Er 244 ante visibilium add. est EP3/facialium: facilius EP3/visui:
visu ErL3/comprehenduntur: comprehenditur Er 246 concursui: cursui EErL3; corr.
ex cursui a. m. C1; corr. ex concursu S/post axium² rep. et . . . axium P1 (ante et scr. et del.
est) 247 remotiori: remotiore P1RS/quod mg. C1/ad concursum: a concursu C1/
concursum: cursum Er 248 post axium scr. et del. et quod est propinquius cursui
duorum axium E/etsi: licet R/post etsi add. quis L3P3 (inter. a. m. L3) 250 visibilium
om. Er/facialium corr. ex facilius a. m. E 251 visu corr. ex viso L3/quod¹ om. Er/illud²
om. C1 252 est propinquius transp. P3 253 quod om. P1S 254 post apparet
add. ex hac C1 255 comprehendit corr. ex comprehenduntur P1/remotorum:
remotarum R

comprehensione nisi moveat radialem axem super omnes eius
 dyametros et super omnes eius partes, sive comprehensio sit
 ambobus visibus sive uno. Visus enim, cum fuerit fixus in
 oppositione visi quod est maximorum dyametrorum, non com-
 260 prehendit totum vera comprehensione, sed solummodo illud
 quod est supra axem et prope certificata comprehensione.
 Residue vero partes eius, et illud quod remotum est ab axe
 scilicet, comprehendit, sed non certe, licet visum sit faciale—et
 indifferenter sive comprehensio sit utroque visu sive uno
 265 tantum.

[2.62] Postea oportet experimentatorem accipere parga-
 menum quattuor digitorum in omni dimensione in quo scribat
 lineas scriptura subtili, tamen manifesta et intelligibili. Deinde
 auferat individuum positum super tabulam, et superponat
 270 tabulam prope visum, ut prius fecit, et erigat pargamenum
 super lineam positam in latitudine quod est in medio tabule.
 Et dirigat pupillam utroque visu ad medium pargameni, et
 intueatur ipsum. Quoniam tunc inveniet scripturam que est in
 pargameno apertam et intelligibilem, sed tamen scriptura que
 275 est in medio pargameni est manifestior quam que est in extre-
 mis quando visus direxerit pupillam ad medium pargameni et
 non fuerit motus super omnes eius dyametros.

[2.63] Deinde obliquet pargamenum adeo quod secet line-
 am positam in latitudine in puncto posito in medio tabule, qui
 280 est punctus sectionis. Obliquatio autem pargameni super line-
 am positam in latitudine sit parva. Et inspiciat ambobus visi-
 bus medium pargameni. Quoniam tunc inveniet scripturam
 legibilem, sed non tantum quantum cum pargamenum erat
 faciale.

285 [2.64] Deinde experimentator debet obliquare pargamenum
 obliquatione maiori prima ita quod medium eius sit super
 punctum sectionis, et dirigat etiam pupillam utroque visu ad

257 eius om. P1 259 maximorum: maximarum R 260 solummodo: solum R
 261 supra: super C1EL3P3R/post certificata add. scilicet C1EErL3P3R 262 est
 om. P1S 263 comprehendit: comprehendit EL3P3; comprehendetur P1RS/faciale
 corr. ex facile L3 264 post sit add. in C1 266 post postea add. ergo EP3
 267 dimensione: divisione R 268 tamen corr. ex cum a. m. C1 269 superponat:
 super Er; alter. ex supponat in ponat L3 271 quod: quae R 272 pargameni corr.
 ex pargamenum P3 273 intueatur: intuetur Er; corr. ex intuetatur C1/ipsam: ipsam
 P3; alter. in ipsam a. m. E/inveniet: invenient L3 274 tamen om. P3 275 est³ om.
 P1S/extremis (276) corr. ex tremis S 276 direxerit: direxerat P1 277 eius om.
 C1L3P3/eius dyametros corr. ex dyametros eius Er 279 qui: quod R 280 punc-
 tus: punctum R/autem: enim L3 283 post quantum add. est pargamenum C1/
 pargamenum erat om. P1 286 obliquatione corr. ex obliquare P3/maiori: maiore R/
 quod: ut R 287 etiam om. R/utroque visu transp. EP3

medium eius. Tunc quidem videbit scripturam latentior
 290 prima. Deinde etiam obliquet pargamenum paulatim paulatim
 ita quod medium eius semper sit in puncto sectionis, et intueatur
 eam successive. Et tunc inveniet scripturam latere apud
 obliques pargameni, et quanto magis pargamenum fuerit
 obliquum, tanto magis latebit scriptura, adeo quod pargame-
 num appropinquet lineae extense in medio longitudinis tabule.
 295 Et tunc scriptura que est in pargameno videbitur multum dubi-
 tabilis, et fere non intelligibilis et non certificata.

[2.65] Deinde oportet experimentatorem revertere parga-
 menum ad primam positionem, et erigere ipsum super lineam
 positam in latitudine, et cooperire alterum visum, et inspicere
 300 pargamenum reliquo visu. Et tunc inveniet scripturam mani-
 festam et legibilem. Deinde obliquet pargamenum, ut prius
 fecit, et inspiciat ipsum uno visu. Et tunc inveniet scripturam
 latentior quam cum erat apud oppositionem facialem. De-
 inde obliquet pargamenum plus paulatim paulatim, et intueatur
 5 ipsum multoties. Et tunc inveniet quod quanto magis
 obliquatur, tanto magis latet pars scripta, adeo quod pargame-
 num appropinquet diametro qui sequitur visum apertum.

[2.66] Declarabitur ergo ex hac consideratione quod mani-
 festissimum visibilium que sunt super axem radialem est illud
 10 quod est faciale visui, et illud cuius positio est magis facialis
 est manifestius illo cuius positio est minus facialis, et quod
 illud quod est obliquum ab axe radiali obliques maxima
 est dubitabile et non intelligibile, sive visio sit utroque visu sive
 uno.

15 [2.67] Deinde oportet experimentatorem revertere indivi-
 duum quod erat super tabulam, et ponere ipsum in medio tabule,
 et applicare ipsum ad punctum sectionis, ut in prima con-

288 latentior: latentior *P1* 289 obliquet: obliquet *C1*/paulatim² *om. P1; inter. L3*
 290 ante ita *scr. et del. prima S*/quod: ut *R* 291 latere *corr. ex late C1* 292 obli-
 quationes: obliques *C1L3*/post magis *scr. et del. per S*/fuerit: fuit *L3* 293 quod:
 ut *R* 294 appropinquet: appropinquet *C1EL3P3*/post longitudinis *scr. et del. to S*
 295 est *inter. L3*/dubitabilis (296): durabilis *P1* 296 non¹ *om. Er; inter. L3* 297 re-
 vertere: vertere *R*; *corr. ex resistere a. m. C1* 299 alterum *om. C1L3* 300 reliquo:
 reliqua *Er*/visu *corr. ex usu S* 2 fecit *corr. ex sit L3* 3 facialem *corr. ex faciem L3*
 4 post paulatim¹ *add. et C1R*/paulatim² *inter. L3* 5 quod quanto *corr. ex quanto*
 quod *Er* 6 obliquatur: obliques *P1S*/post latet *scr. et del. s C1*/pars: per *P3*/quod:
 ut *R* 7 appropinquet: appropinquet *C1EErL3P3* 8 ergo: igitur *C1EErP3; om. L3*
 9 sunt *om. Er; corr. ex est C1L3 (a. m. C1)*/post est *scr. et del. sunt C1* 10 faciale *corr. ex*
 facile *L3*/post et *add. quod R*/illud: istud *S* 11 est¹ *om. P3*/post quod *add. est L3*
 12 post illud *scr. et del. quod est illud L3* 13 et *om. E*/visio sit *transp. C1L3*/visu sive:
 visus *P1* 15 oportet: oportebit *C1EErL3P3*/reverttere: vertere *R* 16 ipsum in
 medio *corr. ex in . . . ipsum Er*/in . . . ipsum (17) *inter. L3* 17 applicare: ampicare *Er*

sideratione. Deinde erigat pargamentum super alteram partem
linee posite in latitudine super verticationem facialem, et diri-
gat pupillam utroque visu ad individuum positum in medio. In
hac quidem dispositione comprehendet pargamentum et scrip-
turam que est in ipso, sed illud quod vicinatur individuo posi-
to in medio erit manifestum, et quod remotum est ab illo est
dubitabile et latens. Et quanto magis removetur ab individuo,
tanto magis latet.

[2.68] Et etiam oportet experimentatorem obliquare parga-
mentum in hoc statu ita quod secet lineam positam in latitudine
super aliquod punctum alterius eius partis, et sit parva obli-
quatio. Et dirigat pupillam ad individuum positum in medio.
Tunc quidem videbit scripturam que est in pargameno laten-
torem quam cum erat facialis. Deinde obliquet plus parga-
mentum, et dirigat pupillam ad individuum positum in medio.
Tunc quidem videbit scripturam dubitabilem, non manifestam
nec legibilem.

[2.69] Deinde oportet experimentatorem cooperire alterum
visum et inspicere uno visu, et revertat pargamentum in sua
prima positione, et erigat ipsum super partem linee posite in
latitudine que sequitur visum insipientem, et dirigat pupillam
unius visus ad individuum positum in medio. Tunc quidem
comprehendet etiam scripturam que est in pargameno, et vide-
bit illam que est prope individuum manifestiorem remota, et
videbit illam que est remotissima ab individuo dubitabilem et
non legibilem.

[2.70] Deinde obliquet pargamentum ita quod secet lineam
positam in latitudine super punctum partis super quam erat
erectum, et inspiciat individuum positum in medio illo eodem
visu. Tunc quidem videbit scripturam que est in pargameno
dubitabilem et illegibilem magis quam cum pargamentum erat
faciale. Deinde obliquet pargamentum magis paulatim paula-

19 facialem: radialem P1; corr. ex facilem P3 20 post pupillam add. in L3/indi-
viduum corr. ex dividuum S 22 vicinatur: intueatur P3; propinquum est R
23 in medio inter. L3; mg. a. m. C1/remotum om. P1 24 post individuo add. posito in
medio C1 (posito mg. a. m.) 26 etiam: iterum R 27 quod: ut R 28 punctum
mg. a. m. Er/post parva add. eius P1 29 post pupillam add. per P1 30 latentiorem
(31) corr. ex latiore C1L3 31 obliquet: obliquat C1ErL3 33 post scripturam scr.
et del. que est in pargameno C1/non: nec P1; inter. P3 34 nec mg. a. m. C1/post nec
add. et C1 36 uno om. Er/revertat: revertatur C1; vertat R 37 super om. Er
38 sequitur: sequuntur C1L3 40 etiam scripturam: et scriptam P1 42 remotissima:
remotissimam P1 44 quod: ut R 45 latitudine: latitudinem EP1/erat rep. P3
47 que est om. P1; est om. L3 48 et om. P1S/illegibilem: legibilem Er/erat: erit P1S
49 faciale: facile L3/post paulatim¹ add. ac R/paulatim (50) inter. a. m. S

50 tim, et videbit quod quanto magis obliquatur pargamentum,
tanto magis latet scriptura.

[2.71] Apparet igitur ex hac consideratione quod visum
quod est faciale est manifestius viso obliquo, etsi visum non
fuerit super axem radialem et fuerit extra axem. Visum enim,
55 quando multum est obliquum, latet multum, etsi sit super
axem radialem, sive visio sit utroque visu sive uno tantum.

[2.72] Et etiam oportet experimentatorem auferre individu-
um a tabula, et erigere pargamentum super extremum tabule,
et superponere finem eius fini latitudinis tabule quod est **CD**,
60 et dirigat pupillam utroque visu ad medium pargameni. Quo-
niam tunc inveniet scripturam manifestam et legibilem.

[2.73] Deinde obliquet pargamentum ita quod secet latitu-
dinem tabule super punctum **Z** quod est in medio latitudinis
tabule, et dirigat pupillam utroque visu ad medium pargame-
65 num. Tunc quidem videbit scripturam latentiorum quam prius.
Deinde addat in obliqutatione pargameni paulatim paulatim, et
videbit scripturam latere paulatim paulatim, adeo quod, si
obliquatio pargameni fuerit maxima, videbit scripturam valde
latentem in eadem dispositione in qua erat quando considera-
70 batur in medio tabule; et similiter si consideraverit ipsum in hoc
loco uno visu.

[2.74] Deinde oportet experimentatorem ponere individu-
um super punctum **Z** et erigere pargamentum super alteram
partem latitudinis apud extremum tabule, sicut fecit in medio
75 tabule, et diriget pupillam ad individuum positum in medio, et
intueatur pargamentum, et consideret scripturam. Tunc quidem
videbit dispositionem sicut videbat eam quando erat in medio
tabule, sive consideretur utroque visu sive uno.

[2.75] Deinde oportet experimentatorem etiam experiri
80 scrotulas parvas quas prediximus apud extremum tabule, et

50 obliquatur: obliquabit C1L3 51 latet: latebit C1EL3P3R 52 igitur: ergo R
53 quod scr. et del. L3/est¹ om. L3/visio: visu EP3/etsi: quamvis R; corr. ex sed si a. m. C1/
visum: visus C1 54 et fuerit: sed R 55 quando: quanto Er/etsi: licet R/post etsi
add. non C1EErL3P1P3RS 56 visio sit: viso sive P3/post sit add. in ErP1S
57 etiam: iterum R 58 a: ex P1 (inter.)/post erigere scr. et del. extremum P1 59 fini
latitudinis: similitudinis Er/quod: qui R 60 pargameni: pargamentum P3 62 par-
gamentum om. P3/quod: ut R 63 quod corr. ex quo C1 64 ad rep. P1/
pargamentum (65): pargameni C1 66 obliqutatione: obliqutationem C1/post paulatim¹
add. et C1R 67 post paulatim¹ add. et R/post paulatim² scr. et del. paulatim P3/quod:
ut R 68 videbit: videat R 70 post si scr. et del. z C1/ipsam P1/ipsam
... loco (71): in hoc ... ipsum P3 72 oportet experimentatorem transp. S 75 diri-
get alter. in dirigat C1 76 post intueatur add. ipsum P1/quidem: enim EL3P3R; corr.
ex enim a. m. C1 77 quando: quanto L3/post quando scr. et del. r Er 78 post tabule
add. et diriget pupillam L3/visu: usu P1 80 scrotulas: schedulas R/parvas corr. ex
per L3/post parvas add. per C1

- videbit dispositionem in eis sicut cum erant in medio, scilicet quoniam pars que est in media scrotula est manifestior parte que est in scrotula remota a medio. Et quanto scrotula magis est remota a medio, tanto magis latebit pars. Sed tamen videbit quod remotio a medio apud quam latet pars posita in extremo, quando consideratio fuerit apud extremum tabule, proportionalis est ad remotionem a medio apud quam latet pars posita in extremo, quando consideratio fuerit in medio tabule, est enim secundum remotionem radiorum exeuntium ad extremum ab axe. Proportio igitur remotionis apud quam latet forma posita in extremo a forma posita in medio ad remotionem forme posite in medio a visu est eadem proportio in consideratione apud medium tabule et in consideratione apud extremum eius.
- [2.76] Et similiter etiam si experimentator abstulerit tabulam et posuerit inde pargamenum in quo est scriptura in maiori distantia quam longitudo tabule sit, et ubi possit legere illam, et fuerit faciale visui, et intueatur ipsam, deinde obliquaverit ipsum in loco suo, inveniet scripturam latere. Et si magis obliquaverit, magis latebit, ita quod, si multum obliquaverit ipsum, adeo quod positio eius sit propinqua positioni radiorum exeuntium ad medium eius, tunc videbit scripturam que est in pargameno latentem valde, adeo quod non possit legi. Et hoc videbit sive consideretur utroque visu sive uno tantum.
- [2.77] Et similiter, cum fixerit aliquam scrotularum parvarum in loco opposito visui remotiori quam sit longitudo tabule, et posuerit ipsam facialem visui, et direxerit pupillam ad ipsam utroque visu, et posuerit aliam scrotulam obliquam super illam aut dextrum aut sinistrum, et erexerit eam ita quod sit facialis, inveniet eam latentiorem.
- [2.78] Deinde si aliquis moverit secundam scrotulam et

82 quoniam: quando P1; quod R/scrotula: schedula R 83 scrotula¹²: schedula R/
magis est (84) *transp.* P1R 84 tamen: cum Er 85 quam: quem ErL3; *corr.* ex quem
a. m. C1 86 apud . . . fuerit (88) *mg. a. m. E*/proportionalis est (87) *transp.* C1EErL3P3R
87 pars posita (88) *transp.* C1L3 88 medio *corr.* ex extremo C1 89 exeuntium *corr.*
ex extremum P3 90 quam *om.* P1 92 a visu *om.* R 96 inde *om.* C1EErL3P3R/
maiori: maiore R 97 illam: scripturam C1EL3P3R 98 intueatur: intuetur P3/
post intueatur *scr. et del.* p Er/ipsam: ipsum R 99 loco suo *transp.* C1EErL3P3R
100 si multum: simul cum P1S/ipsam: ipsam P1 101 quod: ut R 102 que est
om. C1EL3P3R/in *om.* C1; *inter.* L3 103 pargameno: pargameni C1/quod: ut R
104 videbit: videbitur C1; *corr.* ex videbitur P1 105 fixerit: fuerit C1/scrotularum:
scheduling R 106 remotiori: remotiore R 108 scrotulam: schedulam R/
obliquam: aliquam EP3 109 *post* illam *add.* scrotulam Er/dextrum: dextrorsum R/
sinistrum: sinistrorsum R/erexerit: erexerat P1; *corr.* ex exit L3/quod: ut R 111 scro-
tulam: schedulam R

removerit eam paulatim paulatim a scrotula ad quam dirigit pupillam, inveniet partem que est in scrotula que est in extremo quod quanto magis remotior est a secunda scrotula, tanto
 115 magis latet forma partis, adeo quod fiet illegibilis omnino. Et similiter, si consideraverit has duas scrotulas uno visu, inveniet talem dispositionem.

[2.79] Declaratur igitur ex istis considerationibus omnibus quod manifestissimum visibulum in omnibus remotionibus est
 120 illud quod est super axem radialem, et quod illud quod est propinquius axi est manifestius remotiore ab ipso, et quod visum remotum ab axe maxima remotione est dubitabilis forme et non certificabilis, et indifferenter sive visio sit uno visu sive utroque, amplius et quod visum faciale est in omnibus remotio-
 125 nibus manifestius viso obliquo, et quod quanto magis positio visus appropinquatur positioni faciali, tanto erit manifestius, et quod visum obliquum super lineas radiales obliquate maxima habet formam multum dubitabilem et non certificata-
 130 tam, sive visio sit uno visu sive utroque, et sive visum sit super axem sive extra axem.

[2.80] Quare vero visum multum obliquum est dubitabilis forme, licet remotio eius sit mediocris, et licet magnitudo sit comprehensa secundum quod est, et quare visum faciale est manifestius obliquo, hoc est quia forma visi multum obliqui
 135 instituitur in superficie visus congregata propter suam obli-
 quationem. Quoniam, cum visus fuerit multum obliquus, tunc angulus quem subtendit visum super centrum visus erit parvus, et pars visus in qua instituitur forma illius visi erit minor mul-

112 *post paulatim*¹ *add. et R/paulatim*² *om. P3/a* scrotula: ad scrotulam L3; *corr. ex ad*
 scrotulam C1/scrotula: schedula R 113 *post pupillam add. et P1/partem*: quod
 forma partis R/scrotula: schedula R 114 quod: et P1; *om. R/magis om. EP3/post*
 magis *add. illa R/secunda alter. in prima a. m. C1/scrotula: schedula R* 115 forma
 partis *om. R/quod fiet: ut fiat R* 116 *si corr. ex sed S/scrotulas: schedulas R*
 118 considerationibus: dispositionibus EP3; *corr. ex dispositionibus L3/post*
 considerationibus *add. vel dispositionibus C1* 119 quod *alter. ex qui in quid L3/post*
 quod *add. quidem C1* 120 radialem: radiorum C1EErL3P3 121 remotiore:
 remotiori C1EErL3P3 122 *post axe scr. et del. m C1* 123 *et*¹ *om. C1EL3P3R/post*
 sive¹ *add. sit L3/visio corr. ex viso P3/post sit add. in P1/uno visu corr. ex utroque visu*
 P1/post sive² *add. in P1* 124 *et: etiam R* 125 visio *corr. ex visu Er/quod om. P3*
 126 visus appropinquatur: visi appropinquat R 127 visum *corr. ex visus a. m. C1/*
 visum obliquum: visus obliquus EErL3P3/post radiales *scr. et del. ob P3/obliquate*
corr. ex obliquas L3; corr. ex obliques EP3 128 multum: multam L3; *corr. ex*
 multam C1/multum dubitabilem *transp. EP3* 129 *ante sive*¹ *add. a visu EErL3P3R;*
*mg. visu a. m. C1/sit*¹: fiat C1/et *inter. L3* 131 *post visum scr. et del. o Er/multum om.*
 C1/est: sit R 132 eius *om. P1S* 133 faciale *corr. ex obliqui L3/est*²: sit R
 134 hoc: haec R/quia: quod P1S 136 cum visus *transp. P3/multum om. P3*
 137 *post visum add. quod Er/super: per Er; corr. ex per L3/super . . . visus corr. ex cen-*
 trum . . . super Er 138 multum (139): multo R

tum parte in qua instituitur forma eius si fuerit faciale visui.
 140 Et partes eius parve subtenduntur apud visum angulis insensibilibus propter maximam obliquationem, pars enim parva, cum multum fuerit obliqua, tunc due lineae exeuntes a centro visus ad extrema illius partis parve fient quasi una linea; quapropter sentiens non comprehendet angulum contentum
 145 inter eas neque partem quam distinguunt ex superficie visus.

[2.81] Et visum multum obliquum erit dubitabile, quia forma eius que infigitur in visu erit congregata maxima congregatione, et partes eius parve erunt insensibiles, et ideo forma eius erit dubitabilis. Et ideo, si in huiusmodi viso fuerint sub-
 150 tiles intentiones, non comprehenduntur a visu propter latentiam suarum partium parvarum et propter congregationem forme. Visum autem faciale est econtrario, nam forma eius que instituitur in visu erit ordinata secundum quod est in superficie visi, et partes eius parve que possunt comprehendi a visu er-
 155 unt manifeste. Et cum partes parve visi fuerint manifeste et ordinate in superficie visus secundum suam ordinationem in superficie visi, tunc forma erit manifesta et non dubitabilis.

[2.82] Et universaliter intentiones subtiles, et partes subtiles, et ordinatio partium visi non comprehenduntur a visu
 160 vera comprehensione nisi cum forma imprimatur in superficie membri sentientis et instituaturs quelibet pars eius in parte sensibili superficiei membri sentientis. Et cum visum fuerit multum obliquum, tunc forma eius non imprimetur in visu, nec forme aliquarum partium parvarum infigentur in parte sensibili
 165 visus. Hoc enim non fit nisi quando visum est faciale, aut quando obliquatio eius fuerit parva, et fuerit remotio eius cum hoc ex remotionibus mediocribus in respectu intentionum que

139 instituitur: instituuntur P1S/eius: illius C1EL3P3R/post eius inter. visi a. m. L3; scr. et del. visi erit minus multum parte in qua instituitur forma illius E 140 subtenduntur: sustentantur EEerL3P3R; corr. ex sustentantur a. m. C1 142 fuerit: fuerint E 143 parve: et EP3; corr. ex et L3; om. ErR/fient: fuerit P3/post quasi scr. et del. vel P1 144 comprehendet: comprehendit C1EL3P3R 145 distinguunt: distinguit C1EL3P3R 146 post multum add. et EP3 147 infigitur: infigetur P1S 149 eius rep. P1/erit om. P1P3/viso: visio P1/subtiles intentiones (150) transp. C1L3 150 intentiones corr. ex tentiones a. m. E/comprehenduntur: comprehenduntur P1S 151 parvarum om. P1S/propter om. P1S 152 visum corr. ex visus L3/est om. P1S 154 visi corr. ex visu L3 155 et... manifeste om. C1EL3P3R 156 suam ordinationem transp. Er 157 post visi add. et C1R 158 et²... subtiles (159) inter. a. m. S 159 partium visi corr. ex visi partium P3 160 imprimatur: imprimitur R 161 et... sentientis (162) mg. L3/instituatur: instituitur R 164 forme: forma C1L3/aliquarum corr. ex obliquarum L3/infigentur: infigetur C1ErL3/post parte scr. et del. senbili P3/sensibili corr. ex sensibile Er 165 non inter. a. m. Er/est: fuerit R 166 cum hoc (167): simul R 167 post respectu add. remotionum vel C1/intentionum: remotionum P3; corr. ex remotionum EL3 (a. m. E)

sunt in illo viso.

[2.83] Comprehensio vero magnitudinis visi obliqui multum
 170 secundum quod est, cum fuerit in remotione mediocri, licet
 obliquatio eius sit maxima, non est ex ipsa forma visi que in-
 stituitur in visu tantum, sed ex ratione extra formam, scilicet
 ex hoc quod comprehendens comprehendit diversitatem dua-
 rum remotionum duorum extremorum eius cum hoc quod com-
 175 prehendit mensuram forme. Et cum visus comprehenderit
 diversitatem remotionum duorum extremorum visi multum
 obliqui, et comprehenderit differentiam maximam inter eas, sta-
 tim virtus distinctiva ymaginabitur positionem illius visi, et
 comprehendet mensuram eius secundum diversitatem remotio-
 180 num duorum extremorum eius, et secundum mensuram partis
 in qua instituitur forma, et secundum mensuram anguli cui
 subtenditur illa pars apud centrum visus, non solummodo ex
 ipsa forma. Et cum virtus distinctiva comprehenderit diver-
 sitatem remotionum duorum extremorum visi multum obliqui,
 185 et comprehenderit obliquationem eius, statim percipiet con-
 gregationem forme. Comprehendit igitur mensuram eius cum
 senserit quantitatem obliquationis eius, non secundum men-
 suram forme, sed secundum positionem eius. Et partes parve
 et subtiles intentiones que sunt in viso non possunt compre-
 190 hendi ratione si visus non senserit illas partes aut illas inten-
 tiones.

[2.84] Latentia igitur forme visi accidit ex congregatione
 forme eius in visu et ex latentia partium eius parvarum. Et
 apparentia forme visi, cum fuerit in remotione mediocri, est
 195 propter impressionem forme in visu secundum quod est et
 propter hoc quod sentit visus partes eius parvas.

[2.85] Quare igitur forma visi maxime obliqui est dubitabi-
 lis, forma autem visi facialis est manifesta declaratum est.

169 vero: enim C1EErL3P3/visi om. P1S 170 remotione . . . licet: remotionibus
 mediocribus et P1S 171 post est add. hec forma C1EErL3P3 172 visu:
 viso C1EErL3P3 174 duorum om. R/eius mg. a. m. E/post cum add. omni EP3
 175 post et add. enim P1S/comprehenderit: comprehendit C1P1S 176 remotionum:
 remotionis EP3R/visi corr. ex nisi a. m. Er 177 comprehenderit: comprehendit P1S
 178 ymaginabitur: ymaginabit P1 180 et inter. C1/partis . . . mensuram (181) om. P3
 181 anguli om. P1/cui subtenditur (182): quem subtendit C1EErL3P3R 184 remo-
 tionum om. P1RS 185 comprehenderit: comprehendet P1S/percipient: perciet P1
 186 ante forme scr. et del. e E/forme: fore S/comprehendit: comprehendet C1
 187 quantitatem . . . eius: obliquationis . . . quantitatem P1/obliquationis eius transp. P3
 188 positionem: positiones P1S/eius om. P1 189 viso corr. ex visio Er 190 ratione
 mg. a. m. C1 192 forme: forma P3/visi corr. ex nisi a. m. L3 194 apparentia corr.
 ex apparentie L3 197 visi . . . obliqui: obliqui visi maxime P1S/est: sit R 198 faci-
 alis: superficialis P1S/est¹ om. P1S/manifesta: manifestam L3/est² om. P3

[2.86] Hiis autem declaratis, incipiendum est de sermone
 200 de deceptione visus et declarare causas et species earum.

[CAPITULUM 3]

*Tertium capitulum de causis quibus
 visui accidit deceptio*

[3.1] Declaratum est in ipso primo tractatu quod visus
 nichil comprehendit ex visibilibus que sunt cum eo in uno aere
 5 que recte comprehendit nisi visus congregaverit has intentio-
 nes, et sunt: remotio; [et] oppositio; et lux; et hoc quod corpus
 eius sit aliquantum; et quod sit densum aut habeat aliquam
 densitatem; et quod aer medians inter ipsum et visum sit
 diafonum continue diafonitatis in quo nullum corpus densum
 10 interponatur. Hiis igitur existentibus et visu inspiciente salvo
 ex occasionibus et impedimentis, visus comprehendet illud
 visum. Si autem visus caruerit aliquo istorum, non comprehen-
 det visum quod caret illo.

[3.2] Declaratum est etiam in secundo tractatu quod visus
 15 nullum visibile comprehendit nisi in tempore; ergo et tempus
 etiam est unum eorum que exiguntur ad hoc quod visus com-
 pleatur.

[3.3] Et sanitas visus etiam.

[3.4] Et declaratum est in capitulo predicto quod, cum
 20 visum fuerit extra axem radialem et remotum ab eo, non
 comprehendetur a visu certificata comprehensione, licet sit
 faciale. Et declaratum est etiam quod, si visum fuerit obliqu-
 um super lineas radiales maxima obliquate, non compre-
 hendetur a visu vera comprehensione, licet sit super axem
 25 radialem et oppositum medio visus. Visus igitur non compre-
 hendit visum secundum quod est, licet sit oppositum ei, nisi
 cum fuerit visum in propria positione, scilicet cum fuerit faci-

199 *post autem add. itaque C1; add. ita P3/incipiendum: insipiendum Er/est om. P1S/*
de: in C1EErL3P3; a R 200 *deceptione: conceptione Er/et¹ om. C1/declarare causas:*
deklarandae caussae R 4 *nichil om. VaV2/visibilibus corr. ex visibus O* 5 *recte:*
ratione V2/nisi visus scr. et del. O/congregaverit: congregavit OP1V2 6 *post remotio*
add. et O 8 *sit om. V2* 9 *continue: commune S* 11 *ante et scr. et del. immediatis*
P1/comprehendet . . . non (12) mg. a. m. S/illud: illum O 13 *ante visum scr. et del.*
illud S 15 *comprehendit: comprehendet S* 16 *etiam om. FP1VaV2/unum:*
unus V2 18 *visus om. V2* 19 *et om. P1/post est add. etiam OS/post cum scr. et*
del. s V2 20 *visum: visus O* 21 *post sit scr. et del. i P1* 22 *faciale corr. ex*
facile V2 23 *non om. Va; inter. a. m. V2* 25 *igitur: ergo OS* 27 *faciale (28)*
corr. ex facie O; corr. ex facile V2

ale visui aut fere, et cum fuerit cum hoc super axem radialem aut prope.

30 [3.5] Intentiones autem quibus completur comprehensio visi secundum quod est sunt octo: remotio prima; oppositio; lux; aliqua quantitas corporis; densitas; diafonitas aeris; tempus; sanitas visus. Hiis igitur omnibus aggregatis visum comprehenditur vera comprehensione, et si visum caruerit aliquibus 35 istorum et cum hoc fuerit comprehensum a visu, tunc non comprehenditur vera comprehensione.

[3.6] Dicamus igitur quod unumquodque istorum in respectu uniuscuiusque visibilium habet latitudinem in qua visus comprehendit visum secundum quod est, et dum ista fuerint 40 congregata in visu et unumquodque eorum fuerit in latitudine mediocri secundum quam completur comprehensio visi secundum quod est, tunc visus comprehendet illud visum secundum quod est. Et si unum istorum aut plura uno pertransierint illam latitudinem multum, visus non comprehendet illud visum 45 secundum quod est. Visum enim valde remotum a visu non comprehenditur a visu vera comprehensione, et similiter valde visum propinquum visui non comprehenditur a visu vera comprehensione, et inter duas has extremitates sunt plures remotiones ex quibus visus comprehendit visum vera comprehensione 50 sine dubio. Sed tamen remotiones ex quibus visus comprehendit rem visam vera comprehensione sunt ad aliquem terminum, et nulla earum erat maxima nec in remotione nec in propinquitate; et in unoquoque visibilium sunt secundum illud visibile. Visibile enim magni corporis comprehenditur a visu vera comprehensione in remotione in qua latet visum parvi corporis, et 55 similiter visum fortis lucis comprehenditur a visu ex remotione ex qua latet visum debilis lucis.

[3.7] Et etiam visum quod non est oppositum medio visus sed obliquum a medio maxima obliquatione cuius nulli parti 60 occurrit axis radialis nec propinquat non comprehenditur a

31 sunt *corr. ex sicut P1* / oppositio: positio FSVaV2; *corr. ex positio a. m. P1* 33 ante sanitas *add. et O* / sanitas *corr. ex sanitatis V2* / igitur: ergo S 34 aliquibus (35): aliquid V2 35 post a *scr. et del. us F* 39 post visum *add. illud OS* 41 secundum quam: qua O / comprehensio *corr. ex comprehensi O* 43 post uno *scr. et del. tran P1* / pertransierint: pertransiverint P1 44 post multum *add. tunc OS* 45 quod *inter. a. m. FVa* / non . . . visu (46) *om. P1* 46 comprehenditur: comprehendetur V2 / post visu *scr. et del. sola Va* / vera comprehensione *transp. VaV2* 47 comprehensione (48) *om. VaV2* 48 remotiones (49): intentiones FP1VaV2 50 visus *om. FP1VaV2* 51 ad *inter. O* 52 et *om. V2* / earum: eorum O 54 visibile: visum O 55 in¹ *inter. O* / visum *inter. O* 58 medio *corr. ex medium O* / visus *corr. ex visuor P1* 59 sed: si V2 60 occurrit *corr. ex occurrunt O* / non: nec FP1VaV2

visu vera comprehensione. Et visum quod comprehenditur
 duobus visibus in quo non occurrunt axes duorum visuum, et
 radii consimilis positionis cuius situs apud duos visus non est
 positio consimilis, non comprehendetur a visu vera compre-
 65 hensione. Et visum oppositum medio visus super cuius ali-
 quod punctum erit axis radialis aut prope, cum non fuerit
 maximorum dyametrorum, comprehendetur a visu vera com-
 prehensione, etsi axis non moveatur per omnes eius
 dyametros. Et visum comprehensum duobus visibus in quo
 70 concurrunt duo axes radiales et in quo concurrunt radii
 consimilis positionis cuius positio apud duos visus est
 consimilis, comprehendetur a visu vera comprehensione. Et
 visum faciale visui aut modicum obliquum comprehendetur a
 visu vera comprehensione, sed parva obliquatio in qua visus
 75 comprehendit rem visam certe est secundum intentiones que
 sunt in viso. Et similiter remotio ab axe radiali parva in qua
 comprehenditur visum certe est secundum intentiones que sunt
 in viso, visum enim in quo non sunt subtiles intentiones
 comprehenditur a visu certe, licet sit extra axem radialem
 80 tamen remotum parva remotione. Et similiter comprehenditur
 certe cum fuerit obliquum super lineas radiales parva
 obliquatione. Visum autem in quo sunt subtiles intentiones
 non comprehendetur certe cum fuerit extra axem radialem et
 fuerit sua remotio ab axe sicut remotio ex qua comprehenditur
 85 certe forma visi in quo non sunt subtiles intentiones. Et
 similiter non comprehendetur forma eius certe si fuerit
 obliquum super lineas radiales tali obliquatione in illa in qua
 comprehenditur certe forma visi in quo non sunt subtiles
 intentiones.
 90 [3.8] Et etiam visum in quo est modica lux et non bene il-
 luminata non comprehendetur a visu vera comprehensione, et
 maxime cum fuerint in eo subtiles intentiones. Et similiter vi-
 sum fortiter luminosum et lucidum aut visum tersum super
 quod oritur fortis lux non comprehendetur a visu vera compre-

61 *ante et scr. et del.* et visum comprehenditur O/*post et scr. et del.* (??) Va 62 quo
om. P1 65 *ante et add.* et visum etiam super quod sunt oblique linee radiales maxima
 obliquatione non comprehendetur a visu vera comprehensione O/*super:* sicut V2
 67 *post visu scr. et del.* a P1 68 axis: *ante VaV2* 70 duo . . . concurrunt *inter.*
a. m. S 72 *post consimilis add.* positionis cuius positio apud duos visus est consimilis
 FP1SVaV2 (*scr. et del. Va*) 73 faciale *corr. ex facie O/aut:* ad V2 74 obliquatio:
 obliquatione P1 76 *post ab scr. et del.* a O 77 certe . . . sunt (78) *mg. a. m. S*
 80 tamen: cum V2 85 visi: nisi V2/*non om. V2* 86 forma . . . certe: certe . . .
 eius OS 90 illuminata (91) *corr. ex luminata O* 91 *ante et scr. et del.* et inter lucem
 fortem et lucem scintillantem sunt plures luces ex quibus V2 94 quod *om. P1*

95 hensione. Et inter lucem debilem et lucem scintillantem sunt
plures luces ex quibus visus comprehendit rem visam vera
comprehensione. Et etiam lux in qua visus comprehendit for-
mam visi vera comprehensione erit secundum intentiones que
sunt in viso et secundum magnitudinem visi. Visum enim in
100 quo non sunt subtiles intentiones etiam comprehenditur a visu
in parva luce in qua potest latere forma visi habentis subtiles
intentiones. Et similiter visum magni corporis comprehenditur
a visu in parva luce in qua potest latere visum minimum.

[3.9] Et visum etiam, cum fuerit valde parvum et fuerint in
105 eo subtiles intentiones et partes distincte, non comprehendetur
a visu vera comprehensione, ut animalia quorum membra sunt
distincta, et figura membrorum eorum et membra, adeo sunt
parva quod visus non potest comprehendere. Talia enim ani-
malia, si comprehendantur a visu, non certe comprehenduntur.
110 Cum autem corpus animalis est magnum, tunc membra erunt
sibi proportionalia, et tunc visus comprehendet unumquodque
illorum membrorum distinctorum. Et sic comprehendet for-
mam eius secundum quod est. Et similiter omnia visibilia in
quibus sunt intentiones valde subtiles non certe comprehen-
115 dentur a visu. Et si ille intentiones fuerint proportionales
visibilibus magni corporis, tunc visus comprehendet illa visi-
bilia vera comprehensione si ille intentiones fuerint propor-
tionales visibilibus.

[3.10] Et etiam cum visum fuerit diafonum et fuerit in eo
120 aliqua densitas parva valde, non comprehendetur a visu vera
comprehensione. Et cum non fuerit diafonum, aut fuerit in eo
parva diafonitas et densitas eius fuerit manifesta, comprehen-
detur a visu vera comprehensione. Et quanto magis diafonum
fuerit tenuioris coloris, tanto magis indigebit maiori densitate,
125 et quanto magis fuerit fortioris coloris, tanto magis poterit
comprehendi a visu cum parva densitate cum qua visum tenuis
coloris non poterit comprehendere vera comprehensione. Et
erunt invisibilia que sunt in aere medio inter visum et rem vi-

95 debilem: fortem *FP1SVaV2* 97 post comprehendit *scr. et del. cer P1* 98 erit:
est *O* 99 enim *corr. ex ergo S* 100 etiam: non *O* 101 latere *corr. ex labere V2/*
forma: formam *V2* 103 post latere *scr. et del. forma P1* 105 comprehendetur:
comprehenduntur *P1SVa* 106 ut: et *V2/sunt om. O* 107 sunt parva (108)
transp. VaV2 108 ante talia *add. ea O* 109 ante si *scr. et del. quorum membra sunt*
distincta *V2/comprehenduntur: comprehendetur P1* 110 erunt *om. FP1SVaV2*
112 illorum *corr. ex eorum P1* 114 comprehenduntur (115): comprehendetur *FP1;*
comprehenduntur *VaV2* 115 si *om. VaV2* 116 corporis *corr. ex corpore O*
121 non *om. O* 122 parva *om. FP1VaV2* 124 indigebit: videbit *S* 125 poterit
... non (127) *mg. a. m. S* 126 densitate: diversitate *O* 127 post coloris *scr. et del.*
tenuit *P1* 128 erunt *inter. O/invisibilia: visibilia S*

130 sam cum ille aer fuerit spissus et turbidus, ut sunt nubule, et
fumi, et similia. Et quando illa visibilia sunt subtilia aut fue-
rint in eis intentiones subtiles, non comprehenduntur a visu vera
comprehensione. Et similiter, quando aere in medio interpone-
tur corpus diafonum visui et rei vise in quo corpore fuerit ali-
qua spissitudo, illud visum non comprehendetur a visu vera
135 comprehensione. Si autem aer fuerit clarus diafonus et subtilis
et consimilis diafontitatis, et non interponatur in ipso corpus
densum, tunc visus comprehendet visibilia que sunt in illo aere
vera comprehensione. Et similiter, si in aere fuerit aliqua spis-
situs parva et fuerint in eo visibilia non minima carentia
140 intentionibus subtilissimis, tunc visus comprehendet illa visi-
bilia vera comprehensione, et non impediatur ab illo aere, licet
sit spissus aliquantulum. Spissitudo autem aeris in quo visum
comprehenditur vera comprehensione est secundum intentio-
nes que sunt in viso, visum enim in quo non sunt intentiones
145 subtiles comprehendetur certe a visu in aere in quo quidem est
aliqua spissitudo in quo aere non comprehendetur certe visum
aliud in quo sunt subtiles intentiones.

[3.11] Et etiam visum, cum fuerit motum motu valde veloci
et cum pertransierit spatium in quo comprehendetur a visu in
150 minimo tempore, non comprehendetur a visu vera comprehen-
sione. Verbi gratia, quando aliquis respicit a foramine a quo
est motus ultra quod aliquod visum movetur motu velocissimo
valde, et comprehenderit visus illud visum ab illo foramine,
tunc visus non comprehendet quiditatem eius, nec certificabit
155 formam eius bene. Si autem fuerit motum in oppositione visus
per spatium non maxime magnitudinis in tempore sensibili,
tunc comprehendetur a visu certe.

[3.12] Et etiam motus velocissimus circularis, ut motus
troci, non comprehendetur a visu, licet trocus comprehendatur,
160 et comprehendet trocum aut corpus motum per motum troci
quasi quiescens. Et similiter motus tardissimus non compre-

129 ut *om.* *VaV2*/nubule: nebule *OV2* 130 quando: quanto *P1* 131 subtiles *om.*
FP1VaV2/comprehenduntur: comprehendetur *FP1SVa* 132 aere in *transp.* *O*/in
inter. *O* 133 visui *corr.* ex viso *O* 136 post in *scr.* et *del.* ipso *F* 139 eo:
ipso *OS* 140 comprehendet: comprehendit *Va* 141 illo: alio *V2*; *corr.* ex illa *P1*/
post licet *scr.* et *del.* licet *S* 142 autem *inter.* *S* 144 ante que *scr.* et *del.*
comprehendetur certe *S*/intentiones subtiles (145) *transp.* *OS* 145 in². . . aere (146)
om. *VaV2*/quidem: non *O* 146 post visum *scr.* et *del.* aut *P1* 147 aliud *om.* *OV2*
148 motu *om.* *V2* 149 cum *om.* *O*/post quo *scr.* et *del.* erat *Va* 152 motu *om.* *V2*
154 certificabit: certificat *VaV2* 156 maxime magnitudinis *transp.* *FP1VaV2*/
sensibili: insensibili *P1* 158 etiam *inter.* *S* 160 comprehendet: comprehendat
FP1SVaV2; *corr.* ex comprehendat *O*/per motum *om.* *FP1VaV2*

hendetur a visu in parvo tempore, et comprehendetur in tempore sensibili quasi quiescens et immobile.

[3.13] Sanitas habet latitudinem. In quadam enim infirmitate minutie corporis visi absconduntur, in minori percipiuntur.

[3.14] Et generaliter quilibet situs in quo non verificatur forma rei vise sicut est in veritate est situs egressus a temperantia ad rem illam proportionata. Egreditur autem situs rei vise a temperamento in longitudine, vel propter maximum longitudinis excrementum vel maximam eiusdem diminutionem. In situ fit egressio a temperantia per maximam ab axe elongationem, per situs corporis respectu duorum visuum diversitatem, per maximam eius declinationem. In luce egressum a temperamento efficit fortitudo eius maxima vel debilitas nimia; in magnitudine diminutio quantitatis rei vise; in soliditate raritatis intentio; in aere nimia eius spissitudo; in tempore nimia eius duratio; in visus sanitate debilitas visus magna vel eius immutatio secundum egritudinem.

[3.15] Habet autem temperamentum latitudinem que sic patebit. Viso aliquo corpore sicut est, et paululum a visu elongato vel adducto, dum videtur distans a veritate insensibili proportionem adhuc est de temperamento, et ita donec proportionalis sit et sensibilis apparentie immutatio. Mensuratur etiam temperamenti latitudo in quolibet istorum secundum proportionem eius ad alia septem, et secundum colorem et partium corporis parvitatem. Igitur, latitudo temperamenti longitudinis attenditur et secundum colorem, et secundum minutias que in corpore fuerint, et secundum lucem et sex alia que dicta sunt.

[3.16] Secundum coloris varietatem, quoniam corpus fortis et acuti coloris a maiori longitudine percipitur quam obtusi et

164 *post* sanitas *add.* autem C1/habet latitudinem *transp.* C1/quadam *corr.* ex quadam *Er* 165 visi: nisi EP3 167 a temperantia (168): ad temperantiam P3
 168 *post* rem *add.* visam R/*post* illam *add.* visam P1S/*autem* situs *transp.* *Er*
 169 propter: per P1 170 eiusdem: eius R/*post* eiusdem *scr. et del.* in C1/
 diminutionem (171): diminutione S 171 egressio *corr.* ex regressio L3 172 per:
 quod EP3/*post* visuum *add.* per C1 173 *ante* per *add.* et C1/eius: eiusdem *Er*
 174 temperamento: temperantia EP3R/eius maxima *transp.* *ER* 175 nimia: minima P1 177 nimia: minima R; *alter.* in minima a. m. C1/*post* nimia *scr. et del.* est L3/
 visus¹ *om.* R/magna: maxima C1EL3P3R 180 sicut est *om.* R/*et:* etiam *Er*; *inter.*
 C1/paululum: paulatim P3L3; *corr.* ex paulatim a. m. C1E 181 elongato: elongatio
Er; *corr.* ex elongatio P3/*dum* *corr.* ex deinde L3/a: in C1 183 apparentie *corr.* ex
 apparente a. m. C1; apparentem L3/immutatio: mutatio EL3P3R 184 etiam: et
 P1S/quolibet: quodlibet EP3 186 et *inter.* L3/parvitatem *corr.* ex quantitatem C1
 187 et¹ *om.* C1/*et*² *om.* S/*post* secundum² *add.* etiam S 188 *post* corpore *add.* priore
 P1/fuerint: fuerunt P1 190 *post* secundum *add.* etiam C1 191 obtusi: obscuri R

debilis, unde latitudo temperamenti longitudinis maior est proportionata ad colorem fortem quam ad debilem.

[3.17] Similiter si fuerint in corpore viso note notabiles, a
195 maiori longitudine comprehenduntur quam si multum parve,
unde maior est longitudinis temperantia respectu partium cor-
poris notabilium quam respectu minutarum.

[3.18] Pari modo maius erit temperamentum longitudinis
ad rectam corporis oppositionem proportionatum quam ad
200 eius declinationem. Similiter erit maius secundum propinqui-
tatem corporis ab axe quam secundum elongationem.

[3.19] Eodem modo, maior est temperamenti longitudinis
latitudo in forti luce quam in debili.

[3.20] Et maior si corpus visum fuerit magnum quam si
205 parvum.

[3.21] Similiter corpus multum solidum a maiori longitudi-
ne percipitur quam minus solidum, unde soliditati corporis
proportionatur longitudinis temperamentum.

[3.22] Ad qualitatem aeris proportionatur temperamentum
210 longitudinis, quoniam spissitudo aeris ab aliqua longitudine
corporum visui abscondit que ab eadem vel a maiori longitu-
dine claritas exponit.

[3.23] Temporis quantitati proportionatur temperamentum
longitudinis, quoniam in tempore aliquo motus corporis
215 percipitur ab aliqua longitudine et a maiori percipietur in
maiori tempore.

[3.24] Pari modo in aliquo modo santitatis visus a maiori
longitudine videbitur corpus quam in minori.

192 longitudinis: latitudinis P1S 193 post proportionata add. magis R/ad² om. C1;
inter. L3 194 corpore . . . note corr. ex viso . . . corpore Er/notabiles corr. ex notabi-
lis Er 195 longitudine: latitudine Er/comprehenduntur: comprehenduntur EP3;
corr. ex comprehenditur a. m. C1L3 196 est om. EErL3P3R; mg. a. m. C1/longitudinis:
latitudinis P1S/partium om. S 198 post pari add. vero L3/modo inter. a. m. L3/erit:
est R/longitudinis: latitudinis P1S 199 proportionatum: propositum P3; corr. ex
propositum a. m. E/quam: quod EP3 201 secundum om. EP3R/elongationem:
declinationem C1L3 202 temperamenti: temperati P1 203 latitudo inter. L3
204 post maior add. est latitudo C1S (inter. a. m. S)/post corpus add. visus Er/visum
om. P1 206 maiori: maiore R 207 soliditati: solidati P1P3S 208 longitudinis:
latitudinis P1; corr. ex latitudinis a. m. S 209 post temperamentum inter. cum L3
210 longitudinis: latitudinis P1; alter. in latitudinis a. m. S/post spissitudo add. corporis
C1L3/longitudine: latitudine P1; corr. ex latitudine a. m. S 211 corporum: corpora
C1EErP3R; corporea L3/post que scr. et del. ab S/a om. P1/longitudine (212): latitudine
P1; alter. in latitudine a. m. S 213 temperamentum corr. ex temporum L3
214 longitudinis: latitudinis P1; corr. ex latitudinis a. m. S 215 longitudine: latitudine
EErP1P3; corr. ex latitudine C1L3S (a. m. C1S)/maiori: maiore R/percipietur: percipi-
tur L3 216 maiori: aliquo P1; maiore R 217 post modo¹ scr. et del. in aliquo L3/
modo²: statu C1EErP3R; corr. ex statu L3/a maiori: in maiore R 218 longitudine:
latitudine P1S/quam corr. ex quem a. m. C1

[3.26] Similiter mensuratur temperamentum situs secun-
 220 dum proportionem factam ad longitudinem, ad colorem, ad
 minutias corporis, ad lucem, et ad alia que enumeravimus.

[3.33] Et tu considera et singulis adapta, et videre poteris
 defacili. Et eodem modo proportionabis temperamentum
 cuiuslibet istorum ad omnia alia, et videbis quod dictum est
 225 per singula.

[3.34] Quando ergo singula eorum que enumerata sunt
 fuerint in latitudine temperamenti sui, apparebit rei vise
 veritas forme sicut est in re. Quando autem non apparet
 forma sicut est in veritate, egressum est aliquid predictorum a
 230 temperamento aut plura eorum. Igitur causa quare errat visus
 in comprehensione formarum non est nisi egressus alicuius
 predictorum a temperamento aut plurimum, et hec dicenda
 in hac erant parte.

[CAPITULUM 4]

[4.1] Planum est ex libro secundo quod rerum fit compre-
 hensio per sensum, scientiam, sillogismum. Cum autem acci-
 dit error in eis quorum fit comprehensio per solum sensum,
 scimus quod est error sensus tantum. Cum in eis que per sci-
 5 entiam comprehendit quis erraverit, in scientia tantum error
 erit. Si vero in his que per sillogismum comprehenduntur erret
 quis, erit error in sillogismo tantum. Sensus acquirit lucem et
 colorem tantum, sicut dictum est.

[4.2] Scientia vero pretendit ea que prius sunt visa et in
 10 sensu habita, ut lux solis cognoscitur quod plurimum visa est,
 et inter lucem solis et lucem lune discernitur. Et licet fiat com-
 prehensio lucis per sensum tantum, tamen per scientiam acci-

220 longitudinem: latitudinem *EErP1P3*; *corr. ex* latitudinem *L3S* (*a. m. S*) 221 enum-
 eravimus: numeravimus *C1L3* 222 *et*²: de *C1/post* singulis *scr. et del.* *ada P1*
 223 defacili: de facili *Er*; facile *R*/proportionabis: probabis *EP3* 226 que enumerata
corr. ex enumerata que *S* 227 fuerint: fiunt *L3/rei* . . . forme (228): veritas forme rei
 vise *R* 228 *est om. L3/post re add.* visa *C1* 229 *post est*² *add. vel C1EErL3P3R*/ali-
 quid: aliquod *C1EErL3P3R* 230 causa quare *transp. P1/errat: erret R*; *corr. ex*
erat L3 232 plurimum: plurium *C1EL3*; *alter. in* plurium *Er* 233 in hac erant:
 erant in hac *P1* 1 *est om. C1ErL3*/rerum fit comprehensio (2): comprehensio . . . fit *R*
 2 *ante per add. tripliciter C1* 3 eis: hiis *EP3R* 4 scimus quod *om. P1S*/sensus *corr.*
ex sponsus P1/post cum add. vero R/eis: ijs R 5 comprehendit: comprehendet *S*/
post tantum scr. et del. err C1 6 *erret alter. ex erit in erit a. m. L3* 9 pretendit:
precedit S 10 sensu: visu *C1EErL3P3*/ut: inde *EErP3*; unde *C1/ante lux scr. et del. vel*
inde C1/est: sit R 11 *et*¹ *inter. L3/lucem*² *om. R/lucem lune transp. C1/lune: lumine*
E; *corr. ex* lumine *L3P3*/discernitur: decernitur *EP3/post* discernitur *add. per scientiam*
C1S (*inter. a. m. S*) 12 *post sensum scr. et del. lucis L3/tamen corr. ex* quando *C1*

dit distinctio lucium. Similiter accidit per scientiam notitia
figurarum, ut trianguli, quadrati, circuli, et aliarum similium.
15 Similiter notitia asperitatis, lenitatis, umbre, decoris, et simili-
um, per sillogismum fit comprehensio eorum, que supra expla-
navimus, licet ea non plurimum noverit sensus.

[4.4] Omnis autem comprehensio rerum continetur sub ali-
quo horum trium modorum, et cum error evenit in comprehen-
20 sione formarum, non accidit nisi in aliquo istorum.

[4.5] Accidit error sensui si corpus in quo sit multa color-
um particularium diversitas occurrat visui sub luce multum
debili, ut vestis aliqua diversis coloribus et in minutis picturata
apparebit unius coloris. Et erit error in sensu per lucem a tem-
25 peramento suo egressam, ceteris a temperantia non egressis.

[4.6] In scientia error accidit cum in magna longitudine
videtur aliquando homo notus existimatur esse alius similiter
cognitus, unde ab aliqua longitudine videns fratrem putat se
videre patrem vel aliquod in hunc modum. Et est error in
30 scientia propter egressum solius longitudinis a temperamento.

[4.7] In sillogismo accidit error, ut quando motis nubibus
existimatur esse lune motus. Et accidit error iste ex intempera-
ta longitudine, quoniam nisi longitudinis est temperantia non
evenit, ita ut baculum hic fundo aque infixum, et aquam super
35 eminentem in motu videmus, sed non lignum, et motum aque
transeuntis percepimus.

[4.8] Accidit autem error predictus in motu lune cum nubes
fuerint multe et continue, et causa eius est quoniam, sicut pat-
uit superius, non comprehenditur motus nisi per accessum
40 alicuius ad aliud vel recessum consideratum. Cum ergo pauci-

13 lucium: lucis C1EL3P3R/post lucium add. et C1L3 14 aliarum alter. in aliorum
a. m. C1 18 continetur: comprehenditur Er/aliquo (19): alio Er; corr. ex aliqua L3
19 horum trium transp. C1L3/evenit: accidit R 21 accidit: accidet C1 22 occur-
rat: occurrit EP3/visui: sensui P1S 23 ut: aut C1; corr. ex aut L3/in om. C1EErL3P3R
24 et . . error mg. a. m. S (error: heror)/per: propter C1EErL3P3 26 in²: a Er; om. P3;
inter. L3/longitudine: latitudine P1; corr. ex latitudine a. m. S 27 homo notus transp.
C1/notus corr. ex motus P3/post existimatur add. homo P3 28 post aliqua scr. et del.
sum solius longitudine a temperamento Er/longitudine: latitudine P1S/se om. P3
29 aliquod: aliquem C1EP3R; alter. in aliquem L3 30 longitudinis: latitudinis P1S
32 esse lune transp. P1/intemperata (33): temperata P1 33 longitudine: latitudine
P1S/post quoniam add. quando R/nisi: ubi P1; visi R/longitudinis: latitudinis P1S
34 ita ut alter. in ut L3/post ita scr. et del. baculum hic in aliquo loco fundo aque infixum
et aquam super venientem in motu etiam motum videmus seu lignum alia linea C1/ut
om. Er/hic om. R 35 eminentem: venientem C1/post motu add. etiam immotum
EP3R; add. etiam motum ErL3/sed non: seu EErL3P3/sed . . . lignum om. R/aque
transeuntis (36) transp. C1EL3P3R 36 percepimus: percipimus EL3 37 motu:
motis L3 38 fuerint: fiunt L3 39 comprehenditur: comprehenduntur Er

tas fuerit nubium, possumus discernere motus earum propter
uniuscuiusque ad stellam aliquam accessum apparentem aut
recessum. Cum ergo celum nubibus fuerit coopertum, propter
continuitatem earum non discernimus motum; verumtamen
45 lunam modo in parte una videmus, modo in alia, unde ipsam
motu celerrimo moveri concludimus. Eodem modo erit error
per situm a temperamento egressum.

[4.9] Et per unumquodque octo supra dictorum est compre-
hensio per sensum, per scientiam, et per sillogismum.

[CAPITULUM 5]

*Pars quinta, in modis erroris visus propter
sensum ex qualibet causarum errorem
sensui inducentium*

[5.1] Ex predictis palam quod non est comprehensio per
5 sensum nisi lucis et coloris tantum. Non ergo accidit error sen-
sui nisi in luce et colore, nec accidit error per lucem aut colorem
nisi propter intemperatam debilitatem eius aut fortitudinem,
vel propter colorum minutorum diversitatem et debilius. Et
hec colorum diversitas in luce debili venit ad oculum tamquam
10 aliquid obscurum et tenebrosus, et etiam in luce forti, quando
substantia colorum fuerit valde parva.

[5.4] Longitudo inducit errorem sensus. Cum temperata
fuerit elongatio corporis a visu, et fuerint in corpore partes
minute in coloribus diverse ad quas proportionata partium
15 elongatio sit intemperata, apparebit corpus illud unius coloris
tantum, quoniam extra temperantiam est longitudo respectu

41 discernere: decernere EP3/earum: eorum P3 42 uniuscuiusque: unicuiusque E/
ante ad add. nubis C1/stellam: similem P1; corr. ex syllogismam a. m. Er; corr. ex similem
a. m. S/aliquam: aliquem P1S/aut corr. ex et a. m. C1 43 ergo: vero C1EErL3P3R
44 continuitatem: concavitatem P1/discernimus: decernimus EP3 45 parte una
transp. EP3 48 est comprehensio (49): in comprehensione C1EErL3P3R 49 per³
om. C1 1 pars . . . inducentium (3) om. ErP1R/quinta inter. a. m. C1 3 sensui:
visui C1L3S 4 post palam add. est ErP3/quod om. L3; inter. C1/est: fit C1EErL3P3R
5 accidit error transp. R/error om. S 6 post colore add. tantum R/error om. C1EL3P3R
7 intemperatam corr. ex temperatam a. m. E; corr. ex intemperantam P3/aut: vel P3
(mg. a. m.) 8 vel: aut P1/propter om. P1S/diversitatem et debilius: debilius et
diversitatem R 9 colorum: corporum C1EErL3P1P3S 10 aliquid: ad P1S/
obscurum corr. ex obsti P3/et¹: aut C1EL3P3 11 colorum fuerit: oculorum est P1S
12 temperata: intemperata C1; alter. in intemperata L3 15 intemperata: temperata
P1S; corr. ex temperata a. m. E/post intemperata add. et L3/post apparebit add. enim R
16 longitudo: latitudo P1; corr. ex latitudo a. m. S

particularium, licet omnia alia convenient in temperantia. Et est error iste sensualis cum sensus comprehensivus sit coloris.

[5.7] Situs sensum errare facit. Cum maxima fuerit corporis
 20 is visi declinatio, occultabuntur visui minute eius particule. Et si fuerit in partibus minutis colorum diversitas, apparebit in totali corpore colorum unitas. Et accidit error propter situm tantum, quia opposito corpore visui in situ recto aliis sicut sunt immotis, percipientur et partes corporis et coloris cum
 25 solus situs egressus sit a temperamento. Idem error accidit ex situs intemperantia cum elongatio partium minutarum ab axe fuerit magna.

[5.8] Lux multum debilis errorem facit. Abscondit enim visui particulas corporis, et pretendit unitatem tenebrosi coloris.
 30 is. Et si lux ad temperantiam reduceretur, diversitas colorum aut diminutio partium non occultaretur quando lux sola extra temperantiam est sita.

[5.9] Magnitudo errorem invehit. Cum partes corporis minutissime dissimiles fuerint totali in colore, latebunt visum
 35 partes ille propter sui parvitatem, et similiter eorum colores. Et apparebit color unicus in corpore, magnitudine sola extra temperantiam sita, quod non appareret si parvitas partium temperamentum non exiret.

[5.10] Soliditas causa est erroris sensualis si remissa fuerit
 40 soliditas, ut in cristallo, unde cum superponitur ei corpus coloratum, videtur cristallum colore illo affectum propter soliditatis parvitatem a temperamento egressam, quod non accideret si cristallum magis solidum esset.

[5.11] Ex raritate aeris procedit error sensualis. Cum intercidit visum et corpus oppositum flamma, licet fortis coloris
 45

17 particularium: particularum C1; corr. ex particularum L3/ alia: altera P3; inter. a. m. E/ convenient: conveniat Er 18 comprehensivus: comprehensio L3/ comprehensivus sit transp. C1EErL3P3R/ ante sit add. unius C1L3 (scr. et del. C1) 19 post facit add. et P3/ post cum add. eis P1; add. enim S 20 post visi scr. et del. et L3/ visui om. Er; inter. L3/ et: sed C1 21 fuerit . . . minutis: in partibus . . . fuerit C1EErL3P3R 23 post in scr. et del. recto S/ recto corr. ex recedere a. m. C1 24 et¹: etiam R 25 solus corr. ex solius L3/ idem: item P1P3 26 intemperantia corr. ex temperantia E 28 post facit add. et P1S/ enim om. P1S 30 reduceretur: rediret P1S 31 non inter. L3/ occultaretur corr. ex occultarentur P1/ quando: quoniam C1EErL3P3R 33 invehit: inducit C1/ post cum add. enim EP3R 34 totali in transp. C1EL3P3R 35 sui: suam R 36 et om. Er 37 appareret: apparet EErL3P1P3S/ post partium add. extra R 39 est erroris transp. Er 40 superponitur: supponitur EErL3P1P3RS; alter. in superponitur a. m. C1/ superponitur ei transp. EP3R 41 cristallum: cristallus R/ colore illo transp. P1/ affectum: affecta R 42 egressam om. P3 43 cristallum: cristallus R/ solidum: solida R 44 intercidit (45): interciderit C1L3; inciderit P3 45 ante visum add. inter R

sit corpus visum, videbitur tenebrosum, et sola aeris raritas egressa est temperamentum.

[5.12] Tempus est causa erroris. Quoniam, si subito super corpus diversorum colorum fiat visus directio, apparebit color singularis donec prolongetur inspectionis duratio, luce dico sub qua comprehenditur corpus non forti.

[5.13] In luce enim debili non statim immutatur visus secundum quemlibet colorum particularium, quod accideret in luce forti.

[5.14] Visus aliquando errorem pretendit. Luce enim forti in visu cadente, leditur visus, et statim ad colorem alicuius corporis conversus ipsum tenebrosum recipit donec paululum steterit et lesio recesserit. Pari modo, cum aderit oculis infirmitas, occultabitur visui colorum veritas, unde error fit ex sola visus qualitate a temperamento recedente.

[5.15] Patet ergo quod accidunt errores visui secundum quodlibet predictorum considerati, et accidunt in sensu tantum cum ex solo sensu fiat comprehensio colorum.

[CAPITULUM 6]

*Pars sexta in modis erroris visus per
scientiam accidentis per quamlibet
causarum errorum visus*

[6.1] Dictum est in libro secundo quod non nisi per scientiam fit diffinitionis rei adquisitio. Provenit enim diffinitio ex similitudine vel dissimilitudine alicuius rei cum alia in communi forma.

[6.2] Et proprium est scientie communicare rem visui presentem cum re prius visa in forma recepta, et ex hac communicatione acquiritur diffinitio rei cuiuscumque. Diversificatur

46 aeris raritas *transp. R* 47 est *om. P3* 48 est *inter. L3* / causa *corr. ex tam P1* / quoniam: quando *C1* 53 quemlibet: quodlibet *L3P1S*; *corr. ex quodlibet a. m. C1* / colorum: colorem *EP3* 55 aliquando: autem *C1L3* 56 visu: visum *C1R* / cadente: carente *L3*; *corr. ex agente a. m. C1* 57 recipit *corr. ex respicit Er* / paululum: paulatim *C1L3* 58 pari *corr. ex parit L3* / oculis: oculi *R*; *corr. ex oculus Er* 59 fit: est *C1EErL3P3R* 60 post visus *scr. et del. a Er* 61 quod *om. Er* 62 considerati: consideranti *EL3* / accidunt: accidit *EL3P3*; *corr. ex accidit C1* 1 pars . . . visus (3) *om. C1L3P1R*; *mg. EErP3 (a. m. EEr)* / erroris *corr. ex errorum Er* 2 per: secundum *ErS* 3 causarum *corr. ex causam Er* 4 in *inter. a. m. E* / libro secundo *transp. EP3R* 5 provenit: pervenit *EL3P3R* / provenit enim *corr. ex pervenitur et certitudo cognitionis a. m. C1* / enim *om. L3* 6 dissimilitudine: assimilitudine *Er* 8 scientie *corr. ex scientia L3* / ante rem *scr. et del. vel communicare L3* 9 communicatione (10): coniunctione *Er*

autem scientia in scientia individui et universalis, aut utriusque, et omnis error scientie erit error in aliquo istorum aut in utroque.

[6.3] Cum ergo res aliqua aut alia aut alterius speciei apparet quam sit in rei veritate, erit error in diffinitionis assignatione, nec accidit error iste nisi aliquod istorum predictorum fuerit extra temperamentum.

[6.4-5] Error enim scientie in longitudine erit. Si a longitudine magna videatur homo notus, apparebit forsitan esse alius videnti notus, unde aliquando videns Petrum visum dicit esse Martinum, cum constet utrumque ei esse notum.

[6.6] In forma communi erit error. Si quis ab aliqua longitudine videat equum et putet se videre asinum, in utraque formarum—scilicet singularis et communis—est error, ut si quis a longitudine magna videt equum sibi notum et existimat se videre asinum sibi cognitum. Pari modo accidit error in arboribus triplex: in individuis, in communibus formis, in utrisque. Unde aliquando una amigdalus existimatur alia; aliquando a longitudine magna pirus magna apparet amigdalus; aliquando pirus Petri apparet amigdalus Martini. Eadem triplicitas erroris ex longitudine accidit plurimum in vestibis, lapidibus, et aliis.

[6.7] Aliquando videtur res incognita et contingit error in scientia, sicut si aliquis ignem viderit longe remotum in aere, existimat se stellam videre. Planum autem quemlibet errorem predictum cadere in scientiam cum in eo fiat assignatio diffi-

11 autem *om.* L3/scientia²: scientiam R/individui: ydee C1EErL3P3R/et *om.* C1EErL3P3R/post et *add.* forme communis P1S (post forme *scr.* et *del.* in P1)/post universalis *add.* aut singularis C1EErL3P3R 12 scientie: scientia EP1/erit *rep.* P1/aliquo *corr.* ex aliquid a. m. C1/aut *corr.* ex ut P3 14 aliqua *alter.* in alia *deinde corr.* ex alia a. m. C1/apparet (15): appareat C1 15 diffinitionis: diffinitionum P1S 16 nec: non P1; *inter.* L3/accidit: accidat L3/post accidit *add.* autem P1/aliquod: aliquid C1P1/istorum *rep.* P1;*om.* C1EErL3P3R/predictorum *om.* P1S 17 temperamentum *corr.* ex temperamento L3 18 enim *om.* C1EL3P3R/enim scientie: in scientia Er/in longitudine: propter longitudinem C1 19 notus: motus EP3/forsitan: forte P1/esse *om.* P3 20 notus: motus P3; *corr.* ex motus a. m. E/unde: unum S 21 post utrumque *scr.* et *del.* erit enim notum C1/ante ei *mg.* videnti a. m. C1/ei . . . notum *mg.* a. m. C1 23 in . . . asinum (26) *mg.* a. m. S/in ? S 24 est: erit C1/error ? S 25 magna: maxima C1EL3P3R/videt: videat R; ? S/existimat: aestimet R/se *om.* C1L3 27 in¹ *om.* P1S/communibus *corr.* ex communis S 28 amigdalus *corr.* ex amigdalus S/aliam *corr.* ex alius a. m. C1/aliquando²: a natura P1 29 pirus: prius S; *corr.* ex prius E/magna *om.* EErL3P3R/apparet: aestimatur R/aliquando: a natura P1 30 post Petri *scr.* et *del.* a C1/apparet: creditur C1EErL3P3R 31 post vestibis *add.* in P1 33 aliquando: a natura P1/incognita: ignota C1EErL3P3R 34 sicut: si cum C1EL3P3; sed cum Er/ignem viderit *transp.* EErP3R 35 post existimat *add.* forsitan C1EErL3P3R/autem: ante Er 36 in² *om.* L3

nitio[n]is rei vise que non est in ea veritate. Palam etiam quod
accidit error prefatus ex longitudine extra temperantiam exe-
unte. Ea enim ad temperamentum reducta, aliis erroris et
40 causis, sicut sunt, manentibus, non accidit error in scientia
predictus.

[6.8] Situs errorem infert scientie. Cum corpus aliquod
multum fuerit elongatum ab axe, non erit certa forme compre-
hensio. Unde aliquando in hoc situ Petrus existimabitur Mar-
45 tinus; aliquando equus putabitur esse asinus, sicut in arboribus
et vestibus; aliquando equus notus putabitur Brunellus. Et in
hac incertitudine fors[an] eligetur veritas, fors[an] falsitas. Cum
enim incertum sit in hoc situ iudicium, casualis erit electio.

[6.9] Accidit autem error ex intemperamento situs, quoni-
50 am, ipso ad temperantiam reducto, non errabit iudicium ex
scientia sumptum.

[6.10] Pari modo in magna corporis declinatione non veri-
ficantur particule minute, unde accidit in hoc situ error figure,
coloris, magnitudinis; fors[an] enim quadratum videtur circulare,
55 et ita in quantitate et colore.

[6.11] Egressio lucis a temperamento errorem inducit scien-
tie. Debilitas enim lucis nimia errorem infert forme, unde ac-
cidit error in crepusculis in animalibus, vestibus, arboribus—
scilicet triplex: vel in individuo, vel in specie, vel in utroque—
60 quod non accideret in temperata luce.

[6.12] Amplius, si fuerit egressus lucis a temperamento,
proportionato viso opposito visui, accidit error predictus, licet
non sit intemperata in se lux, sicut evenit in quadam ave ara-

37 *post ea add. in EErP3R/veritate corr. ex vertitate S/etiam alter. in ergo a. m. C1*
38 *temperantiam: temperamentum R* 39 *erroris: ex formis P1S/et om. C1EErL3P3R*
40 *sicut corr. ex sint C1/accidit: accidet C1EErL3S/scientia om. P1* 41 *predictus:*
predictis P1P3 42 *cum corr. ex ut C1 (mg. a. m.)* 43 *multum corr. ex punctum P1/*
fuerit scr. et del. P3 44 *aliquando: a natura P1/existimabitur: existimabatur P1*
45 *aliquando: a natura P1/post equus scr. et del. existimabitur L3/putabitur: existimabitur*
C1EErL3P3R/esse om. C1/sicut: sic EErP3/sicut . . . Brunellus (46) om. R/post sicut add.
etiam C1 46 *aliquando: a natura P1/notus: motus Er/Brunellus: Burnellus C1EErL3P1S*
47 *incertitudine: certitudine P1/forsan²: forte P1; forsitan S* 48 *incertum: certum*
P1S/incertum . . . situ: in hoc situ . . . sit R/situ: statu EP3R/erit electio transp. EP3R/
electio: electo Er 49 *ex corr. ex in C1* 50 *temperantiam: intemperantiam ErS; corr.*
ex intemperantiam C1L3 52 *ante non add. nisi S/non . . . minute (53) om. P1/*
verificantur (53): vertificantur Er 53 *post particule add. in C1* 54 *videtur om.*
C1EErL3P3 55 *ante et¹: add. putabitur C1/post ita add. error R/post colore add. fit*
error C1 56 *lucis rep. Er/post lucis scr. et del. et coloris P1* 57 *lucis nimia transp.*
C1L3/infert forme corr. ex forme infert P1/accidit error (58) transp. C1L3 59 *in¹ om.*
ErL3P1P3S 60 *accideret: accidet P3* 62 *proportionato: proportionate C1EErL3P3;*
corr. ex proportionatio S/viso: visui C1EErL3P3/visui om. C1EErL3P3/accidit: accidet
C1EErL3P3R/predictus corr. ex predictis P1

bice aluerach dicta. Non enim videri potest nisi de nocte.

65 Tamquam ignis de die vero, cum non plene discernatur, forsan papilio cui est similis putabitur. Et sic accidit error in diffinitione rei ex immoderata luce.

[6.14] Quantitas extra temperantiam suam errare facit scientiam, unde aliquando formica pre sui parvitate existimatur
70 musca tritico innata, et aliquando eadem causa sinapis granum reputatur nasturtium.

[6.16-17] Soliditas a temperamento egressa errorem efficit. Cum crystallo continuatur corpus rubeum, alia cristalli facie visui opposita, existimabit videns colorem cristalli esse rube-
75 dinem, unde error est scientie, quia in coloris diffinitione.

[6.18] Raritas aeris nimis diminuta erroris est causa, unde in eius spissitudine fit error in rei diffinitione. Similiter, si oculo et corpori viso interponatur corpus cuius raritas extra temperantiam est respectu raritatis aeris temperate, sicut est vitrum, existimabitur color corporis oppositi mixtus ex colore proprio et colore vitri. Et est iste error in coloris diffinitione. Pari modo, si anteponatur oculo pannus multum rarus et post illum videatur corpus, apparebit color corporis mixtus.

[6.20] Sed oritur questio quomodo post panni oppositionem appareat coloris corporis oppositi mixtura cum partiales corporis colores non accedant ad oculum nisi per panni foramen, et ex panno non accedat ad oculum color nisi ex filis eius per que non transit color corporis.

[6.21] Et huius rei veritas est quod, licet partiales corporis
90 colores singillatim veniant, et in sua loca cadant, nec commis-

64 dicta: dicte C1EErL3P3/post nocte add. egreditur enim lux a temperamento respectu illius percipitur autem de nocte C1EErL3P3R 65 tamquam: sicut R/cum non: non sit EP3/discernatur: deducta EP3/post discernatur add. et L3/forsan alter. in forsitan P1 66 sic om. C1EErL3P3R 68 post quantitas add. ergo C1L3/suam: sita C1EErL3P3R 69 aliquando: a natura P1/pre: propter P1/parvitate: parvitatem P1; corr. ex parvitate P3 70 tritico innata: tertio villata P1/et om. ErP1S/post aliquando add. in C1L3 (scr. et del. L3)/post eadem add. de R 72 post efficit add. ut C1EErL3P3R 75 est om. C1L3/quia: accidit C1 76 post raritas add. autem C1L3/unde om. P3 77 post eius add. enim P3/si: in Er 79 est¹ om. ErP1S; inter. L3/raritatis... temperate: aeris... raritatis EP3R 81 colore: colori L3; corr. ex colori a. m. C1/post vitri scr. et del. cata est C1/et est iste mg. a. m. C1/est iste: ita est EEerL3P3R/est iste error: ita error est P3 83 post corpus add. et L3 84 questio inter. L3/post quomodo scr. et del. post P1 85 oppositi: oppositioni P1S; om. EP3R/partiales: partialis EP3 86 corporis colores: coloris corporis C1EErL3P3/non om. EEerL3P3R; mg. a. m. C1/post non add. colores C1EL3P3 (post colores mg. non a. m. C1)/post oculum add. non C1EErL3P3R/panni foramen (87) transp. C1/foramen (87): foramina R 87 accedat: accidit EP3; accedit Er; accedit L3/color om. P3/eius om. P3 88 transit color: transeunt colores C1EL3P3R 89 huius: huiusmodi Er; rep. P3 90 singillatim: sigillatim EP1P3RS/commisceantur (91) corr. ex commiscantur C1

ceantur filorum coloribus, sed filorum colores sint ab eis separati intra visum et extra, nec sit ibi aliqua confusio, tamen, quia valde propinqua sunt puncta in que incidunt color corporis superficialis et color fili, cum non sit distantia sensibilis inter ea,
 95 videntur quasi punctus, unde colores illi apparent unus ex eis mixtus.

[6.22] Si autem magna sint panni foramina, discernetur et panni et coloris corporis veritas sine mixtura, et quanto compressior fuerit foraminum strictura verior apparebit mixtura,
 100 unde viso corpore post pannum lane videbitur mixtura colori plurimum consonans colorum filorum. Foramina enim panni lanei sunt in se stricta, et quoniam pilis panni teguntur, efficiuntur et strictiora.

[6.23-24] Aliud erroris ex raritate exemplum cum aliquis ioculator facit ymagine lignea moveri, umbre earum inspicienti per pannum, sicut solet fieri lineum subtilem, apparebunt
 105 aves aut animalia formis ymaginum consona, nec accidit error iste in diffinitionis assignatione nisi ex raritatis aeris diminutione.

[6.25] Temporis distantia preter temperamentum erroris scientie est causa. Si quis per foramen inspiciat corpus transiens veloci motu, non plene adquirit formam corporis, unde accidet error in individuo, in specie, vel in utroque, ut in equis, hominibus, arboribus. Similiter accidit etiam sine foramine; si
 110 quis subito aliquid videat quod statim a visu recedat errabit in comprehensione illius forme, unde forsitan erit error in specie, individuo, vel utroque. Et erit error iste in solo tempore.

[6.27] Visus solus errorem facit. Si lux solis fortis descen-

91 coloribus *corr. ex. corporibus Er* 92 ante intra *scr. et del. sint L3* 94 color fili:
 colorum filiorum *P1/fili: filii S* 95 illi: ibi *R* 97 autem: vero *R/sint: fuerit R/*
 discernetur *corr. ex discernatur P3* 98 coloris *corr. ex colores C1/quanto: quando Er/*
 compressior (99): comprehensor *C1 (mg. a. m.); corr. ex comprehen S* 99 strictura:
 structura *EP3; statura P1/post strictura add. tanto R/mixtura corr. ex structura E*
 100 viso *corr. ex visio P1* 101 enim *om. P1* 102 lanei *corr. ex lae L3/sunt in se:*
in se sunt C1EErL3P3R/panni om. C1EErL3P3R/teguntur: tanguntur P1 103 ante et
scr. et del. a L3/et: etiam Er; om. C1EL3P3R 104 aliud . . . exemplum: similiter *R/*
 erroris *corr. ex errans P1* 105 ligneas *corr. ex lineas P3/inspicienti (106): inspici-*
endo C1 106 lineum *corr. ex ligneum a. m. P3* 108 post aeris *scr. et del. diffi P1*
 110 distantia: instantia *EErP3; corr. ex instantia C1L3 (a. m. C1)/preter: extra R*
 111 post quis *add. enim C1EErL3P3R/corpus mg. a. m. C1* 112 adquirit: ad-
 quirat *C1EL3P3R* 113 accidet: accidit *C1EL3P3R/in¹ om. P1/vel: et C1; om. EErL3P3R/*
ut: aut S/post equis add. in C1L3 114 post hominibus *add. et R; add. et in C1EL3P3/*
post similiter add. autem EP3; add. etiam R/accidit: accidet Er/etiam: et P3; om. P1R/ante
si add. ut R 115 quod *corr. ex post a. m. C1/errabit: eiusdem Er/in: cum P1S*
 116 forsitan: forte *P1/in om. P1S/post specie add. in EErP3R* 117 post vel *add. in RS/*
in: ex C1EErL3P3R 118 fortis: fortiter *C1EP3R*

120 dat super colorem viridem fortem vel intensam rubedinem,
adhibito visu, ledetur. Et cum aliquid deinceps inspexerit,
aliud quidem ei quam sit in veritate apparebit, aut alterius
coloris, propter presentiam lesionis. Et modo simili accidunt
errores plurimi.

[6.29-30] Pari modo in oculorum egritudine aliquando equ-
125 us apparet asinus, et accidit error triplex predictus et in pluri-
bus. Et planum est errorem esse in scientia ex sola immoder-
antia visus.

[6.31] Palam ergo sunt errores qui in visu scientie accidunt
secundum singulas erroris visus causas.

[CAPITULUM 7]

*Pars septima in modis erroris visus qui
accidunt in sillogismo secundum
singulas erroris visus causas*

[7.1] Plurima eorum quorum in visu sit comprehensio ad-
5 quiruntur ex sillogismo, sicut patuit ex precedenti libro, et
precessit explanatio eorum quorum per sillogismum sit com-
prehensio et quod ex eis occurrat sensui compositio in formis
singulis. Cum ergo accidit error in aliquo illorum, erit error in
comprehensione facta per sillogismum. Bipartita est autem
10 partitio erroris in sillogismo; aut enim erit in propositionibus
aut in earum congregatione. In propositionibus tripliciter: aut
enim falsa loco vere sumitur, aut particularis loco universalis,
aut in comparatione propositionum erratur. Verbi gratia, si
fuerint in re visa partes que appareant et partes que lateant,
15 que tamen comprehensibiles sunt visui, si in illam figatur visus
intentio, cum videntem partes ille pretereant, ex eis tantum que

119 viridem fortem *transp.* C1L3 120 *post* adhibito *scr. et del.* in *Er*/cum *inter.* a. m.
S/aliquid: aliquis P3/deinceps: deinde R 121 quidem: enim P3; *om.* C1EErL3R
122 *post* et *scr. et del.* a L3 123 plurimi: plurum *Er* 124 aliquando: a natura P1
125 et²: etiam S 126 et *om.* P3/immoderantia (127): immoderatione C1EL3P3R
128 palam: plani R/qui: que EEr/scientie *alter.* ex si vere in scientia a. m. C1 1 pars
... causas (3) *om.* ErP1R/modis; modum C1EL3/erroris: errorum L3 4 plurima:
plura C1/quorum *om.* Er/sit: fit R 5 ex¹: in P1; *corr.* ex in S 6 sit: fit R 7 *post*
occurrat *scr. et del.* sensu C1/in: etiam P1/formis singulis (8) *transp.* C1EErL3P3R
8 accidit: acciderit EP3R 9 est autem *transp.* ErS 10 in sillogismo *om.* EP3;
inter. L3 12 vere: vero S/*post* vere *add.* propositionis C1/particularis: particular-
es C1 14 *post* partes *scr. et del.* que C1/appareant *corr.* ex apparent P1 15 tamen:
cum ErL3; *corr.* ex cum a. m. C1/sunt: sint EErP3/figatur: figuram *Er*; figuratur L3/*post*
figatur *scr. et del.* i S 16 intentio *alter.* in intuitio a. m. C1/*post* intentio *add.* visus C1L3
(*scr. et del.* C1)/videntem *corr.* ex videntes P1/pretereant: precedant EP3R/que: quare *Er*

in re visa acquirit concludit. Cum etiam conclusiones aliquas
 quas rei illi accidentes considerat, existimat eas ei accidere ex
 partibus eius apparentibus, quoniam non nisi eas computat.
 20 Cum vero intuitus diligentiam in re illa figit partes prius laten-
 tes, percipit et errorem cognoscit. Enumerabo igitur errores
 eorum que comprehenduntur per sillogismum quorum numerus
 est 22, ut sic pateant errores in sillogismo. Et hec enumeratio
 erit secundum unamquamque octo causarum prius dictarum.

[Distinctio 1]

25 *Et primo secundum longitudinem*

[7.2] Dico igitur quod longitudo egressa a temperamento
 errare facit videntem in longitudine, sicut accidit cum quis
 arbores valde remotas inspexerit, licet plurimum distent inter
 se; videbuntur quasi coniuncte aut saltem existimabuntur sibi
 30 propinque.

[7.3] Ob eandem causam evenit quod stelle aliquae reputan-
 tur quasi coniuncte, licet plurimum distent in veritate. Ob hoc
 stelle erratice existimabuntur ab omnibus in eadem superficie
 cum fixis, licet plurimum elongate sint ab eis. Est igitur error in
 35 longitudine propter egressum longitudinis a temperantia, et est
 error iste in sillogismo cum longitudinis tantum per sillogis-
 mum fiat comprehensio.

[7.4] Longitudo extra temperantiam situs errorem inducit,
 quoniam a tali longitudine corpus declinatum apparebit rec-
 40 tum, et ob hoc corpus quadratum in hac longitudine declina-
 tum videbitur oblongum. Eodem modo oblonga apparebit
 circularis forma si in hac longitudine fuerit declinata, nec

18 rei illi *transp. P3*/eas ei *transp. C1ErL3*/ei: eis *C1P1*/ei accidere *transp. EP3* 19 eas:
 eam *L3*/post eas *add. apparentes C1* 20 re illa *transp. P1*/illa: visa *C1EL3P3R*/figit
alter. in signat a. m. C1 21 ante percipit *add. prius P1*/enumerabo: enumerabit
C1L3P1P3; enumerabis *ErS* 22 post que *add. cum que C1* (cum *inter. a. m.*)/
 comprehenduntur: comprehendit *C1EL3P3R*/ante per *add. visus R*/quorum numerus:
 qua numero *R* 23 est: sunt *R*; *mg. a. m. C1*; *om. L3*/ut *corr. ex et a. m. C1*/hec . . . erit
 (24): erit hec enumeratio *C1L3*/enumeratio erit (24) *transp. EP3R* 24 erit: eorum *Er*/
 octo: scilicet *P1*; *inter. a. m. S*/post octo *add. scilicet S*/prius *om. C1*/dictarum: predic-
 tarum *C1* 25 et primo *mg. a. m. C1* 26 igitur: ergo *R* 27 ante in *add. ipsum*
C1; *add. eum EP3* 28 distent: distant *P1S* 29 videbuntur . . . veritate (32) *mg.*
a. m. C1/post videbuntur *add. tamen R* 31 quod: ut *R*/alique: aliquando *EL3P3R*
 32 distent: distant *P1* 33 existimabuntur: existimantur *C1EErL3P3R*/omnibus:
 hominibus *C1EErL3P3R* 34 fixis *mg. a. m. C1*; *corr. ex fixus S*/sint: sunt *C1L3P1*/
 igitur: ergo *R* 38 temperantiam *corr. ex temperamentum P1* 39 a: in *P1S*/corpus
 declinatum *alter. in longitudine declinatum a. m. C1* 40 in . . . declinatum (41) *om.*
P1/longitudine *om. C1*; *inter. L3*/declinatum (41): declinatione *C1*; *om. P3*; *corr. ex*
 declinatione *L3* 42 circularis: quadrati *P3* (*mg.*)/si *om. R*; *inter. L3*/post hac *scr. et del.*
 in *S*/fuerit *om. R*

accidet error iste nisi ex declinationis occultatione que latet in
 tanta longitudine, si enim appareret declinatio, non esset
 45 assignate quare occultaretur veritas corporalis forme. Est igitur
 error in solo situ ex longitudinis immoderatione.

[7.5] Et quare ignoretur situs est hec ratio: Excessus unius
 radorum in latus quadrati cadentium super longitudinem al-
 terius non est proportionalis respectu totalis remotionis cor-
 50 poris a visu, proportionem dico sensibili; unde propter insensi-
 bilitatem excessus non existimabitur maior aliquo aliquis ra-
 dius.

[7.6] Reputatur ergo oblonga quadrati forma, quoniam
 unum latus eius non declinatum respectu visus cadit in partem
 55 oculi, et in minorem incidit forma lateris declinati, quoniam
 sub minori angulo. Et erit minoritatis perceptio secundum
 quod fuerit quadrati declinatio, et quoniam non attenditur
 declinatio, existimabitur unum latus maius alio, quoniam sub
 maiori angulo, proinde forma apparebit oblonga. Pari ratione
 60 in circulari forma, unus dyameter maior apparet alio, unde
 reputatur oblonga. Et est error iste ex intemperata longitudine,
 quod non accideret si temperata esset.

[7.7] Si vero longitudo, licet intemperata, non fuerit mul-
 tum magna, sed valida sit illius corporis declinatio, perpendet
 65 fortassis videns declinationem sed non declinationis veritatem;
 immo minorem existimabit quam sit. Et conferet declinatio-
 nem lateris angulo sub quo comprehenditur, unde minor ap-
 parebit quantitas lateris quam sit, et sic reputabitur quadrati
 forma oblonga, sed minus quam prius.

70 [7.8] Superfluitas longitudinis errorem generat corporeita-
 tis, corporeitas enim est ex deviatione superficiei, et compre-

43 accidit: accidit C1EL3P3R/que: qua P1 44 tanta om. P3/appareret corr. ex
 apparet a. m. E 45 assignate: assignare C1EL3P3R 47 est hec corr. ex ex hec
 a. m. C1 48 longitudinem: longitudine ErP3 49 proportionalis: proportionatus
 L3/corporis (50) om. P3 50 sensibili: sensibilis Er 51 existimabitur: existimatur
 C1EErL3P3R/aliquo: alio Er/aliquis corr. ex aliqui C1 53 ergo: vero C1EErP3R; alter.
 in vero L3S (a. m. S)/quoniam: quando C1EL3P3RS 54 latus eius transp. C1EErL3R/
 post declinatum add. in C1 56 post erit add. huius C1; add. huiusmodi EErL3P3R
 57 et . . . declinatio (58) om. Er 59 ratione inter. L3 60 unus: una R; corr. ex unius
 C1L3/unus . . . maior corr. ex unum latus maius a. m. S/unus . . . apparet: unum latus
 magis apparebit P1/dyiameter corr. ex dyametri C1/alio: alia R 62 quod: quoniam
 ErP1; corr. ex quoniam a. m. S 63 longitudo corr. ex longum P1 64 sed . . .
 declinationem (65) inter. a. m. S/perpendet: appareret P3 65 fortassis: forte P1;
 fortasse R/sed non declinationis mg. a. m. C1 67 post lateris add. cum R
 68 lateris: talis R/post sit add. unde C1EErL3P3R 71 corporeitas corr. ex corpora C1/
 enim: autem R/deviatione: declinatione Er; derivatione P1; dispositione R; alter. in
 derivatione a. m. C1/superficiei: speciei EErL3P1P3RS; corr. ex speciei a. m. C1

henditur notitia corporeitatis ex notitia huiusmodi deviationis.
 Cum ergo accidit error in corporeitate, erit in superficiei vel
 superficierum dispositione, velut si superfices corporis incur-
 75 vata ex aliqua longitudine videatur plana, aut plana existime-
 tur curva. Et hec apparentia erit in figura, est enim figura
 superficierum corporis dispositio. Respicit etiam situm dis-
 positio superficierum, unde corporeitas includitur sub figura et
 situ, unde errorem corporeitatis gerit in se error figure et situs.
 80 Accidit autem error figure absque situs errore ex longitudinis
 immoderatione.

[7.9] Verbi gratia, figura multorum laterum equalium direc-
 te visui opposita in longitudine intemperata circularis apparet
 non ob aliud quidem nisi quia anguli figure divisi sunt et im-
 85 perceptibiles visui. Longitudo enim illa abscondit visui etiam
 proportionalia toti, etsi non totum.

[7.10] Eodem erroris tenore ab hac longitudine, linea curva
 existimatur recta, non enim perceptibilis est maioritas accessus
 unius lineae partis incurvate ad visum super partis eiusdem
 90 remotioris accessum, quare occultatur incurvatio partium, licet
 error non accadat in situ lineae illius.

[7.11-12] Similiter visa spera ab hac longitudine, reputabi-
 tur superfices plana quoniam propinquitas tumoris eius im-
 perceptibiliter propinquitatem extremitatum ab hac longitudi-
 95 ne excedit, unde existimatur equalis partium propinquitas—
 unde superficiei planitudo, inde est quod sol et luna superfici-
 ales videntibus reputantur, que erronea excluderetur figure
 reputatio si temperata esset longitudo.

72 ex inter. P3/huiusmodi: huius C1/deviationis: derivationis P1; dispositionis R; alter.
 in derivationis a. m. C1 73 accidit: accidet Er/accidit error transp. C1R/error om.
 EL3P3/superficiei: speciei EErL3P1P3RS; corr. ex speciei a. m. C1 74 superficierum:
 specierum EErL3P1P3RS; corr. ex specierum a. m. C1/superficies: species EErL3P1P3RS;
 corr. ex species a. m. C1 76 erit: erunt EL3P3/enim: igitur EL3P3R; corr. ex igitur
 a. m. C1 77 superficierum: specierum EErL3P1P3RS; corr. ex specierum a. m. C1/
 respicit: recipit ER; corr. ex recipit L3/etiam: et C1 (mg. a. m.)/dispositio superficierum
 (78) transp. R 78 superficierum: rerum P1S; specierum R 79 figure et situs: situs
 et figure C1EErL3P3R 83 visui inter. L3; mg. a. m. C1/visui opposita transp. EL3P3R
 84 quidem om. C1EErL3P3/divisi: diversi S; om. R/sunt om. EErP3; inter. L3/et om. R/
 imperceptibiles (85) corr. ex perceptibiles P3 85 longitudo . . . visui om. P1/post etiam
 scr. et del. ex L3 86 etsi: quamvis R 87 post eodem scr. et del. modo C1/tenore corr.
 ex tempore a. m. C1 90 remotioris: remotionis EL3P3/quare: quia C1EL3P3R
 91 accadat: accidit EL3P1P3RS; corr. ex accidit C1/lineae illius transp. S 92 post hac scr.
 et del. spera P3/reputabitur (93): aestimabitur R 93 superficies: species EErL3P1P3RS;
 corr. ex species a. m. C1/tumoris: timoris P1S; corr. ex timoris E 96 superficiei: speciei
 EErL3P1P3RS; corr. ex speciei a. m. C1/inde: unde L3; corr. ex unde C1/post est add. et P1S
 97 reputantur: reputentur L3; corr. ex reputentur C1/que: itaque P1/excluderetur:
 excluderetur C1; alter. ex excludentur in excludetur L3 98 esset longitudo transp. P1

[7.13] In magnitudine corporis erit error ex intemperata
100 longitudine, quoniam videbitur multo minus quam sit in veri-
tate.

[7.14] Huius rei ratio est quoniam, ut diximus, longitudo
intemperata est que partes proportionales toti proportionem etiam
sensibili abscondit visui, et cum fuerit occultatio partium sensui
105 perceptibilium, anguli in quos cadunt non sentiuntur, licet sint
totali angulo proportionales.

[7.15] Unde, cum discurrit axis rem visam, absconduntur ei
lineae multae ex ea et partes multae, unde minor efficitur totalis
apparentia.

[7.16] Amplius magnitudo partis alicuius corporis non
110 consideratur nisi secundum magnitudinem anguli in quem ca-
dit, et magnitudo anguli attenditur secundum partem in visu
sectam. Et partis sectae quantitas non existimatur nisi secun-
dum duo puncta illius partis terminalia, et puncta illa sunt
115 sensibilia et parti sectae proportionalia, quoniam a longitudine
tanta existimatur res visa secundum fines toti viso proportio-
nales. Aliter enim non essent fines illi sensibiles. Et fines par-
tis sectae directe opponuntur finibus partis vise ei proportio-
nalibus. Puncta ergo illa partis sectae terminalia abscondunt ex
120 re visa partes sensibiles. Cum ergo incedit axis super singulas
rei partes ex singulis partibus, absconduntur partes sensibiles,
et ita minor apparet totalis rei vise quantitas. Cum autem
videtur corpus a temperata longitudine, puncta terminalia
partis sectae valde sunt parva et quasi insensibilia ad ipsam
125 collata. Fines enim rebus visis insensibiles eligit in temperata
longitudine estimatio videntis, unde non absconduntur toti
proportionales partes, quare corpus non apparet minus quam
habeat veritas eius. Amplius, sicut dictum est in superioribus,
magnitudo non acquiritur in corpore nisi ex longitudinis et

99 erit *corr. ex erat C1; corr. ex esset a. m. E* 102 ante huius *add. et C1EErL3P3R/huius*:
huiusmodi *C1* 105 sentiuntur: sentientur *EP3R; corr. ex sentuntur L3* 106 sint
om. C1EErL3P3R/post angulo inter. sint L3 107 ante unde *add. sint R* 110 alicuius
corr. ex aliquid a. m. C1 111 consideratur: consideretur *P3; corr. ex consideretur a. m.*
E/quem: quam P3 113 non *om. R/nisi om. R* 114 ante duo *add. quod Er/illius*
partis inter. L3/sunt sensibilia (115) transp. EP3R 115 secte: recte *ErP1S/quoniam*
corr. ex quondam C1/a longitudine mg. a. m. C1 117 illi *inter. L3/partis (118):*
parti S 118 ei *om. R/proportionalibus (119): proportionalis C1; corr. ex proportio-*
nalis S 119 ex: a *P1S* 120 incedit *corr. ex incendit L3* 122 totalis: tota *EP3/*
vise om. EErL3P3R; mg. a. m. C1 123 puncta *mg. a. m. C1* 124 sunt *om. P3*
125 collata: collocata *P1/temperata longitudine (126) transp. R* 126 longitudine
estimatio corr. ex lineae estimatio a. m. C1/toti . . . partes (127): partes . . . proportionales
C1EErL3P3R (toti: totius Er) 127 proportionales: proportionones *S* 129 longitudinis:
longitudine *EP3*

130 anguli collatione. Et iam dictum est quod in immoderata longitudine apparet minor angulus, quia minor est in veritate, sed remotionis non fit discretio.

[7.17] Iam enim superius patuit quod remotio moderata comprehenditur per corpora interposita, immoderata vero
135 minime. Cum ergo remotio rei vise sit ignota, fiat fortassis collatio ipsius ad longitudinem notam. Et existimabit eam minorem, quare putabitur in angulo minoritas et in longitudine quam sit in veritate, unde error in corporis quantitate. Et quanto augmentabitur longitudo invalescet error, et adeo poterit
140 augmentari longitudo quod existimabitur quantitas corporis quasi punctalis, et si ultra creverit longitudo, occultabitur visui corpus illud.

[7.19] Simili modo accidit corporis occultatio in temperata longitudine non ex ipsa remotione sed ex coloris corporis debilitate.
145 Et patet occultationem fieri in debili colore, quoniam, si loco huius corporis in eadem elongatione statuatur corpus eiusdem quantitatis in quo sit fortitudo coloris, non latebit visum sicut corpus in quo fuerit coloris debilitas, quare aliquando occultat corpus visui non elongatio, non diminuta
150 quantitas, sed sola coloris debilitas.

[7.20] Amplius evenit aliquando corporis occultatio ex coloris eius similitudine cum interpositorum ipsi et visui corporum colore, et hoc in temperata longitudine. Unde corpus album a longe positum, effusa nive super superficiem interioris
155 terre, non discernetur, nive vero remota percipitur. Et palam quod erit occultatio ex hac colorum ydemptitate, quoniam, si loco corporis illius opponatur visui ab eadem remotione cor-

130 est *om. P3S*/in *om. EP1P3* 133 superius: supra *C1EErL3P3R*/moderata: immoderata *L3* 134 interposita *mg. a. m. C1* 135 fiat: fiet *C1EErL3P3R*/fortassis: forte *P1*
136 collatio: collectio *ErP1*; *corr. ex collectio L3S (a. m. S)/longitudinem corr. ex longitudine C1* 137 quare: quando *P1*; *corr. ex quando a. m. S/post* putabitur *scr. et del. est C1*; *add. et EErL3P3*; *add. minor et R/angulo: eo P1*; *corr. ex eo a. m. S/et om. Er/post et scr. et del. e C1* 138 post unde *mg. est a. m. C1* 139 post longitudo *add. tanto R/inva-*
lescet: invalescit C1EErL3P3/et inter. L3 140 post augmentari *scr. et del. ideo ? C1/longi-*
tudo mg. a. m. C1/quod: quam P3/existimabitur: aestimatur R/post existimabitur add.
visui corpus illud C1L3 141 punctalis: punctualis *R* 143 corporis *om. P3*; *corr. ex corpus P1/ante in mg. ex a. m. C1/temperata longitudine (144) transp. R* 144 debilitate (145): debilitatione *C1EErL3S* 145 in: ex *C1EErL3P3*/colore: corpore *L3*
146 huius: huiusmodi *C1/eadem mg. a. m. C1/elongatione: longitudine R/statuatur:*
statur P1 147 sit *om. C1* 149 corpus *om. P1S/elongatio: longitudo P1S*
150 ante sed *add. corporis C1* 151 evenit aliquando *transp. C1EL3P3R* 152 cum
inter. a. m. S/ipsi: ipsum EP3/ipsi et visui corr. ex ipsum visui a. m. C1/et om. EErL3P3
153 post corpus *scr. et del. alo P1* 154 nive super *transp. P1/nive . . . superficiem:*
super . . . nive S/superficiem: superficies P1 155 ante terre *scr. et del. i L3/discernetur:*
discernitur EP3R 156 erit: erat *R* 157 corporis illius *transp. C1EErL3P3R/visui*
corr. ex visu S/eadem: eodem L3/post eadem scr. et del. mo P3

pus equale alterius coloris, non occultabitur.

[7.21] Cum igitur aliqua res opposita visui non percipitur,
160 poterit esse causa absconsionis superfluitas elongationis ad
partem visus insensibilem formam dirigentis, vel quasi punc-
talem. Quod si in partem visus sensibilem forma inciderit,
poterit iterum preterire visum aut propter coloris remissionem
aut colorum rei vise et corporum interiacentium conformitatem.

[7.22] Amplius accidit error in rei vise quantitate etiam in
165 temperata longitudine. Quoniam corpore aliquo secundum
moderationem elongato et viso, occultabuntur visui partes eius
minute que quidem in minori elongatione apparerent, licet for-
tassis non plene, et paululum amplius elongate iterum minus
170 plene. Et minuetur comprehensionis plenitudo invalescente
remotionis augemento donec occurrat partium occultatio, licet
non egrediatur temperantiam illa elongatio.

[7.23] Iterum immoderata remotione pars aliqua plene
comprehenditur, et aliqua minimarum eius partium occultatur,
175 quoniam elongatio rei egressa est a temperamento proportio-
nato ad partes illas, licet non respectu totalis corporis aut
comprehense partis. Et licet nota sit homini hec longitudo,
tamen accidit error in comprehensione quantitatis partium, et
hoc propter angulum sub quo pars comprehenditur cuius ca-
180 pacitas minor existimatur quam habeat veritas. Et causa
apparentie minoritatis eius est ex punctis terminalibus secte in
visu partis partium occultantibus, et anguli capacitatem con-
stringentibus. Igitur, cum immoderata fuerit rei vise ab aliquo
distantia, perveniet error in eius quantitate dupliciter: et ex
185 anguli minoritate et ex longitudinis incertitudine. Immoderata
vero longitudine erit error in quantitate minutarum partium ex

160 causa: clausa P1/superfluitas: superfluitatis P3 161 ante formam add. partem
P3/dirigentis: diligentis S/punctalem (162): punctualem R 162 forma inciderit:
formam acciderit P1 163 aut: vel R/coloris: color S 164 aut: vel R/interia-
centium corr. ex interiatum P3 165 post vise scr. et del. et corporum S/etiam:
et C1L3P1S 166 temperata longitudine transp. R/secundum corr. ex etiam C1
167 moderationem: moderantiam Er/elongato: elongatio Er/ante visui add. per visus
a. m. C1; scr. et del. per L3/partes: parte P1 168 in om. P3/minori: minore R/fortassis
(169): forte P1 170 post minuetur add. et P3 172 post elongatio scr. et del. rei
egressa est a temperamento proportionato ad partes illas S 173 plene: plena P3
174 et om. EErL3P3R; mg. a. m. C1/minimarum: minutarum P1/eius om. P1 175 rei
... est: est rei egressa S/proportionato (176): proportionata C1EErL3P3 176 totalis:
totius R 178 post error scr. et del. in corpore C1 179 post hoc add. est C1
180 habeat: sit P1 181 eius: cuius P3/est om. P1/in visu (182) om. C1EErP3; inter.
L3S (a. m. S)/in ... partium (182): partis in visu partem R 182 constringentibus
(183): constingentibus EP3 183 ante igitur scr. et del. sibi P3 184 perveniet:
provenit C1; proveniet EL3P3; corr. ex pervenit S/ex om. EErL3P3; mg. a. m. C1
185 post et add. sic C1L3 (scr. et del. C1) 186 partium om. EP3; inter. ErL3 (a. m. Er)

errore anguli tantum. Et hee sunt cause quare corpus existimatur minus quam sit in temperata longitudine.

[7.24] Immoderatio longitudinis aliquando errorem inducit
 190 maioritatis, unde in longitudine non temperata (minima scilicet), quando corpus visum fuerit multum prope oculum, videbitur corpus maioris quantitatis quam in longitudine temperata vel quam sit re vera.

[7.25] Et hoc duplici de causa, quoniam, ut dictum est,
 195 intellectus longitudinem et angulum considerat et inde quantitatem corporis sillogizat, et in hac elongatione angulus pyramidalis est valde magnus. Et elongatio corporis non existimatur nisi a visus superficie ad superficiem corporis, non enim potest cadere in visus estimationem longitudo ad interiora
 200 visus penetrans a corpore viso cum pars eius interior radiis non subiaceat nec mensurari a visu queat. Sillogizat ergo visus ex anguli capacitate et nota longitudine. Vera autem remotio corporis attenditur secundum lineam a centro oculi ad corpus procedentem, cum respectu centri fiat consideratio
 205 anguli. Et in temperata corporis distantia semidiameter oculi qua vera corporis elongatio excedit apparentem, insensibilis est respectu totalis distantie corporis, unde non facit errorem in longitudinis estimatione. Sed corpore circa oculum existente, erit magnitudo semidiametri proportionalis distantie
 210 corporis proportionem sensibili. Erit igitur aliquando maior, aliquando equalis, aliquando minor, sed proportionem modica, velut subdupla vel huiusmodi; unde in propinquitate rei vise excrementum anguli pyramidalis et sensibilis minoritas longi-

187 anguli *mg. a. m. C1/post anguli scr. et del. et hoc sunt P1/tantum om. P1S/et om. P1/cause corr. ex eadem a. m. C1/existimatur (188): aestimetur R* 188 temperata: multa *P1S/temperata longitudine transp. C1L3R* 189 aliquando: a natura *P1/inducit: ducit P1S* 190 non temperata: immoderata *C1EErL3P3R/minima: minuta C1* 191 *post multum add. vel P1S/prope oculum: vicinum visui R/post prope add. circa P1S/oculum om. EErL3P3; mg. a. m. C1* 192 in *om. Er/longitudine om. EL3P3; inter. Er/longitudine temperata transp. C1* 193 *post sit add. in C1L3* 195 considerat *corr. ex siderat L3* 196 pyramidalis (197): pyramidis *R* 197 est *om. EErL3P3; mg. a. m. C1/non om. P1* 198 superficiem: speciem *EErL3P1P3S; corr. ex speciem a. m. C1* 200 *post visus scr. et del. estimationem longitudo ad interiora visus C1/interior corr. ex interiora P1* 201 queat *inter. L3/ante ergo add. autem S/ergo: igitur EP3R* 202 nota: mota *L3; tota R/vera: natura P1S* 205 semidiameter: semidiametri *P1S/oculi om. P3* 206 qua: quia *P1; corr. ex que L3/excedit: excedet L3; corr. ex excederet C1; corr. ex procedit P1* 207 totalis *corr. ex talis E* 209 proportionalis: propinquior *C1EErL3P3; alter. in propinquior a. m. S* 210 igitur: enim *C1EErL3R; erit P3/ aliquando: a natura P1/major aliquando (211) om. P1* 211 aliquando¹: a natura *S/ aliquando²: a natura P1/sed om. C1; inter. L3/post proportionem scr. et del. n P1* 212 propinquitate *corr. ex propinquitata P3* 213 minoritas longitudinis (214) *corr. ex in minorialis vel a. m. C1/longitudinis (214) inter. L3*

215 tudinis estimate respectu vere inducunt apparentiam maiori-
tatis in corpore.

[7.26] Immoderata extensio remotionis errorem invehit
distinctionis. Pariete igitur aliquo a longe intuito, si in parte
eius fuerit color tenebrosus, fiet videnti fides colorem illum
esse distinctionem partium, unde continuum ex hoc errore
220 reputatur discretum. Similiter, si prope parietem illum crescat
altitudo herbarum, videbitur distinctio partium inter quas
fuerit pars occulta ab oppositione herbarum, unde non reputa-
bitur paries aliquid continuum.

[7.27] Pari modo, luce solis in parietem descendente non
225 multum forti, si corpus umbram iaciat que umbra in parietem
cadat, accidit error idem in partium sine intermedio separa-
tione.

[7.28] Palam ergo quod error distinctionis est in sillogismo
ex immoderantia remotionis.

230 [7.29] Longitudo a moderatione egressa erroris continuita-
tis est causa. Corpora enim a longe visa in colore similia sibi
propinqua creduntur continua. Hinc accidit quod tabule pari-
etis vel scanni apparent aliquando continue, licet adinvicem
sint divise modica, dico, distinctione. Et accidit hoc in tem-
235 perata remotione vise, sed immoderata quantum ad compre-
hensionem distinctionis tam parve.

[7.30] Et ita ex hoc remotionis errore discretum creditur
continuum.

240 [7.31] Et quoniam secundum considerationem continuitatis
et discretionis attenditur numeri comprehensio, accidit error in
numero cum in rebus discretis apparebit unitas aut in re una

214 ante estimate add. vel L3/respectu om. P3 217 post pariete add. enim Er/longe:
longo C1L3/intuito: intuito Er; viso R 219 unde: et P1S/ex: et P1 220 repu-
tatur: reputabitur C1EErL3P3R 221 herbarum corr. ex fabarum C1L3 (a. m. C1)/post
herbarum scr. et del. crescat altitudo herbarum S/post videbitur add. forsan C1EErL3P3R
222 occulta alter. in occultata C1/post ab add. omni P1R/unde: inde EP3; videre L3; corr.
ex videre a. m. C1 223 aliquid: aliquis Er 225 post corpus add. aliquod
C1EErL3P3R/ante umbram scr. et del. i C1/iaciat: iaceat C1; lateat P1S 226 accidit:
accidet R 228 quod om. EEerL3P3; mg. a. m. C1/ante error mg. est a. m. C1/est om.
C1EErL3P3/est . . . sillogismo: in . . . est R 229 immoderantia: immoderatione R/
post immoderantia scr. et del. i P3 230 moderatione: remotione P3 231 in om. C1;
inter. L3/similia: similuna P1; similima S 233 apparent aliquando transp. C1L3/
continue: continui P1/adinvicem: abinvicem R 234 sint: sunt P1S/dico inter. a. m.
S/accidit: accidet P1R/accidit hoc transp. C1L3/post hoc add. etiam EP3R; add. et Er/in
om. ErL3/temperata (235): intemperata R 235 post remotione add. rei C1R (mg. a. m.
C1)/sed: scilicet R/quantum: quam P3 236 ante distinctionis add. remotionis EP3R
237 et mg. a. m. C1 240 et inter. a. m. S 241 numero corr. ex modo a. m. C1/in¹
om. L3; inter. a. m. C1/discretis: distinctis P1S/una: visa P1

pretendetur pluralitas.

[7.32] Egressus remotionis a moderamine errorem efficit
 245 motus. Si quis ad partem in qua lunam, aut solem, aut stellam
 aliquam viderit moveatur cum plurimum motus, lunam ante se
 videat elongatam non minus quam in principio motus. Con-
 cludit ipsam in partem eandem moveri, et ab eo recedere, et ob
 hoc elongationes durare. Et accidit hoc luna etiam ad partem
 eius properante. Et huius erroris ratio est quia notum est vi-
 250 denti quod in hiis inferioribus, statutis duobus corporibus quo-
 rum unum moveatur in partem aliquam, si permanserit ydemp-
 titas situs uni respectu alterius, necesse est aliud moveri in par-
 tem oppositam et motu equali.

[7.33] Cum ergo in hiis non percipiatur situs motus moven-
 255 tis ad stellam motam, occulte ex propositionibus iam dudum
 animo notis, infertur sillogistice motio. Et occultatur situs eius
 moventi ad stellam immutatio, quoniam via quam peragit
 motu suo non est proportionalis ipsius stelle magnitudini, mul-
 to magis excessus postreme propinquitatis eius ad stellam
 260 super primam propinquitatem non est sensibilis respectu to-
 talis remotionis. Idem error accidit in motu nubium, creditur
 enim velocissimus esse lune motus, licet non sit, et nos supra
 explanavimus.

[7.34] Evagatio remotionis a temperamento errorem infert
 265 quietis. Si quis a longe visus motu moveatur non veloci, quies-
 cere putabitur, unde stellas erraticas credimus immotas, licet
 insit eis motus velocitas.

[7.35] Et hec est quietis stellarum estimatio, quoniam vie
 quas incedunt etiam in tempore magno non sunt perceptibiles

242 pluralitas: pluritas EP1P3 246 videat: viderit R 247 partem eandem *transp.*
 EP3R/eandem: oppositam P1S 248 elongationes: elongationis EP3/etiam: et P1S
 249 eius: contrarium R/et . . . erroris *corr. ex erroris et huius S/huius erroris transp. C1/*
ratio corr. ex non a. m. C1/est² om. EP3; inter. C1L3 250 *post inferioribus add. na-*
turis R 252 uni: unius P3R/*post uni scr. et del. reel C1/aliud: alium Er; corr. ex ali-*
quando L3; alter. ex aliquando in alium a. m. C1/partem oppositam (253): eandem par-
tem R 253 *post equali add. verum hoc non oportet existimare in luna et stellis R*
 254 ergo: enim R/*motus om. C1ErL3P1S/moventis (255) om. P1S* 255 stellam: illam
 P1S/ex: et Er 256 sillogistice *alter. ex simile in stelle a. m. C1/post occultatur add.*
 immutatio R 257 moventi: momenti P1/immutatio *om. R; alter. ex et mutatio in*
immutatione a. m. C1/quoniam: quam EP1/via corr. ex una S/post quam add. quis R
 259 magis: maius P1S/*post magis add. igitur R* 261 accidit *om. P1S* 262 *post et*
add. etiam P1S; add. ut R 264 evagatio: et vagatio L3; evacuatio P1S; *corr. ex et*
vagatio C1/ante a scr. et del. idem errore S 265 moveatur non veloci: non . . .
 moveatur C1EErL3P3R/*non corr. ex vero a. m. C1/quiescere putabitur (266) transp.*
 C1EL3P3R 266 erraticas: errantes C1EL3P3R 267 insit eis: in superficie eius sit
 Er; *corr. ex in superficie eius sit a. m. L3/velocitas: velocitatis P3* 268 et: etiam EP3/
 hec: hoc P1/hec est *transp. R* 269 non sunt: est EEerL3P1P3S; *corr. ex est a. m. C1/*
 perceptibiles: perceptibilis EEerP1P3S; *alter. in perceptibilis L3*

270 visui a tanta remotione, unde durante situs earum respectu
videntis ydemptitate, existimantur quiescere.

[7.36] Pari modo si corpus aliquod a longitudine magna
moveatur super radios visus, et est accedendo ad visum vel
recedendo ab eo, putabitur immotum nisi motus eius fuerit
275 valde fortis. Et accidit error iste quoniam, ut supra patuit,
motus non comprehenditur in corpore nisi quia modo videtur
cum aliquo corpore, modo cum alio. Hic autem excluditur hec
perceptio, quoniam via quam incedit movens super radios
imperceptibilis est a tanta longitudine.

280 [7.39] Superflua longitudo errorem ingerit asperitatis.
Unde in capillis alicuius picte ymaginis a longitudine intem-
perata existimatur asperitas enim cum expressa fuerit pictura.
Quia notum est asperitatem esse in veris capillis, concludit
eam animus similiter illis inesse propter expressionem forme.
285 Idem error accidit in vestibis depictis et animalium pilis
expresse depictorum.

[7.42] In hiis autem omnibus non est asperitas sed immensa
lenitas; et licet a corporibus lenitis fiat reflexio lucis non ab
asperis, tamen in pictura aliquando videtur reflexio lucis, nec
290 ob hoc excluditur opinio asperitatis. Quoniam opinanti est
certum aliquando in eodem corpore asperitatis et reflexionis
fieri concursum, sicut accidit in capillis hominis nigerimis et
bene lotis, reflectitur enim lux in eis licet asperis.

[7.43] Unde ex hac similitudine accidit error in estimatione
295 asperitatis picture per immoderatam remotiorem ad corpus
pictum proportionatam. Non enim poterit comprehendere leni-
tas in pictura nisi cum multum fuerit certa; unde distantia res-
pectu aliarum rerum temperata extra temperantiam est ad

270 situs: situ R; acus S 271 videntis *corr. ex videns a. m. Er*/existimantur: existimabi-
tur EP3 272 magna *om. EL3P3R; mg. a. m. C1* 273 et: etiam *Er*/est accedendo:
accedat R/post ad *add. ipsum EP3R/vel om. P1* 274 recedendo: recedat R
275 accidit: accidet S/error iste *transp. R* 276 quia: quoniam P1 277 corpore
corr. ex tempore L3/modo: moto P1/post modo scr. et del. n Er 278 perceptio:
preceptio P1S/post perceptio *add. motus C1* 279 post tanta *scr. et del. picte ymagi-*
nes S 280 ingerit: invehit L3; *corr. ex invenit a. m. C1* 281 picte: picture *Er*/
intemperata (282): temperata EP3 282 enim *om. C1ErL3P3R/post enim scr. et del.*
expressa P1 283 post quia *add. enim R/esse om. L3/capillis om. P1; inter. ErL3S*
(a. m. ErS) 284 similiter illis *transp. R* 285 pilis *alter. in pennis a. m. C1*
287 sed *corr. ex et a. m. C1* 288 lenitas *corr. ex lentas S/lenitis: laevibus R; alter. in*
lenibus a. m. C1 289 tamen: cum L3/lucis *corr. ex licet a. m. Er* 290 ob: ab EP3/
quoniam . . . asperitatis (291) *om. P1/opinanti: opinati P3* 291 certum: centrum S/
corpore: tempore *Er/ante asperitatis inter. corporis a. m. Er* 292 concursus: cursum
P1S/hominis *om. P1* 294 ex: in C1 296 post pictum *add. et C1L3 (scr. et del. C1)/*
proportionatam: proportionatum *EEL3P3R; corr. ex proportionatum a. m. C1/lenitas*
(297) *corr. ex lenita a. m. C1; corr. ex lenitates S* 298 temperata *om. R*

adquisitionem lenitatis comparata.

300 [7.44] Ex evagata remotione accidit error in lenitate. Si enim
a magna longitudine opponatur visui corpus in quo est modica
asperitas, putabitur lene, asperitas enim non acquiritur in cor-
pore nisi ex diversitate situs partium inter se vel luce
eminentium et umbra depressarum, sicut explanatum est su-
perius. Et a tali longitudine non attenditur diversitas situs
5 partium aut proiectio umbre eminentium super depressas,
unde iudicatur in eo lenitas.

[7.46] Ex immoderatione elongationis oritur error raritatis.
Cum circa oculum erigitur acus aut aliquid subtile multum, licet
10 appareat visui maius quam sit, ei tamen nihil occultat de op-
posito pariete aut alio opposito corpore. Unde, cum fiat rari-
tatis comprehensio in corpore ex eo quod post ipsum possum-
us aliquid videre, in acu erecta aut in aliquo consimili raritas
existimabitur, cum post ipsam totus paries videatur. Quare
15 autem acus prope visum sita maior appareat patet ex superi-
oribus. Quare autem in tanta propinquitate nihil abscondat
visui ex opposito pariete est quia remotio tam modica respec-
tu occultationis acus est immoderata. Si enim paululum elon-
getur ab oculo acus illa, occultabitur pars parietis maior acu
20 ipsa.

[7.47] Et huius rei causa plenius deinceps explanabitur.

[7.48] Ex superhabundantia longitudinis accidit error soli-
ditatis. Si quis a longe intueatur corpus rarum, et statuatur
post ipsum corpus coloratum aut quid tenebrosum, non repu-
25 tabitur corpus illud rarum sed solidum. Et est error quoniam
post corpus illud non percipit aliud. Cum natura rari sit ut post
ipsum possit videri solidum, concludetur corpus illud non
esse rarum sed solidum.

[7.50] Ex superfluitate remotionis oritur error in umbra. Si
30 a tali longitudine opponatur visui corpus album in quo sit pars

300 evagata: vagata L3; corr. ex vagata a. m. C1 1 est om. EErL3P3; mg. a. m. C1/est
modica transp. R 2 corpore (3) corr. ex corde a. m. C1 5 attenditur: percipi-
tur R 6 aut . . . umbre om. R/post depressas add. aut proiectio umbre R 7 iudi-
catur: indicatur Er 8 ante ex add. et Er 9 post cum add. enim R/circa alter. in contra
a. m. C1/erigitur: eritur E; erit P3 10 ei om. C1EErL3P3R/post occultat add. ei C1EErL3P3R
11 pariete . . . opposito om. P1/alio om. S/raritatis (12): unitatis EP3; corr. ex unitatis C1L3
(a. m. C1); corr. ex raritas S 13 aliquid om. C1EP3; inter. L3/aliquid videre transp. L3/
aut om. C1EL3P3 15 sita: situm P3; corr. ex situm a. m. E/appareat: apparet C1
17 opposito pariete transp. R 18 est immoderata transp. C1EL3P3R 21 huius:
huiusmodi C1/deinceps: deinceps P1; om. C1EL3P3R/post explanabitur add. in septimo
libro C1 23 post quis add. enim R 24 corpus om. S/quid: aliquid C1 26 aliud:
illud Er/rari: raritatis P1S 27 corpus illud transp. P1 29 post si add. enim R
30 post tali add. in Er/opponatur corr. ex operatur P1

tenebrosa, luce solis super corpus illud descendente, apparebit umbra in parte corporis tenebrosa.

[7.51] Et hoc pro constanti habito, si circa corpus illud videatur aliud, fiet conclusio quod umbra apparens proiciatur
35 ab illo alio. Et palam quod accidit error iste ex nimia remoti-
one.

[7.52] Propter distantie excessum se ingerit error tenebra-
rum. Si a longe videatur corpus album in quo pars nigra mul-
tum sit, existimabuntur fortassis in parte illa tenebre, unde fiet
40 conclusio quod in directo illius partis sit foramen corporis per
quod appareat tenebrarum egressio post corpus illud existen-
tium.

[7.54] Remotio excedens modum causa est erroris speciei
et deformitatis. Cum a longe inspicitur res aliqua, si fuerint in
45 ea macule parve ipsam deformantes, quia occultantur ex lon-
gitudine, iudicatur formosa. Quoniam ex solis apparentibus
fit conclusio, et quia latent macule, apparent vero partes for-
mose.

[7.56] Similiter, si a tanta longitudine videatur res in qua
50 sunt picture, sed minute rei totali, decorem conferentes, cum
lateant visum cause decoris, iudicabitur res illa deformis, cum
ex apparentibus tantum iudex sumat iudicium.

[7.58] Ex superflua elongatione accidit error in similitudine
corporum et dissimilitudine. Si dirigantur visus in corpora
55 longe remota in colore similia, si fuerint in eis note vel protra-
ctiones minute sibi dissimiles et diverse, cum visus pretereant,
iudicabuntur corpora ex toto similia.

[7.60] Econtrario, si diversitas fuerit in totalibus corporum
coloribus, sed in eis sunt note minute inter quas adinvicem sit
60 similitudo, iudicabuntur dissimilia ex toto. Et accidet error

33 hoc . . . habito *om.* R/circa: cura L3; *alter.* in contra C1 34 quod: quam P3/
proiciatur: percipitur C1EP3; *corr.* ex percipitur L3 35 nimia: minima P1
38 *post* si *add.* enim R/a: autem EP3/a longe: procul R 39 *post* sit *add.* et P1/
existimabuntur: existimabitur P3; *corr.* ex estimabitur a. m. E/fortassis: forte P1/*post* fiet
scr. et *del.* oculo C1 40 conclusio *corr.* ex oculo L3/quod: quia C1EL3P3/directo:
directe P1S 41 *post*: preter C1Er; *corr.* ex preter L3 43 speciei: pulchri-
tudinis R 44 deformitatis: formitatis P1/a longe: enim procul R/inspicitur: res-
picitur EP3 45 ipsam: eam R 46 iudicatur: indicatur Er; videtur P1/*post* solis
add. rebus C1 47 *ante* et *add.* quod est P1S/et *om.* P1S; *scr.* et *del.* C1/quia *om.*
EErL3P3R; *mg.* a. m. C1/*post* macule *add.* et P1S/vero *om.* P1S 49 si *om.* P3/a:
cum P1 50 cum: non L3 51 cause: causa P3; *inter.* L3 52 iudex sumat
transp. C1EErL3P3R 54 *post* si *add.* enim R 55 *ante* si *add.* et R/si *inter.* a. m. C1/
protractiones (56): pertractiones Er; *corr.* ex pertractiones C1L3 (a. m. C1) 56 mi-
minute: minue Er/sibi: sed si Er; scilicet L3/*post* diverse *add.* quae R 59 sunt: fuerint
C1; sint EErL3P3/adinvicem *om.* R 60 accidet: accidit C1Er/error quoniam (61)
rep. P3

quoniam ex solis apparentibus fiet conclusio.

[Distinctio 2]

*Situs egreditur a temperamento et error-
em inducit in quolibet eorum quorum
fit comprehensio per sillogismum.*

[7.63] In longitudine, si videantur duo corpora quorum
5 unum sit post aliud directe, ita quod unum cooperiat partem
alterius, et pars posterioris emineat, et hoc in longitudine tem-
perata, non tamen multum certa, nec inter ea fuerint alia cor-
pora, non plene existimabitur longitudinis unius ad aliud men-
sura, et forsitan iudicabit videns ea sibi esse valde propinqua.

10 [7.64] Et est error iste in sillogismo, cum per sillogismum
tantum comprehendatur longitudo per situm, quoniam, si non
occultaret unum alterius partem, sed utrumque totum expon-
eretur visui, ut via inter ipsa in diversos non in eundem inci-
deret radios, discerneretur distantia unius ab alio. Et est error
15 ex sola situs intemperantia, quoniam situ ad temperantiam
reducto, ceteris partibus non mutatis, non accidit error.

[7.65] Situs extra temperantiam situs visui errorem invehit.
Cadente axe visuali in corpus a temperata longitudine opposi-
tum visui, sumpto alio corpore multum elongato ab axe declin-
20 ato modicum super lineam intellectualem super quam cadit
axis perpendiculariter, non comprehendit videns corporis illius
declinationem propter situm a temperamento egressum. Quo-
niam non plena fit comprehensio corporum longe ab axe posi-
torum, et in hoc errore declinatum iudicabitur rectum.

25 [7.67] In figura accidit error per situm. Si corpus circulare,
ut ciphus vel scutella, ab axe elongetur et modicum super line-

61 solis: solum EP3R 1 et inter. C1 4 in longitudine: inde P1; corr. ex inde a. m.
S/ ante si add. ut R 5 sit om. EErL3P3; mg. a. m. C1/ aliud: alium EL3P3S/ quod: ut
C1L3RS 7 inter: intra L3; corr. ex intra C1/ fuerint: fiunt L3 8 aliud: alium
C1EErL3P3; illud S 9 forsitan: forte P1/ sibi . . . valde: valde . . . esse C1EL3P3R
10 iste om. R/ ante cum scr. et del. cum C1 11 post situm add. vero C1EErL3P3R/ non
. . . unum (12): unum non occultaret C1EErL3P3R 12 post utrumque add. istorum P1/
totum: toti P1; om. C1; inter. L3 13 ipsa corr. ex ipsam L3/ incideret (14): incider-
ent EP3 14 discerneretur: discernetur C1L3 16 reducto: redacto Er; deducto P1/
non¹: que P1/ accidit: accidet Er/ post error add. aliis C1EErL3P3; add. talis R 17 visui:
in situ EErL3P3R/ invehit corr. ex invenit a. m. C1 18 post cadente add. enim R/ visuali
corr. ex visui Er/ temperata: temperamenta S 19 elongato: elongatio Er/ post axe add.
et R 20 cadit: cadet C1EL3P3 21 comprehendit: comprehendet C1EErL3P3
23 longe ab axe: ab axe longe R 24 declinatum: declinans P1S/ iudicabitur: iudicabit
EP3R/ ante rectum add. visus R 25 accidit: autem EP3R/ post error add. est R/ per
situm corr. ex partium a. m. C1/ post si add. enim R 26 ciphus: cophus EErP3

am intellectualem quam diximus declinetur, quoniam occulta-
tur eius declinatio, et unus eius dyameter sub maiori angulo
comprehenditur quam alius, qui enim apparet rectus maiorem
30 respicit angulum quam declinatus, et quia notabilis est exces-
sus unius anguli ad alium, iudicatur dyameter rectus maior
declinato, unde circularis figura corporis iudicabitur oblonga.

[7.68] Pari errore figura quadrangula existimabitur oblon-
ga, cum latus eius directe oppositum oculo maius appareat
35 latere declinato.

[7.70] Et est error in sillogismo, premittit enim propositio-
nes in quibus falsitas est—scilicet neutrum laterum esse declin-
atum; et visa ab eadem longitudine sub eodem situ et inequali-
bus angulis sunt inequalia; et oblonga est forma cuius unum
40 latus inaequale alii—inde concluditur error non veritas figure.
Ex eadem causa palam esse errorem in quantitate cum dyame-
ter circularis corporis maior videtur alio eiusdem dyametro cui
est equalis.

[7.71] Amplius alio modo accidit error in magnitudine ex
45 situ intemperato et solo cum aliquis in altum positus intuetur
sub altitudine illa incedentes et inter se equales eis in ordine
uno post alium dispositis, radius cadens super primum absque
dubio demissior erit radio cadente super secundum. Et secun-
dum quod augmentabitur elongatio alicuius eorum a primo,
50 maior erit radii super ipsum cadentis altitudo, unde altior erit
radius cadens in postremum quam in aliquem alium. Iudica-
bitur ergo a vidente postremus maior omnibus ita, dico, si terre
spatium inter quoslibet duos situm lateat visum ne in collatio-
ne ad terram apparentem facta comprehendi possit altitudinis

27 quoniam *om.* R/occultatur (28): occultabitur R 28 unus: unius C1; una R/
dyameter: dyametri S/maiori: maiore R 29 comprehenditur: comprehendetur R/
alius: aliis Er; angulus P1S; alia R/qui: quae R/rectus: recta R 30 respicit: recipit
C1EP3; recipit L3/declinatus: declinata R/excessus . . . alium (31): unius anguli ad
alium excessus C1EErL3P3R 31 rectus: recta R 32 declinato: declinata R
33 oblonga (34) *corr.* ex longa L3 36 error *mg.* P3/premittit: premittit EL3P3S; *corr.*
ex premittit a. m. C1Er/propositiones (37): proportiones S 37 falsitas est *transp.*
P1R/est *om.* EEerP3; *inter.* L3; *mg.* a. m. C1/esse *om.* C1EErL3P3 38 et²: etiam P1
39 sunt: esse R/est: esse R 41 esse errorem *transp.* R 42 alio: alia R 44 alio
modo *om.* P1S 45 intemperato: intemperamento P1P3/altum: alto R; *corr.* ex
alterum a. m. C1/intuetur: videtur L3; *corr.* ex videtur a. m. C1 46 altitudine:
latitudine Er/ante illa *add.* vel latitudine P1S/et: etiam EEerP3 47 dispositis: depositus
L3; *alter.* ex deponitur in disposito a. m. C1 48 dubio *corr.* ex duo L3/secundum¹ *corr.*
ex secunda C1/et *om.* P1S/secundum (49) *om.* C1 49 ante quod *add.* quanto enim
C1P1S (*mg.* a. m. C1)/quod *scr.* et *del.* C1/augmentabitur: augmentatur EP3/primo: primis
C1; prima L3/post primo *add.* secundum illud R 50 cadentis: cadentes C1/erit²: aut
S/post erit² *scr.* et *del.* c Er 53 situm: situum L3; situs P1/ne *corr.* ex neque P1/
collatione ad terram (54) *corr.* ex collectione de terra a. m. C1

55 homini mensura.

[7.72] Et erit error in sillogismo, quoniam errat in antecedentibus quorum unum est quecumque apparent altiora sunt maiora, et hoc non invenitur in omnibus sed in pluribus.

[7.73] Et est error ex situs immoderatione respectu comprehensionis magnitudinis rei sic disposite, si enim radius
60 cadens in primum sit equidistans terre, et idem radius cadat in quemlibet alium processu suo, non habebit locum error iste.

[7.75] In distinctione provenit error ex excessu situs. Si magna fuerit corporis alicuius super radios declinatio, et fuerint in eo puncta sensibilia nigra vel valde tenebrosa, putabuntur forsitan esse foramina, et ita inter partes huic tenebrositati affines iudicabitur divisio, licet ibi sit continuitatis unio. Si vero in hoc corpore fuerint lineae sensibiles tenebrosae, iudicabuntur conterminales divise cum sint continue, et ita error
70 accidit ex corporis declinatione.

[7.77] In continuitate erit error ex situ. Si apponatur visui plurium parietum dispositio quorum unus sit ordinatim post alium modicum distans ab eo, et omnes cadant super eundem radium, occultabitur forsitan videnti spatium quod inter eos
75 fuerit.

[7.78] Unde putabuntur continui cum sint divisi, quod non accidet situ parietum immutato ut non comprehendantur sub eodem radio.

[7.79] Error inducitur in numero ex situ immoderato quando corpus aliquod videtur duo, et hoc accidit cum respectu
80 duorum visuum corpori diversitas situs fuerit. Pari modo et in corpore uno iudicabitur pluralitas cum inter duos axes corpus visum ceciderit, sicut supra patuit.

55 homini: hominum C1EErL3RS 56 et om. R/errat: error P1/in²: inde Er 58 invenitur: inveniuntur P1/post pluribus add. tamen C1 59 immoderatione: immoderamine C1ErL3 60 sic disposite transp. C1EL3P3/post radius add. visualis C1EErL3P3 61 terre: cum re L3/cadat om. EP3 62 iste: enim Er 63 ante in add. et C1EP3/provenit: erit C1EL3P3/error om. P1/ex om. ErL3/situs: eius P1S/post si add. enim R 64 fuerit corr. ex fuerint P3 65 ante in scr. et del. e Er/post puncta scr. et del. decli P3 66 forsitan: forte P1/huic: hec P1S (inter. P1); om. L3; mg. a. m. C1/huic tenebrositati corr. ex tenebrositati huic Er/tenebrositati: tenebrositas ErP1S; tenebrositati R 67 affines om. P1S/ibi corr. ex sibi P1/unio corr. ex uno ErS (a. m. S) 68 sensibiles: subtiles P1; corr. ex subtiles a. m. S/iudicabuntur coterminales (69) transp. C1L3 69 sint: sit L3P1S/ita om. EP3; corr. ex prima a. m. S 70 accidit: erit C1Er (inter. a. m. Er); om. EL3P3/post ex add. nimia C1ErL3; add. minima EP3 71 ex situ mg. a. m. E/apponatur: opponatur C1/visui inter. a. m. E 72 plurium: plurimum L3/sit om. C1EErL3P3/ordinatim: ordinatum C1L 74 forsitan: forte P1 76 unde: inde L3; corr. ex inde a. m. C1 77 immutato: terminato EP3; corr. ex terminato L3; alter. ex terminato in mutato a. m. C1/comprehendantur: comprehendatur EErL3P3 81 corpori diversitas: corporis diversus R/situs fuerit transp. EP3R 82 iudicabitur: iudicatur C1EL3P3R/pluralitas: pluralitas EP1P3/corpus visum (83) om. P1S

[7.80] Et est error in sillogismo, premitit enim videns esse
 85 diversa corpora exterius visa. Cum forma interius in diversa
 visus ceciderit loca, inde diversitatem ubi ydemptitas est con-
 cludit.

[7.81] In motu oritur error ex situ, ut navem currentem in
 flumine aliquo inspiciente, si fuerint in littore fluminis arbores
 90 ab axe multum elongate, putabuntur moveri.

[7.82] Et si fiat directio axium super eas, videbuntur im-
 mote.

[7.83] In quiete error ex situ se ingerit. Intuita re aliqua, et
 tota que citissimo motu volvatur ab axe elongata, apparebit
 95 immota.

[7.84] Et planum est per situm esse errorem, quoniam, situ
 mutato, percipietur eius motio, unde error ex situ solo intem-
 perato.

[7.85] In asperitate situs errorem facit. Si a capillis ex-
 100 presse depictis fiat reflexio lucis, et non fuerit visus in loco
 reflexionis, fiet in eis comprehensio asperitatis cum sola sit in
 eis lenitas.

[7.86] Et est error ex situ solo, quoniam visu sub luce
 reflexa sito non comprehenditur asperitas in corpore viso.

105 [7.87] In lenitate erit error ex situ. Cum aliquid elongatum
 fuerit ab axe, si modica fuerit in eo asperitas, apparebit lene
 cuius quidem asperitatem.

[7.88] Situ ad temperantiam reducto, posset videns com-
 prehendere.

110 [7.89] In raritate et soliditate fiet error ex situs immodera-
 mine. Si descenderit lux declinata in vitrum vino plenum, et
 lateat visum transitus lucis per vitrum, et magna sit declinatio
 illius a radiis, et videntem lateat vinum esse in vase vitreo,

84 *post enim add. error P3/post esse scr. et del. di C1* 85 *in: et Er* 86 *inde diver-*
sitatem: in diversitate ErP1S/ubi: nisi P3/post ubi add. est Er/ydemptitas: dentitas Er
 88 *ut: alio EL3P3; aliquo Er; corr. ex alio a. m. C1* 89 *fuerint: fuerit L3* 91 *et*
om. C1L3 93 *error ex situ: ex situ error C1L3/intuita: visa R/aliqua: alia C1EL3P3/*
et: ut R 94 *tota: rota ER/citissimo: certissimo S/citissimo motu transp. C1EErL3P3R*
 96 *et... errorem om. P1S/est om. ErL3; inter. a. m. E* 97 *percipietur: percipitur C1L3/*
motio corr. ex mutatio L3/post unde inter. est a. m. C1/solo: suo L3; corr. ex suo a. m. C1/
intemperato (98) corr. ex imperat P1 99 *facit om. P1/post si add. enim R/a inter. a. m.*
S/expresses (100) corr. ex depresse a. m. C1 100 *et non: nec C1EErL3P3R* 103 *est*
... solo: ex situ solo est error C1EL3P3R 104 *sito: fixo C1EL3P3R* 105 *elongatum*
fuerit (106) transp. R 106 *fuerit¹ om. C1EErL3P3/lene: lenis P3* 108 *ante situ add.*
ex L3/reducto: redacto C1L3P1S 110 *raritate et soliditate: soliditate et raritate P1/*
fiet: fit P1/immoderamine (111): immoderatione P1 111 *post si add. enim R/*
descenderit: descenderet C1 112 *lateat: latet C1/sit corr. ex fit a. m. C1* 113 *post*
illius add. lucis C1EErL3P3R/post radiis add. incidentibus R/videntem alter. in viden
P1/vase vitreo transp. P1/vitreo: vitro Er

existimabitur a vidente vinum esse corpus solidum unum cum
 115 vase. Et non accidit error iste in transitu lucis per vas vitreum
 patente, unde error ex situ in raritate et soliditate.

[7.92] In umbra et tenebris: Corpore aliquo ab axe elonga-
 to, si fuerit in eo pars tenebrosa, putabitur fortassis umbra, et
 corpore aliquo circa posito, existimabitur umbram procedere
 120 ab illo.

[7.94-95] Si autem in corpore illo fuerit pars multum nigra,
 existimabitur forsitan in loco nigredinis perforatio per quam
 egrediatur tenebra, quod non accidet in corpore statuto in situs
 temperantia.

125 [7.96] In specie et deformitate autem error accidit ex situ.
 Cum corpus aliquod remotum fuerit ab axe, et sint in eo macu-
 le minute ipsum deturpantes, occultabuntur, et iudicabitur in
 corpore species, unde facies lentiginosa in hoc situ videtur
 speciosa. Similiter in hoc situ latet videntem lune adherens
 130 umbra, unde ascribitur decor lune sic inspecte.

[7.98] Si autem in corpore viso fuerint picture ei speciem
 redentes, nec sit corpus decorum nisi ex pretentu earum, cum
 ipse in hoc situ lateant visum, iudicabitur corpus deforme.

135 [7.99] Et est error in sillogismo quia per apparentiam tan-
 tum sit deformitatis vel decoris conclusio.

[7.100] In similitudine et dissimilitudine ex situ error oritur.
 Si longe ab axe stabiliantur duo concordantia in specie, figura,
 et colore, sed in eis sint modice et dissimiles note, iudicabitur
 in ea similitudo omnimoda, cum note ille videnti sint ignote.

140 [7.102] Si autem fuerit diversitas inter ea in specie, et col-

114 esse *om.* EP3R/corpus solidum *transp.* C1EL3P3R 115 non *om.* P1S/iste . . . acci-
 dit (125) *om.* Er/in *om.* EL3P3R; *inter.* C1/lucis: luci R 116 *post* unde *add.* erit C1/ex:
 in R/in: ex R 117 tenebris: tenebrosis C1/*post* corpore *add.* enim R/ab . . . aliquo
 (119) *inter.* L3 118 fortassis: forte P1L3/*et inter.* P1 119 circa posito: composito
 P1R; *alter.* ex circa positio in contra posito a. m. C1/umbram *om.* C1EL3P3R 121 nig-
 ra: magna EL3P1P3S; *corr.* ex magna a. m. C1 122 forsitan: forte P1 123 egredi-
 atur tenebra: egrediantur tenebrae R/accidet: accideret R/in¹ *om.* P1S 125 in . . .
 accidit *om.* P1S/accidit: incidit C1EL3P3 126 fuerit: fuerint S/sint: fuerint R/*post* eo
add. multe EP3R/macule (127) *inter.* a. m. E/macule minute (127) *transp.* EP3R
 127 deturpantes: turpantes C1L3/iudicabitur: iudicabuntur P1S 128 lentiginosa
corr. ex litiginosa P3 129 *post* situ *add.* obliquo R/latet: latent R/adherens umbra
 (130): adherentes maculae R 130 ascribitur: describitur C1L3 131 viso *mg.*
 a. m. C1 133 situ: statu C1EL3P3R/deforme *corr.* ex difforme C1 135 sit: fiet
 C1EL3P3R/deformitatis *corr.* ex deformitas a. m. E/*post* decoris *scr.* et *del.* de S
 136 *ante* in *add.* iste (115) . . . accidit (125) Er (in [115] *om.* /elongato [117/118]: elongatio/
 in eo [118] *om.* /nigra [121]: magna/*ante* forsitan [122] *scr.* et *del.* umbra/in¹ [123] *om.* /
 accidit [125]: incidit; *add.* in (125) . . . accidit (125) P1S (et *om.* P1S/autem error *transp.*
 P1)/et dissimilitudine *inter.* a. m. S/*post* situ *scr.* et *del.* ex Er/oritur *om.* S 137 *post* si
add. enim R/stabiliantur: statuuntur R/in *om.* P3/specie figura *transp.* EP3R
 138 sint: sunt C1P1 139 *post* ille *add.* sint C1L3 140 in: et P1S/et: in C1L3; *om.*
 EE^rP3R/colore et figura (141): figura et colore EP3R

ore, et figura, sed in eis sint note similes, putabuntur ex toto dissimilia, cum aliqua dissimilitudo sit inter ea. Et ita est error in similitudine et dissimilitudine propter conclusionem ex apparentibus tantum factam.

- 145 [7.103] Et in omnibus predictis procreatur error ex solo situ intemperato, quoniam eo intra temperamentum sito, aliis sicut sint manentibus, non accidet erronea estimatio.

[Distinctio 3]

*Lux a temperantie finibus egreditur, et ob hoc
solum in omnibus quorum fit adquisitio
per sillogismum error procreatur.*

- [7.104] In longitudine ex lucis parvitate: Si in longitudine
5 temperata non multum circa fiat hominum dispositio ut sit unus post alium, et visu huic dispositioni de nocte adhibito, videbuntur sibi coherere incomprehensa inter eos distantia propter debilitatem lucis, que pateret si lux esset fortis. Qui homines, si in eandem partem moveantur equali motu, simul
10 semper moveri putabuntur.

[7.106] In situ: Si in nocte non obscura aliquid modicum a visu declinatum opponatur visui, existimabitur in eo situs rectitudo propter debilitatem lucis egressam a temperamento.

- [7.107] Similiter figura multorum laterum equalium circu-
15 laribus apparebit de nocte inspecta, quoniam occultat angulos lux nimium debilis.

[7.108] Pari modo, spera sic visa reputatur superficies plana, quia occultatur visui partium eminentia.

- [7.110-111] In magnitudine: De nocte inspecto homine, et
20 viso nemore aut remoto ab eo pariete, videbitur propinquitatis hominis ad nemus vel parietem, cum lateat visum distantia

141 sint: sunt P1/note inter. a. m. S/post toto scr. et del. s Er 142 post aliqua add. eis
C1/dissimilitudo corr. ex similitudo C1Er/est om. C1EErL3P3 145 procreatur: pro-
creetur L3; corr. ex procreetur a. m. C1/error om. C1L3 147 sint: sunt C1EErL3P3R/
accidet: accidit C1EErL3P3R 1 temperantie corr. ex temperantia L3/ob: ab S
4 ex corr. ex et a. m. C1/post si add. enim R 5 temperata corr. ex tantum S/circa: certa
SR; alter. in certa C1P3 (a. m. C1)/hominum: homini ErP1P3 6 et: vel EEerL3P3; alter.
ex vel in parum a. m. C1/post et add. non ErL3 (scr. et del. L3) 7 coherere: cohere P3/
post coherere add. et R/incomprehensa: ita comprehensa Er 8 que: et P1S/post fortis
scr. et del. si h P1 11 post situ add. ut R/aliquid corr. ex aliud Er/modicum: mo-
dice R 12 post visui scr. et del. es P3/rectitudo (13) alter. ex rectudo in erectudo S
13 egressam: egressae R 15 inspecta: aspecta R 17 superficies corr. ex
species P3 18 visui: visum Er; visu S 19 de: ut R 20 post nemore add. et
E/remoto corr. ex remote a. m. C1

eorum, licet sit plurima. Et forsan exhibit idem radius super
caput hominis ad altitudinem nemoris secundum quantitatem
distantem a nemore, et in hoc situ videbuntur eiusdem esse
25 altitudinis, aut forsitan homo videbitur maioris, quod non
accideret si lux in temperamento esset, quoniam distantia homi-
nis ad nemus etiam discerneretur, et altitudo uniuscuiusque
secundum terram apparentem mensuraretur.

[7.112] In distinctione, numero, continuitate erit error ex
30 lucis debilitate. Si de nocte videatur tabula in qua sit linearum
obscurarum protractio, ut sit ad mensuras capiendas, putabit
forsan videns divisiones esse vel fissura; et ita error in distinc-
tione, quia continuum apparet divisum, et in numero, quia
pluralitas in uno.

35 [7.114] Similiter, existente visu in lucis fortis reflexione, si
adhibeantur corpora modicum distantia, apparebunt continua;
et ita error in continuitate propter lucem nimium, aut fortem,
aut debilem.

[7.116] In motu aut quiete accidit error in luce. Si de nocte
40 comprehenderit visus hominem et remotum ab eo nemus, oc-
cultabitur distantia hominis ad nemus. Et si moveatur videns
ad hominem illum, quanto magis ad eum accesserit distantiam
illam certius videbit, unde, cum prius, simul cum nemore ap-
pareret ei homo visus. Et quanto ad eum accedit plus videtur
45 a nemore remotus, et cum certum sit ei nemus immotum ma-
nere, sillogizabit hominem visum a parte nemoris incedere, licet
veritas habeat ipsum immotum esse, quod non accideret in
temperata luce.

[7.117] In quiete: Homo de nocte visus non plene compre-

22 licet sit *om.* P3/sit *om.* C1EEr; *inter.* L3/plurima: plana P3; *corr.* ex plura L3; *alter.* ex
plura in plana *a. m.* E/forsan: forte P1; forsitan S 23 ad: et C1EErL3P3 24 dis-
tante: distantie EErP3R/situ: casu C1EErL3P3/videbuntur *corr.* ex debuntur *a. m.* S/
eiusdem esse *transp.* EP3R 25 aut: et C1P1S/forsitan: forte P1/post videbitur *add.*
esse R/post maioris *add.* altitudinis C1 27 etiam *om.* EErP3R/uniuscuiusque *corr.* ex
unuscuiusque S 28 secundum *corr.* ex super C1 30 ante si *add.* ut R/videatur:
videantur C1P1 31 obscurarum *om.* P1; *inter.* *a. m.* S/ut . . . capiendas *om.* R/ut sit:
insit Er/ad *om.* P1 32 forsitan: forte P1; forsitan S/divisiones *corr.* ex dicens L3/
fissura: fissuras R/ita: iste P1S 33 quia¹: quod P3/divisum *om.* P3/et *om.* P1S
34 pluralitas: pluritas EP3 37 post et *scr.* et *del.* pri S/post error *add.* est R/nimium:
nimiam P1 38 aut debilem *mg.* L3 39 aut: et R/in²: ex C1EErL3R/de: enim R
40 comprehenderit: comprehendit C1L3 42 eum: illum R/post accesserit *add.*
tanto R 43 certius *corr.* ex tertius *a. m.* C1/nemore *corr.* ex nemor P3/appareret (44):
apparet E 44 ei homo *transp.* S/et *om.* P1RS/quanto: quando R/accedit: accidit L3S
45 et cum *transp.* EP3/cum *om.* Er; *inter.* L3 46 ante sillogizabit *scr.* et *del.* simil S/a
parte: ad partem C1EErL3P3 47 ipsum: hominem P3/esse: et E/quod: qui
error C1EErL3P3R 49 post quiete *add.* ut R/plene *om.* L3

50 henditur, unde si modicum moveatur, non discernetur motus,
et putabitur quiescere.

[7.118] In asperitate et lenitate erit error. De nocte visi
enim asperitas iudicabitur forsitan erit lenitas, aut econtrario
secundum quod fuerit rei vise qualitas.

55 [7.119] In raritate et densitate: De nocte enim remissa
iudicabitur in corpore multum raro raritas, quia, cum post
ipsum non plena fiat comprehensio solidi, existimabitur remis-
sionem raritatis eius viam negare visui. Corpus vero modicum
rarum iudicabitur solidum.

60 [7.121] In umbra et tenebris: Si in pariete albo fuerint par-
tes obscure, et cadat super parietem illum lux candele, iudica-
bit forsitan videns obscuritatem illam esse umbram, et videbi-
tur ei forsitan quod procedat apparens umbra a vicino pariete;
et ita error in umbre estimatione.

65 [7.122] Similiter, si fuerit in parte parietis nigredo multum
intensa, existimabitur forsitan vacuitas foraminis iter prebens
egredientibus tenebris. Et si tota parietis superficies afficiatur
intensa nigredine, totus forsitan putabitur tenebre, ut accidit in
pariete cooperto ignis fuligine, viso sub debili luce.

70 [7.124] In specie et deformitate: Palam quod de nocte vi-
detur facies formosa, licet in ea sint macule, sicut lentiginosa.

[7.125] Et si fuerint in re visa picture subtiles totalis speci-
ei cause, cum in nocte visum lateant, videbitur res deformis.

75 [7.127] In similitudine et dissimilitudine: In corporibus
eiusdem speciei, coloris, et figure in quibus partialis diversitas
per latentes notas in debili luce omnimoda iudicabitur simili-
tudo.

[7.128] Et si diversa fuerint corpora in specie, colore, et

50 moveatur: videatur ER; corr. ex videatur a. m. P3/discernetur: discernitur EP3R/post
discernetur scr. et del. et C1/motus corr. ex visus S/motus et (51) transp. EL3P3R
51 et inter. a. m. C1 52 visi: ubi C1; nisi ErP1; visa R; corr. ex ubi a. m. S/visi enim (53)
transp. R 53 iudicabitur: iudicatur EP3R/forsitan: forte P1; forsitan R/erit om.
EErL3P3R; inter. a. m. C1 54 qualitas: quantitas EP3; corr. ex equalitas L3 55 den-
sitate: lenitate Er; corr. ex lenitate L3/post densitate add. fit error C1 56 iudicabitur:
iudicantur S/cum om. P1/post inter. a. m. E 57 estimabitur: estimabit C1EErL3P3/
remissionem (58): remissio R 58 raritatis: raritas EP3/post eius scr. et del. viam P3
59 iudicabitur: videbitur C1EL3P3R 62 forsitan: forte P1 63 forsitan: forte P1/
procedat: procedit P1 64 post error add. est R 65 si inter. P3/in parte om. P1S/
nigredo: ingredo Er 66 intensa om. R/forsitan: forte P1 67 afficiatur: corr. ex
efficiatur C1L3 68 forsitan: forte P1 69 cooperto: cooperte L3; corr. ex cooperte
a. m. C1/post fuligine add. et C1EL3P3R/sub: in C1EL3P3R 70 post palam add. enim
R/quod: et L3 71 sint: sunt P1/post sicut add. in R 75 ante eiusdem add. enim
R/post quibus add. est R 76 iudicabitur: videbitur C1/iudicabitur similitudo (77)
transp. EP3R/iudicabitur . . . omnimoda (80/81) mg. a. m. E 78 post specie add. et P1/
et² om. C1ErL3S

80 figura, sed ex aliquibus notis conformitas partialis propter occultationem notarum ex remissione lucis iudicabitur omni-
moda diversitas corporum.

[7.130] Et palam in omnibus predictis errorem accidere ex sola debilitate lucis, cum enim ipsa inter terminos temperantie fuerit sita, error non accideret aliis immotis.

[Distinctio 4]

*Quantitas egreditur a temperantia, et ille
egressus causa est erroris in omnibus
quorum fidem facit sillogismus.*

5 [7.131] Error erit in longitudine ex causa predicta. Si vide-
antur duo homines a longitudine temperata, et si in suo genere
maxima, et unus paululum fuerit ante alium, non discernetur
via inter eos sita, unde unus eorum apparebit circa alium. Et
accidit error quoniam distantia eorum, cum multum sit parva,
non est proportionalis totali eorum a visu elongationi, licet
10 elongatio sit temperata.

[7.133] Est autem error in longitudine quoniam homines illi
iudicabuntur ab oculo eque remoti, et ita quantitas unius longi-
tudinis maior quam sit in veritate, unde est error in longitu-
dine.

15 [7.134-135] In situ propter quantitatis parvitatem est er-
ror. Quoniam si granum sinapis fuerit ab oculo declinatum,
tamen videtur rectum, quoniam pro parvitate nimia non potest
deprehendi declinatio huius grani super lineam intellectualem
in quam axis communis cadit orthogonaliter, quoniam non
20 plene discernitur longitudo inter hanc lineam et extremitates
grani, cum sit minima, et secundum hanc longitudinem consi-
deratur declinatio eius super lineam illam. Et secundum hanc
lineam consideratur semper declinatio rei vise respectu visus

79 sed: si P3/post conformitas add. est R 80 remissione: remotione P1S 83 enim
om. EErL3P3R; mg. a. m. C1 84 fuerit om. EErL3P3R; mg. a. m. C1/fuerit sita transp.
C1/accideret: accidat R 1 post ille scr. et del. eg P3 2 egressus corr. ex egressa L3/
causa corr. ex causam C1/causa est transp. C1L3 3 quorum: quibus R 4 error
inter. L3/post error mg. enim a. m. C1/error erit transp. C1/ante ex add. et S/predicta corr.
ex predicta a. m. E/ante si add. ut R 5 si om. P1R 7 unde om. P1S; corr. ex unum
a. m. C1/unus: unius Er/et: vel L3; corr. ex vel a. m. C1 10 temperata: intemperantia
P1S; corr. ex intemperata C1 13 est om. EErL3P3R/est error: error erit C1 15 quan-
titatis parvitatem: quantitatem longitudinis L3 16 si . . . sinapis: granum . . . si
EErL3P3R/fuerit: fuit L3 17 nimia corr. ex minima P1/non: ut Er 18 deprehendi:
comprehendi C1L3/grani om. P1 19 quam: qua P1S/orthogonaliter: dico generaliter
Er/ante quoniam scr. et del. i Er 20 hanc mg. a. m. C1 21 minima: nimia ErL3;
corr. ex nimia a. m. C1 23 semper om. P3

utriusque, et ita error in situ ex quantitate immoderata.

25 [7.137] In figura: Cum res visa fuerit multum parva, si fuerint in ea anguli, occultabuntur visui, unde fortassis eius forma, cum non sit, existimabitur rotunda aut longa.

[7.138] Et si fuerit in ea aliqua incurvatio modica, latebit visum, et existimabitur superficies eius plana, unde palam
30 quod error in figura.

[7.140] In quantitate quantitas errorem invehit. Propositis visui duobus corporibus quorum unum modicum excedat aliud, aut in longitudine sola aut in latitudine, forsitan iudicabuntur equalia in omni dimensione. Et est error iste quoniam excrementum unius dimensionis super aliam evasit fines temperantiae respectu visus cum sit ei insensibile pro nimia sui diminutione. Ob hoc necessarie sunt mensurae ut verificentur quantitates corporum cum non adquiratur certitudo per visum.

[7.142] In divisione error accidit. Capillo adherente vasi
40 vitreo, apparebit divisio esse in vitro et fissura cum ibi sit continuas vera. Et provenit hoc ex capilli tenuitate, quoniam, si adhererit vitro quantitas corpulenta, non existimabitur in eo fissura.

[7.143] In continuitate: Si pretenduntur visui folia pargameni tenuia, equalis altitudinis, bene compressa, et ignoret videns esse folia, iudicabit ipsa esse continua et unum corpus efficere. Et est erroris causa quantitas viae interiacentis foliaque pro sui parvitate non percipitur a vidente. Et eadem erit causa erroris numeri que continuitatis.

50 [7.145] In motu: Si moveantur duo quorum unum paulu-

24 *post ita add. est P1/post error add. est R* 25 *post figura add. erit error C1/multum: valde P1* 26 *fuerint: fiunt C1L3/anguli rep. C1EP3R/fortassis: forte P1; fortasse R*
28 *aliqua om. C1EErL3P3R/incurvatio corr. ex curvatio C1* 29 *plana mg. a. m. C1/post palam scr. et del. et Er* 30 *quod error alter. in error quod Er/post error add. est C1R* 32 *ante visui add. enim R/modicum: modice R/aliud (33) om. EP3*
33 *aut: ut C1; om. R/sola . . . latitudine om. P3; inter. a. m. S/forsan: forte P1; forsitan EP3R* 34 *in om. EP3R/excrementum (35): incrementum C1L3/aliam: alium L3/post aliam scr. et del. eq C1* 36 *pro nimia: propter nimiam P3/sui: sua R/diminutione (37): dimensionem EL3P3; corr. ex dimensione a. m. C1* 37 *mensurae corr. ex figure EP3/verificentur: inficientur P1* 39 *post capillo add. enim R/adherente corr. ex adhem P3/vasi om. R; corr. ex vase L3* 40 *vitreo: vitro R/fissura: fixura Er*
41 *tenuitate alter. in parvitate a. m. S* 42 *adheserit corr. ex adherit P1/adheserit vitro transp. P3/corpulenta corr. ex copulenta P3* 43 *fissura: fixura Er; corr. ex fixura L3*
44 *ante si add. erit error C1/post si add. enim R/pretendantur: pretendunt C1/visui: visu Er; om. L3* 45 *altitudinis: latitudinis R/compressa corr. ex compresse Er/ignoret: ignoratur P1; corr. ex ignoret C1* 46 *esse² om. C1ErL3S* 47 *erroris: entoris Er/causa quantitas transp. C1L3/interiacentis: interiacentes Er; corr. ex interiacentes C1/ante folia add. inter R* 48 *sui: sua R* 49 *erroris om. L3; mg. a. m. C1* 50 *post si add. enim R/quorum: quarum Er/post unum add. moveatur R/paululum (51): paulum ErP1S; paulo R*

lum velocius alio, putabit videns equalem esse motum eorum, quod est cum insensibile sit videnti unius super alium excrementum.

[7.146] Similiter quantitas excessus vie quam incedit unus
55 super eam quam incedit alius imperceptibilis est visui, unde iudicatur equalitas viarum et motuum.

[7.147] In quiete: Cum offertur visui animal multum parvum, forsitan movebitur pars eius aliqua, et ipsum iudicabitur immotum, cum motus partis lateat visum.

[7.149] In asperitate et lenitate: Cum enim occurrerit visui
60 res multum parva, iudicabitur forsitan lenitas ubi fuerit asperitas, aut econtrario. Quoniam, ut dictum est, asperitas non comprehenditur in corpore nisi ex umbra quarumdam partium super alias, vel eminentia earum et depressione aliarum, quod
65 totum occultatur iudicio videntis pre nimia parvitate corporis.

[7.151] In raritate et soliditate: Si quis intueatur corpus valde parvum politum, ut ab eo possit lux reflecti, margarite simile, rarum esse iudicabit cum non sit.

[7.152] Similiter, viso corpore raro multum parvo, quia
70 post ipsum non sit corporis solidi comprehensio, simulatur esse solidum.

[7.154] In umbra et tenebris: Si in pariete albo visui opposito fuerit punctorum valde nigrorum distinctio, adhibita
75 solis luce, sed directe in pariete cadente vel prope, existimabuntur a vidente singula puncta singula esse foramina postquam erumpant tenebre, unde error cum tenebrarum estimatione ex sola punctorum parvitate, que non accideret si nigredo quantumcumque intensa magnam partem parietis inficeret.

51 putabit: putabis *Er* 52 quod: quia *R*/est *om.* *L3R*; *inter. a. m.* *Er*/cum *om.* *R*; *alter. in* est *L3*/sit: est *R*/videnti *om.* *R*/post unius *add.* motus *C1* 54 ante similiter *add.* videnti *R*/quantitas: quantitatis *P1* 55 incedit: incedat *P1S* 57 post quiete *add.* fit error *C1*/post cum *add.* enim *R*/animal: aliquid *R* 58 forsitan: forte *P1*/eius *om.* *P1S*/aliqua *corr.* ex alia *L3*/iudicabitur: iudicabatur *P3*; *corr.* ex indicabitur *a. m.* *E* 59 visum: visuum *E*; *corr.* ex visuum *P3* 61 forsitan: forte *P1*; forsitan *RS*/ubi *corr.* ex nisi *L3* 62 aut: et *C1EL3P3R*/econtrario *corr.* ex econverso *C1* 63 quarumdam: quarumdem *S* 64 post super *scr.* et *del.* aq *C1*/post alias *scr.* et *del.* e *C1*/et: vel *EP3* 65 occultatur: occultabitur *EP3*/post nimia *scr.* et *del.* asper *P3* 66 post quis *add.* enim *R*/intueatur: intuetur *Er* 67 possit lux *transp.* *C1EErL3P3R*/post reflecti *add.* sicut est *R* 68 iudicabit: iudicabitur *P1RS*/non *corr.* ex vero *a. m.* *C1* 69 similiter *corr.* ex aliter *a. m.* *S*/multum parvo: multo *P1*/quia: quod *C1R* 70 simulatur: existimatur *R*; *alter. in* silogizatur *a. m.* *C1* 72 ante si *add.* fit error *C1*/post si *add.* enim *R*/pariete *corr.* ex parte *a. m.* *C1*/albo: aliquo *C1*/opposito (73) *corr.* ex oppositio *a. m.* *C1* 73 post fuerit *scr.* et *del.* po *P3*/nigrorum: magnorum *EP3* 74 pariete: parietem *EP3R* 75 postquam (76): postquae *R* 76 erumpant: erumpnant *C1L3*/unde *corr.* ex une *S* 77 que: qui *R* 78 quantumcumque . . . nigredo (79) *mg.* *a. m.* *S*/magnam: magna *P1P3S*/post partem *add.* magnam *P3*/inficeret: interficeret *P1*

[7.155] Si autem fuerit in punctis illis nigredo non adeo
 80 intensa, reputabuntur quidem puncta illa foramina in quibus
 sit umbra cum lux non penetret ea, sicut solet accidere luce
 super multorum foraminum superficiem cadente, unde error
 umbre ex sola punctorum diminutione.

[7.156-157] In specie et deformitate: Cum pre sui parvi-
 85 tate occultentur visui deturpantes corpus visum macule, acci-
 dit erroneum speciei iudicium, quia sumitur ex apparentibus
 tantum, sicut est error in deformitate cum propter parvitatem
 latent picture decorem ingerentes rei vise.

[7.159-160] In similitudine et dissimilitudine: Cum note
 90 minutissime inter aliqua corpora similitudinis aut dissimili-
 tudinis fuerint cause, quia pretereunt visum pre parvitate sua,
 iudicabitur similitudo aut dissimilitudo omnimoda. Et sume-
 tur iudicium ex apparentibus tantum.

[7.162] In omnibus predictis est error in sillogismo ex par-
 95 vitate corporis; cum ea temperata, non accidit error, aliis im-
 motis.

[Distinctio 5]

*Soliditas aliquando egreditur temperamentum
 et errorem inducit in quolibet eorum que
 comprehenduntur per sillogismum.*

[7.163] In longitudine: Si minima fuerit corporis soliditas,
 5 et est ut sit valde rarum sicut est cristallus purus, et sit post
 ipsum lucidum luce forti corpus, non plene comprehenditur
 cristallus; sed quasi non esset intermedium comprehendetur
 corpus per ipsum. Unde, cum quasi non sit fiat rari acquisitio,
 non plena erit longitudinis eius ab eo comprehensio, unde error
 10 in longitudine, quare, si corporis rari situs fuerit declinatus,

80 post intensa scr. et del. p Er 82 multorum: multarum S/superficiem: speciem
 EErL3P1P3RS; corr. ex speciem a. m. C1 84 et om. ErL3P1S/ante cum add. accidit
 error C1/sui: sua R 85 occultentur: occultantur C1EL3P3R; occultatur Er/macule:
 macula S 86 erroneum corr. ex errorem L3/post erroneum scr. et del. erroneum C1/
 speciei: specie EP3/iudicium corr. ex iudicatur a. m. C1 88 latent: lateant EP3
 89 ante cum add. accidit error C1/post cum add. enim R 90 aut corr. ex et P1
 91 post pre scr. et del. sui P1 92 aut corr. ex a a. m. Er/aut dissimilitudo om. C1;
 inter. L3 95 post ea add. existente EP3R/accidit: accidat C1EErL3P3R/post accidit
 add. nisi C1L3 (scr. et del. C1) 1 aliquando: autem C1L3 4 ante si add. erit error
 C1/minima: minuta L3; corr. ex minuta a. m. C1 5 sit^l om. P1S 6 ipsum: ipsam
 corpus R/forti: forte P1; corr. ex forte C1/corpus om. R/plene om. R/comprehenditur:
 comprehendetur EP3R 7 non: nullum R/comprehendetur: comprehenditur C1
 8 per ipsum corr. ex ipsum per C1/ipsum: ipsam R/post sit add. sic P3 9 longitu-
 dinis . . . eo: ab eo longitudo P1/eius om. S/ab eo om. L3

occultabitur videnti declinatio, et iudicabitur forsitan rectitudo, unde error in situ et etiam in longitudine, quoniam una eius extremitas eiusdem longitudinis reputabitur cum alia, cum sint diverse.

- 15 [7.164-165] Verum quoniam quantitas corporis comprehenditur ex longitudine et anguli sub quo videtur capacitate, ignorata longitudine, accidit error in quantitate. Modo consimili accidit error in figura, si enim in corpore fuerint anguli, occultabuntur videnti, unde sexquiangula forma putabitur
20 sperica. Et si modica fuerit incurvatio in corpore, latebit, et iudicabitur corpus planum esse.

- [7.166-169] In divisione: Si fuerit per corpus hec linea nigra, apparebit enim corpus divisum in loco in quem cadit linea, unde existimatur plura. Si vero fuerint duo corpora talia
25 modicum a se distantia, reputabuntur continua, unde error in continuitate. Et palam quod ex hiis error erit in numeri comprehensione, cum unum plura vel plura unum appareant.

- [7.170] In motu erit error ex immoderamine raritatis. Si opponatur foramini corpus valde rarum, ut cristallus, et huius
30 corporis extremitates lateant visum, et post corpus hoc moveatur aliud, putabit videns corpus rarum moveri cum sit immotum, quod non accideret ipso temperate solido.

- [7.171] In quiete accidet error ex eadem intemperantia. Si includatur in manu corpus valde rarum coniunctum manui, et
35 ab ea recedat, et moveatur intra manum revolutionis motu, immota manu, ita tamen quod appareat divisio aliqua inter ipsum et manum, iudicabitur corpus illud immotum. Quoniam

11 forsitan: forte P1 12 post et add. est C1P1/post etiam add. error C1EErP3R/una
corr. ex vana L3 13 post longitudinis add. a visu C1/cum² corr. ex que L3; cum sint:
tamen sunt P1S; corr. ex tamen sunt a. m. C1 15 verum: deinde EL3P3R; corr. ex vel
unum a. m. C1/post verum scr. et del. deinde C1 17 longitudine inter. ErL3 (a. m. Er)
18 accidit: erit C1EErL3P3R 19 sexquiangula: sexangula R; corr. ex sexquianguli
a. m. C1 20 et¹ om. EP3R/post si add. vero EP3R (inter. E; inter. a. m. P3) 22 divi-
sione: distinctione EL3P3; figura Er/post divisione add. vel distinctione C1/ante si add.
erit error C1EErL3P3R/post si add. enim R/per: pars C1EErL3P3/corpus: corporis
C1EErP3; alter. in corporis L3/hec: huius C1EL3P3; huiusmodi Er; magnae raritatis R/
nigra (23) corr. ex recta C1 23 enim om. R/cadit: eadem Er 24 unde . . . plura om.
R/existimatur: existimabitur C1EErL3P3/plura: plana EErL3P3; alter. ex plana in divisa
a. m. C1 26 quod: quia L3/post hiis scr. et del. erit C1/error erit transp. C1ErL3P3R
27 post cum add. vel C1EErL3P3R/appareant: apparebunt EP3R 28 immoderamine:
immoderatione EP3R; corr. ex immoderatione P1 29 opponatur: opponuntur L3/
opponitur P1S/ut: vel L3/huius: huiusmodi L3 31 aliud rep. C1 32 ipso: ipsum
E/post ipso add. corpore C1/solido om. P1S/post solido add. existente C1 33 accidet:
accidit R/intemperantia: temperantia ErP1S/post si add. enim R 34 includatur . . .
rarum: corpus valde rarum . . . in manu R/manui: manu P1S 35 intra: inter EL3P3;
corr. ex inter C1/post intra scr. et del. in C1/revolutionis: resolutionis EP3 36 quod: ut
R/appareat corr. ex apparet a. m. C1 37 iudicabitur corr. ex videatur a. m. C1/
immotum: motum P3

non potest in eo comprehendi motus nisi mutatione situs partis alicuius respectu manus vel partis eius, et quia omnimoda
 40 est similitudo in partibus vel pretenditur propter raritatem, non potest discerni alicuius partium situs, quare nec motus.

[7.173] In asperitate: Si in corpore multum raro fuerit asperitas non magna, putabitur forsitan lene. Si vero fuerit lene et post ipsum statuatur corpus asperum aut corpus diversorum colorum, existimabitur hoc rarum asperum, unde error
 45 in lenitate.

[7.175] In raritate: Si post corpus valde rarum sit aliud corpus rarum non multum et colore forti coloratum, apparebit primum non multum rarum; sed existimabitur eius raritas secundum raritatem postpositi, unde vitrum alii vitro superpositum non apparet ita rarum sicut apparet eo solo visui adhibito, unde error in raritate.

[7.176] Si autem post primum rarum statuatur corpus solidum, iudicabitur primum solidum, unde error in soliditate.
 55 Pari modo, si vas valde rarum contineat vinum, cum post illud non percipiatur lux aut corpus aliud, iudicabitur forsitan totum cum vino vitrum esse unum corpus solidum.

[7.178-179] In umbra erit error ex raritate. Luce solis in domum aliquam per foramen aliquod descendente et super
 60 fenestram vitream cadente, tamen domus illa sit umbrosa, apparebit super fenestram illam umbra, licet in veritate lux super ipsam incidat, que quidem lux comprehenderetur si solidum esset fenestre corpus, quoniam non transiret, et ita super solidum appareret, unde error in umbra.

38 in eo comprehendi: comprehendi in eo C1L3/post nisi add. in P1S/post situs add. partium EP3R/partis (39): parti P1S 39 omnimoda: omnimodo P1S 40 post vel add. pre P1/raritatem: parvitatem P1 41 quare: quia P1 42 ante si add. erit error C1; add. est laenitate R/post si add. enim R; scr. et del. post corpus C1 43 post asperitas scr. et del. in asperitate sit in corpore C1 43 post putabitur scr. et del. non Er/forsitan: forte P1/si . . . lene (44) om. P1 44 et om. EL3P3; mg. a. m. C1/post . . . statuatur: statuatur . . . ipsum R 45 post colorum scr. et del. re P1/post hoc add. corpus R/post rarum add. et laene R 46 in om. EP3 47 post si add. enim R 48 forti corr. ex forte C1 49 primum: post P3/sed: si E; inter. C1 50 postpositi corr. ex positi post a. m. S/ante unde add. corporis C1L3 (inter. L3)/vitrum: vitri P1S 51 apparet ita rarum corr. ex apparum L3/ita rarum mg. a. m. C1/ita . . . apparet om. P3/apparet²: appareret ER; om. C1 54 post unde add. est C1/soliditate corr. ex solita P3 56 forsitan: forte P1; forsitan R/totum (57) om. C1L3P3 58 erit om. P1S/post luce add. enim R 59 descendente corr. ex descendere a. m. C1; corr. ex ascendente L3/et mg. a. m. C1 60 post fenestram add. aliquam C1L3/illa mg. a. m. C1 61 post fenestram scr. et del. tam P1 62 super: in EEerL3P3R; corr. ex in a. m. C1/ipsam: illam Er/incidat: incidit EEerP1P3S/comprehenderetur: comprehenderatur S; corr. ex comprehenderentur C1 63 non transiret: pertransiret S/ita om. P3 64 post super add. in P3/appareret: apparet EL3P3; corr. ex apparet C1/in inter. a. m. Er

65 [7.180] In tenebris: Luce solis in aquam fluminis non descen-
dente, aut in mare, sicut accidit hora matutina et vespertina,
si fuerit claritas in aqua, apparebit tenebrosa. Et quanto fuerit
clarior, tanto putabitur tenebrosior.

[7.182] Et accidit hoc quoniam pars aque superior umbram
70 iacit super proximam partem inferiorem, et illa proxima super
aliam inferiorem propinquam, et ita per singulas usque ad fun-
dum.

[7.183] Et licet singularum partium umbra in se sit modica,
tamen coniuncte unam efficiunt maximam, sicut palam est in
75 colore vini accidere. In modica enim quantitate vini color est
debilis, et in multa, licet eiusdem modi, fortis. Causa autem
quare in mari umbra iacente videantur esse tenebre in maris
claritate est quoniam intensa claritas intensam redit raritatem,
unde visui maiorem pretendit penetrationem. Unde fit
80 acquisitio plurium maris partium umbram facientium quarum
umbrarum aggregatarum perceptio inducit fidem tenebrarum.

[7.184] Si vero mare fuerit turbulentum, propter diminutam
raritatem penetrabit visus paululum, et comprehendet modi-
cam aque partem. Et licet faciat umbram, cum ipsa sit remis-
85 sa, color illius partis vincit umbram, in turbida enim color
apparet, in clara nullus. Unde et propter apparentem turbide
colorem et propter umbre partis apparentis remissionem non
comprehenduntur in aqua tenebre, unde ipsa turbida appare-
bit clara, et clara tenebrosa. Solis autem radio cadente super
90 faciem maris, cum ei per raritatem ipsius pateat transitus,
abicietur omnis tenebra et umbre apparentia.

[7.185-187] In decore et deformitate: Si in vase multum

65 *post luce add. enim R/aquam: aqua P1S* 66 *aut corr. ex autem C1* 67 *ante si add. et C1EL3P3R/in aqua mg. C1L3 (a. m. C1)/aqua: qua Er/et . . . tenebrosior (68) mg. a. m. C1/quanto: quando P1; corr. ex quando L3* 68 *post putabitur add. magis C1/tenebrosior: tenebrosa C1; corr. ex tenebrosa P3* 69 *ante hoc add. ex P1S/hoc om. Er; mg. a. m. C1; inter. L3* 71 *aliam corr. ex illam a. m. C1/propinquam corr. ex propinquitate S/fundum (72): summum P1* 73 *et mg. a. m. C1/singularum: singularium Er; alter. ex singulariter in singularium a. m. C1* 75 *vini¹² alter. in vinis a. m. C1/quantitate vini transp. Er/vini² inter. L3/color om. EL3P3/color . . . debilis (76): est . . . color C1* 76 *licet eiusdem transp. P3* 77 *umbra: umbram EErL3P1RS/iacente: iacienti P1S; alter. in oriente a. m. E* 78 *est inter. C1* 79 *pretendit: redit C1EL3P3R; concedit Er* 80 *plurium corr. ex plurimum S/quarum: quam EP3; quare P1; quoniam R; corr. ex quare a. m. S* 81 *umbrarum: umbram P3* 83 *comprehendet: comprehendat P1* 84 *post licet add. modicam C1/cum . . . vincit (85) om. C1* 85 *umbram: umbra C1 (mg. a. m.)/post enim add. aqua C1R* 86 *post apparet add. in turbida EP3 (scr. et del. P3)/apparentem om. R/post turbide add. aquae R* 88 *turbida corr. ex turbidam P3/turbida apparebit (89) transp. P3; corr. ex apparebit turbida C1/apparebit clara (89) transp. L3* 89 *clara¹: colorata R/clara² om. S/solis corr. ex solum P1* 90 *ei corr. ex rei C1/pateat: patet C1* 91 *tenebra: transitus L3; tenebrarum R; corr. ex transitus a. m. C1/umbre: umbra P1S* 92 *ante et scr. et del. in eo S/si inter. E/post si add. enim R*

raro sint particule vel incisure ipsi decorem inferentes, et
imponatur vasi illi vinum turbidum et turpe, occultabuntur
95 decoris cause, et iudicabitur vas deforme, ut aliquando accidit
in vitreo vase. Econtrario, si vas tale deformat aliquem eius
particule, et imponatur ei vinum clarum lucidum et in colore
formosum, occultabuntur deformitatis cause, et reputabitur
vas speciosum cum sit deforme.

100 [7.189] In similitudine et dissimilitudine: Si duo vasa mul-
tum rara convenient in forma, specie, raritate, sed discrepant
in aliquarum partium dispositione, vino eiusdem coloris eius-
dem claritatis implenta, latebunt cause diversitatis, et reputa-
buntur omnino similia.

105 [7.190] Si vero inter ea fuerit diversitas in specie et forma,
sed in aliquibus partialibus convenientia, vino simili plena,
putabuntur omnino dissimilia, unde error in similitudine et in
dissimilitudine, quia sumitur iudicium ex apparentibus tan-
tum.

110 [7.192] Et in omnibus predictis accidit error ex sola solidi-
tatis intemperantia, quoniam, aliis in esse suo manentibus,
non accidit error ea ad temperantiam revocata.

[Distinctio 6]

*Raritas aeris visum et rem visam intercidentis
egreditur temperamenti proprii metas et
errorem generat in omnibus quorum
fidem visus efficit et sillogismus.*

5 [7.193-194] In longitudine: Si fuerit aer pruinosis et ob-
scurus, sicut in horis matutinis solet accidere, turre aliqua visui
opposita in longitudine temperata, existimabitur plus a visu
elongata quam habeat veritas, unde error in longitudine est,
quoniam non comprehenditur longitudo inferioris terre secun-

93 sint: sunt C1L3/inferentes: afferentes R 95 ut corr. ex ubi a. m. C1 96 vitreo
vase transp. P1/deformant: deformatur P1S/alique eius transp. C1EL3P3R/eius: om-
nis P1 97 ei: enim P3 99 speciosum: preciosum P1S 101 in forma om. L3;
inter. a. m. C1/post specie add. et P1/discrepant: decrepant P3; discrepent R 102 post
aliquarum add. rarum P1 103 implenta: impleantur R 106 ante vino add. et R/
plena: impleantur R; corr. ex plene Er 107 similitudine: specie P1S/et in dissimi-
litudine (108) inter. L3 108 iudicium: indicitur Er 111 esse suo transp. R
112 accidit: accidet C1ErL3/post error add. ex ea sola soliditatis intemperantia EP3 (post
intemperantia scr. et del. in P3) 1 intercidentis: interdicentis L3 2 temperamenti
om. P1S 4 et om. EErP3; inter. L3; et sillogismus: per syllogismum R 5 si . . .
longitudine (7) mg. a. m. E/post si add. enim R/obscurus (6): obscuris C1 6 turre:
turri P1RS 8 habeat: habet P1/post est add. et est C1ErL3; add. et causa est EP3R
9 comprehenditur: complectitur P3; corr. ex complectitur a. m. E/secundum (10):
super R

10 dum quam elongationis turris conviciatur mensura, et occulta-
tur terra ex raritate aeris diminuta, unde raritas est erroris
causa.

[7.195] Si autem in hoc aere declinetur modicum corpus
visum, occultabitur declinatio que pateret in aere claro, unde
15 error in situ.

[7.196] Et si fuerit in corpore gibbositas modica, apparebit
planum in tali aere, et si fuerint in corpore anguli, latebunt,
unde erroneum erit figure iudicium.

[7.197] In quantitate erit error ex tali aere, quoniam visum
20 maius apparebit quam in temperato aere, sicut accidit in cor-
poribus post aque raritatem comprehensis.

[7.198] Et si fuerit in corpore quasi linea nigra, putabitur
esse partium divisio, unde error in divisione.

[7.199] Et si fuerint duo corpora modicum a se disiuncta,
25 apparebunt in hoc aere continua, unde error erit in continui-
tate. Et ex hiis palam quod error est in numero.

[7.202] In motu: Si in hoc aere duo videantur quorum
unum alio paululum velocius moveatur, iudicabuntur forsitan
equales esse eorum motus, cum in temperato aere discerni
30 posset unius ad alium excessus. Et est error propter latens
excrementum vie unius super viam alterius.

[7.204] In quiete: Si quis post talem aerem a longitudine
temperata non parva videat aquam fluentem, aut iudicabit
eam immotam, aut, si fuerit fortis eius fluxus, minus quam
35 moveatur motam.

[7.206] In asperitate et lenitate: Quia in hoc aere videbitur
asperum lene propter latentes asperitatis causas, et visa re
polita, cum non discernatur reflexio in ea, existimabitur as-
pera.

40 [7.207-209] In umbra: Si post hunc aerem videatur corpus

10 conviciatur: coniciatur EP3; sumitur R 11 ex rep. S/diminuta: diminute E/erroris
causa (12) transp. R 13 modicum: modice R 14 in aere claro mg. a. m. C1/aere
om. C1; corr. ex aoere L3 16 post corpore scr. et del. anguli latebunt P3 17 planum
corr. ex plana P3 19 ex: in P1S 20 maius: magis EEr 22 quasi corr. ex
quas S 23 ante esse scr. et del. cor P1 24 post se scr. et del. esse C1/disiuncta:
distincta P1 25 hoc inter. a. m. C1/erit om. EErL3P3R; inter. a. m. C1 26 et om. C1/
est om. EErL3P3; inter. a. m. C1 27 post si add. enim R/hoc om. EP3 28 paululum:
paulo R/forsitan: forte P1; fortasse R 29 esse om. C1L3/post aere add. sic P1
30 unius: unus L3; corr. ex unus C1 32 in inter. L3/post quiete add. erit error C1/si
quis mg. a. m. C1/post quis add. enim R; scr. et del. si C1/post: per R/post longitudine scr.
et del. tem L3 33 post non add. tamen R/videat: videt P1S/aquam corr. ex quam S
34 immotam corr. ex immota P3/aut si: si autem P1S 36 lenitate corr. ex lenita P3
37 latentes corr. ex latentia a. m. C1 38 discernatur: discernetur C1/reflexio in ea: in
ea reflexio R 40 post si add. enim R

album in quo sint particule rotunde nigre, luce ignis in corpus
illud cadente ita tamen ut sit interpositio huius aeris, appare-
bit in locis illis umbra, aut forsitan reputabuntur foramina
viam tenebris erumpentibus prestantia, unde error in tenebris,
45 quare post hunc aerem corpus rarum apparebit minus rarum,
et forsitan putabitur solidum, et ita error in soliditate et raritate.

[7.211] In specie et deformitate per causas particulares
corpus decorantes vel deformantes in hoc aere latentes.

[7.213] In similitudine et dissimilitudine propter partiales
50 diversitatis aut convenientie causas inter duo corpora non
apparentes.

[7.216] In hiis omnibus provenit error ex raritate aeris sola
immoderata, cum, aliis immotis, in aere temperato non acci-
deret.

[Distinctio 7]

*Tempus extra temperamenti sui fines loca-
tum causa est erroris per singula quorum
fides in visu sumitur ex sillogismo.*

[7.217] In longitudine: Si subito intueatur quis aliquod
5 remotum a turre quod statim visui subripiatur, non poterit
plene discernere longitudinem inter illud et turrem, et iudica-
bitur forsitan aut minus remotum a turre quam esset in veritate,
aut magis. Et est quoniam in illa temporis instantia non per-
cipitur a vidente terra turri et rei vise intermedia secundum
10 quam sumatur distantie mensura, aut quoniam in tam brevi
tempore non potuit axis viam intermediam discurrere, unde
nec plene comprehendere, et ita error in longitudine.

41 sint: sunt P1 42 post ita scr. et del. quod cum non sit in ipso huius C1 / tamen om.
C1 / tamen . . . interpositio: que cum non sit in positio L3 / ut: quod C1 / ut . . . huius mg.
a. m. C1 / huius: huiusmodi C1 43 forsitan: forte P1 44 erumpentibus:
irrupentibus P1S; erumpentibus P3 / post in add. umbra et R 45 hunc aerem transp.
C1 / ante corpus add. caliginosum C1 46 forsitan: forsitan C1P3; forte P1 47 in: et
P1S / post et scr. et del. fo Er / per: propter R 48 vel: et P3 / deformantes corr. ex de-
forma a. m. C1 49 partiales: particulares R; corr. ex partialis a. m. C1 50 con-
venientie corr. ex continentie a. m. C1 51 apparentes: comparentes EEerL3P3; alter. ex
cooperantes in comparentes a. m. C1 52 ante in add. et C1EEerL3P3 / hiis inter. a. m. S /
hiis omnibus transp. P3 / provenit: prevenit P1 53 post cum add. aliis cum E; add. alias
cum P3 4 ante si add. ergo P1 / si inter. a. m. C1 / post si add. enim R / aliquod: ali-
quem P1S 5 turre: turri R / quod: et P1S 6 plene: plane P3 / turrem: turrim C1R /
et²: inde C1 (mg. a. m.) 7 forsitan: forsitan C1; forte P1 / aut om. P1; corr. ex autem C1 /
remotum om. P1S / turre: turri R / esset: sit R 8 et corr. ex autem a. m. C1 / post est add.
caussa R / post quoniam add. causa EP3 9 turri: intermedia inter turrim R / rei vise:
rem visam R / vise corr. ex visa C1 / vise intermedia transp. EP3 / intermedia om. R
10 sumatur: sumitur C1EP3R / tam om. R 11 potuit: poterit C1EL3P3R / discurrere:
discernere C1EL3P3R

[7.218] In situ: Cum aliquid subito occurrit visui et statim recedit, reputabitur forsitan rectum declinatum, aut econtrario.

15 [7.221] In figura: Si fuerit modica gibbositas in re subito visa latebit, et reputabitur res plana, aut latebunt anguli si fuerint in ea.

[7.222] In quantitate: Si quis tirsum ardentem moveat motu citissimo et intra viam modicam ut sepius vadat et revertatur per eam, apparebit via motus ignea, quoniam motus tirsi
20 ab uno vie termino ad alium sit quasi instanti.

[7.223] Unde propter temporis brevitatem non potest discerni vel quantitas vel motus tirsi, unde et hic error in motu.

[7.226] In divisione: Si aliquid subito visum a visu divertatur, et fuerit in eo linea nigra, putabitur esse divisio partium
25 illa nigredo.

[7.227-228] Et si corpora contigua aut valde propinqua subito videantur, existimabuntur continua, sicut accidit in scanni tabulis subito inspectis, unde error in continuitate.

30 [7.230] In motu: Cum duorum unum paulo velocius alio movebitur, motus in tempore modico comprehensi equales iudicabuntur, cum non tam subito comprehensibilis sit excessus.

[7.232] In quiete: Si aliquid modicum moveatur subito
35 visum, moveri non videbitur, quoniam via quam percurrit in tempore perceptionis sue imperceptibilis est visui pre sui parvitate. Superius autem explanatum est quod non comprehenditur motus in corpore nisi in sensibili tempore.

[7.233] Similis error accidit in rota modica. Cum citissime
40 volvatur, apparet immota cum non possit fieri comprehensio revolutionis eius in tempore tam parvo quam parvum est in

13 *post situ add. erit error C1* 14 *forsitan: forte P1/ aut econtrario: ex contrario L3/ post econtrario scr. et del. extremo C1* 15 *post figura add. accidit error C1* 16 *reputabitur: putabitur C1EErP3R/ anguli: aliqui E* 18 *ante in scr. et del. in quantitate si quis Er/ post quis add. enim R/ tirsum: titionem R; corr. ex visum a. m. C1/ moveat: moverit P1S; corr. ex movea C1* 19 *citissimo: cissimo P1/ intra: in terra S/ ut om. P1S* 20 *tirsi: titionis R; corr. ex visi a. m. C1* 21 *post quasi add. in R* 22 *unde: unum S/ temporis brevitatem transp. C1EL3P3R* 23 *vel² inter. C1L3 (a. m. C1)/ tirsi: titionis R; corr. ex visi a. m. C1/ post motu add. est P1S; scr. et del. subito C1* 24 *aliquid: quid C1EL3P3R/ ante subito add. enim R/ subito mg. a. m. C1/ divertatur (25): diversatur P1S* 27 *aut: vel R* 28 *continua: contigua P1/ post in scr. et del. san C1* 29 *scanni: scamnorum R/ post subito scr. et del. videan S* 30 *post duorum scr. et del. in C1* 31 *movebitur: movetur R* 34 *post si add. enim R/ modicum: modice R* 35 *visum: visu Er/ videbitur: movebitur P3* 36 *perceptionis sue transp. R/ visui: in visu C1* 37 *post superius add. etiam C1EErL3P3/ autem om. Er* 38 *in sensibili corr. ex visibili a. m. C1/ sensibili tempore transp. R* 39 *in: et Er/ post cum scr. et del. non C1* 40 *volvatur: volvitur R/ possit: sit P1S/ fieri om. P1S* 41 *tempore tam: temperatam Er/ post parvum add. illud P1S*

quo fit una eius revolutio.

[7.234] Idem error accidit in troco, unde error in quiete, quoniam non potest discerni mutatio situs partium troci, quare nec
 45 motus eius. Et si unius coloris fuerit trocus, palam quod non comprehenditur motus. Si vero plurium et diversorum colorum nec sic etiam apparebit motus, cum lateat colorum diversitas et pretendatur ex nimia festinatione confusa quedam colorum unitas.

50 [7.237] In asperitate: Cum subito videatur asperum, putabitur forsitan lene. Et si hoc modo videatur lene, non poterit in eo discerni lenitas aut asperitas, unde dubitatio et error.

[7.239] In raritate. Luce declinata super corpus rarum
 55 descendente subito visum, cum non percipiatur declinatio lucis, putabitur forsitan quod finis raritatis sit apparens raritas corporis. Quod, si in tempore modicum maiori adhibeatur visui, percipietur declinatio causa apparentie raritatis remisse.

[7.240] In soliditate: Si quis instantanter videat corpus rarum
 60 et post ipsum non discernat lucis transitum, putabitur esse solidum.

[7.241-242] In umbra: Si in albo pariete sint partes sub nigredine, descendente super ipsum ignis luce, subito vise, putabuntur esse umbre. Si vero nigredo visa fuerit intensa, existimabuntur foramina tenebris plena.
 65

[7.244-246] In specie et deformitate: Quoniam in tam parvo tempore non sunt comprehensibiles minute decoris vel deformitatis cause, sicut accidit cum aliquis movens per foramen intuetur faciem iudicat aliquando fedam formosam, vel
 70 econtrario. Et idem error accidit mota re visa, oculo immoto.

[7.247] In similitudine et dissimilitudine. Quoniam latent

42 quo: qua P1S 45 post non scr. et del. p C1 46 ante motus add. trocus P1S/
 plurium corr. ex plurimum C1/post colorum add. sit trocus C1 47 lateat: latet E
 48 pretendatur: pretenditur Er/colorum: color P1S 50 post cum add. enim R
 51 forsitan: forte P1/post videatur add. forte P1/lene² om. R 52 aut corr. ex ut a. m.
 C1/post aut scr. et del. aut S/et error (53) corr. ex error et Er 54 post raritate add. erit
 error C1/post luce add. enim R/post corpus add. remisse R 55 visum: visu P1
 56 forsitan: forte P1/finis: in fine R/raritas (57) corr. ex tanta a. m. C1 57 modicum
 maiori: paulo maiore R 58 visui: visus EP3R/percipietur: percipitur EP3/remisse:
 rei vise C1P1S; corr. ex rei vise L3/post remisse scr. et del. vel remisse C1 59 ante si
 add. accidit error C1/instanter mg. a. m. C1/post instanter add. motum C1/videat corr. ex
 videt a. m. E 60 ante esse add. illud R 62 ante si add. accidit error C1/pariete:
 parietes L3/nigredine (63): nigra EErL3P3R 63 subito: subite L3S 64 post
 nigredo add. earum C1EErL3P3R 65 ante foramina add. esse S (post esse scr. et del.
 umbre) 66 quoniam: quia R 68 movens: inspiciens R 69 vel: et P1
 70 error om. P1S; inter. a. m. Er/re corr. ex rei S/immoto corr. ex moto L3

particulares similitudinis aut dissimilitudinis cause.

[7.249] Et in hiis omnibus ex solo tempore non moderato
75 accidit error, cum in predictis nulla accideret eo ad temper-
antiam reducto.

[Distinctio 8]

*Visus debilitas et immoderatio errorem
invehit singulis per sillogismum
in visu comprehensis.*

[7.250] In longitudine: Si opponantur visui duo corpora
5 quorum unum coloris fortis et remotius aliud coloris debilis et
oculo propinquius, cum non fiat comprehensio longitudinis nisi
facta collatione inter aliqua, incertam faciet collationem debili-
tas visus.

[7.251] Et quia certum est homini quod ex propinquieribus
10 certior fit fides visui quam ex remotioribus, concludit illud
quod apparet ei certius ex hiis corporibus esse propinquius.
Et planum quod visui debili certior fit fides coloris fortis quam
debilis, licet modicum plus elongati.

[7.252] Idem error accidit etiam in temperantia visus, quo-
15 niam in longitudine magna propinquius iudicatur corpus cuius
color fortis quam cuius color debilis, licet non sit multum re-
motius.

[7.254] In situ errat visus debilitas. Si ab aliquanta longi-
tudine, licet temperata, declinetur corpus, et sit modica decli-
20 natio, ignorabitur cum plene comprehenditur longitudo.

[7.255] Et incertitudo longitudinis et situs errorem ingerit
quantitatis.

[7.256] In figura: Quia gibbus corporis modicus et multi-

72 particulares *corr. ex particularis a. m. E* 73 non *inter. P3* 74 error *inter. a. m.*
E/ nulla: nullus R; *alter. in nullus a. m. C1/post eo add. tempore C1L3 (inter. L3; scr. et del.*
C1)/ad temperantiam (75): a temperantia Er 2 invehit *corr. ex invenit a. m. C1*
4 ante si *add. accidit error C1/post si add. enim R/opponantur: apponatur Er* 5 post
unum *add. sit R* 7 inter: ad R/post aliqua *add. corpora interiecta R/incertam: et*
certam Er/incertam faciet *transp. R* 9 post ex *add. locis R* 11 ei *om. P1* 12 post
fit *scr. et del. visus E/fides coloris transp. E/fortis mg. a. m. C1; inter. a. m. L3* 13 modi-
cum: modum P1; paulo R 14 etiam: et ErL3P1S/post visus *add. visus EP3 (scr. et*
del. P3) 15 in: a C1EErL3P3R 16 multum: motum EP3; multo R/remotius (17)
corr. ex remotus L3 18 visus *mg. a. m. C1/post si add. enim R/ab mg. a. m. C1/post ab*
scr. et del. ab P3 19 licet *corr. ex ab a. m. C1* 20 ignorabitur: ignorabiliter P3/ante
cum *add. illa declinatione C1/post cum mg. non a. m. C1* 21 post longitudinis *add.*
quantitatis R/et²: etiam R/et situs *om. Er; inter. L3/et² . . . errorem: errorem et situs EP3R/*
ingerit: ingerunt C1L3S 22 quantitatis *om. R; corr. ex quantitas P1* 23 post figura
add. erit error C1/quia om. P1S/corporis om. R

plex angulus latet debilitatem visus.

25 [7.257] Et si in corpore linea nigra fuerit, existimabitur
divisio vel fissura, et existimabitur unum continuum corpora
contigua, unde error in divisione, continuitate, numero.

[7.258] Eadem erroris causa strabo unum iudicat duo si
fuerit informitas in uno tantum oculo, quoniam tenebit res visa
30 diversitatem situs respectu duorum oculorum eius.

[7.259] Si autem in duobus oculis eius sit deformatio, cum
accidit eos moveri, forsitan accidet ei diversitas situs respectu
vise rei, et ita in uno pluralitas.

[7.261] In motu: Si quis sepius in circuitu volvatur, cum
35 quiescit putat quod parietes moveantur. Et est quoniam, moto
vidente, movetur interius vis visibilis. Et licet videns steterit,
non statim vis visibilis stabit, sed motus eius in videntis quiete
durabit, et ob hoc motus visarum rerum estimatio insurgit. Et
huiusmodi motus exemplum in troco videmus, quoniam diu
40 post manus moventis quietem volvitur trocus. Est etiam infir-
mitas in qua videntur patienti omnia volvi.

[7.264] In quiete: Quando corpus similium partium volvi-
tur revolutione pauca, visus debilis non percipit eius motum
quem quidem percipiet visus temperatus.

45 [7.265] Si autem multa sit revolutio, non percipitur etiam a
temperato. Si vero sit dissimilium partium corpus motum, ut
in rota, visus debilis comprehendet motum. Si autem festina
fuerit revolutio, occultabitur visui debili motus. Quoniam par-
tes rote non multum sunt dissimiles, non plene comprehende-
50 tur dissimilitudo in festinatione, et per dissimilitudinem par-
tium fit comprehensio motus earum.

24 angulus *corr. ex angula P3*/latet: latent R 26 fissura: fixura *ErL3*/existimabitur:
existimabuntur *C1ErL3R*/unum . . . contigua (27): corpora contingua . . . continuum R
27 contigua: continua *P3*; *corr. ex continua a. m. E*/post continuitate *add. et C1*
28 strabo *corr. ex stabo P3* 29 informitas: deformitas R/tenebit: habet R/visa *corr.*
ex visam L3 30 post eius *add. et ita in numero communi C1* 31 in *om. Er*/oculis
eius *transp. C1L3* 32 forsitan: forte *P1*/ei: eis *C1ErL3R* 33 vise rei *transp.*
C1EErL3P3R/post rei *add. vise C1Er*/pluralitas: pluritas *EP1P3*/post pluralitas *add.*
videbitur *C1* 34 post quis *add. enim R*/in circuitu *om. P1*/circuitu: circuitum R/
volvatur: volvitur R 36 movetur: moveatur *Er*/interius: intrinsecus R/vis *om. C1*;
inter. L3; *corr. ex visus P3* 37 statim: stabit *C1L3*/vis: visus *Er*/stabit: statim *C1L3*/
sed: licet *L3*; *corr. ex licet C1* 38 durabit *corr. ex dabit a. m. C1*/post durabit *scr. et del.*
quiete *E*/ob *om. Er*/visarum rerum *transp. C1ErL3* 39 huiusmodi: huius *C1EErL3P3R*
40 volvitur: volvatur *ErL3* 42 post quiete *add. erit error C1*/post partium *add. ut sunt*
quaedam rotae horologiorum R; *scr. et del. partium P1*/volvitur (43): revolvitur R
44 percipiet: perciperet R 47 rota: tota *EP3*/post rota *add. moletrinae tunc R*/autem:
tamen *C1ErL3* 48 post fuerit *add. rote C1EErL3P3R* (*inter. a. m. E*) 49 rote: tote
EP3/non¹ *om. R*/sunt *om. ErL3P1S*; *inter. a. m. E*/sunt dissimiles *transp. R* 50 dis-
similitudo: similitudo *P1*

[7.267-268] In asperitate et lenitate: Quia forsitan reputabitur modicum lene asperum, vel econtrario si inter formas asperi et lenis fuerit dissimilitudo.

55 [7.269] In raritate. Cum fuerit in corpore raro soliditas pauca, existimabitur a visu debili maior vera.

[7.270] In soliditate: Cum fuerit in corpore raro color fortis, aut post ipsum, et raritas non magna, putabit illud esse solidum.

60 [7.272] In umbra: Note parietis albi sub nigredine descendente super ipsum luce, apparent etiam huic visui umbre.

[7.273] Et si fuerint multum nigre, apparebunt foramina in quibus tenebre.

65 [7.275-276] In decore, deformitate, similitudine, et dissimilitudine [error accidit] per particulares decoris vel fedtatis et similitudinis causas visum latentes.

[7.278] Et est error in predictis omnibus ex sola debilitate visus.

[7.279] Iam diximus quomodo accidit error in sillogismo secundum unamquamque causarum erroris visus in qualibet partium que adquiruntur per sillogismum. Iam incessimus super quemlibet erroris modum, et cuiuslibet supposuimus
5 exemplum. Et licet in erroribus visus sit copiosa multitudo, tamen omnium ad modos dictos fiet reductio, et ad exempla ordinatim proposita. Et assignavimus errores secundum quod singuli eorum accidunt ab unica tantum causa.

10 [7.280] Et aliquando error infertur non ab una tantum sed duabus causis vel pluribus. Verbi gratia, si moveatur aliquid a longitudine magna motu lento subito visum, videbitur immotum, et percipi posset motus ille in temperata longitudine visus

52 *post lenitate add. erit error C1/forsan: forte P1/reputabitur (53): reputabit C1EErL3P3R*
 53 *post vel scr. et del. asperitate C1* 56 *vera: vero Er; videtur P1S; corr. ex enim a. m. C1* 57 *soliditate corr. ex solitate a. m. C1/cum: si R/color om. EP3* 58 *magna: maxima C1EL3P3R/putabit: putabis S* 60 *albi om. R/post albi add. vel EP3/nigredine: nigre C1EErL3P3R* 61 *etiam om. C1EErL3P3R/huic: hoc L3 (scr. et del.)* 64 *decore deformitate: deformitate et decore C1EL3P3R/ante similitudine add. et C1EL3P3/et om. S* 65 *per: propter R; om. S/et om. C1ErL3R; inter. a. m. E* 66 *ante causas add. et dissimilitudinis C1R (mg. a. m. C1)/causas: causam S* 67 *est mg. a. m. C1* 1 *quomodo: quando EP3/accidit: accidat ErR; corr. ex accidunt S/error om. P3* 2 *qualibet: quemlibet L3; corr. ex quemlibet a. m. C1* 3 *per om. L3; inter. a. m. E/iam: et R* 4 *supposuimus: supponimus L3S; corr. ex supponimus a. m. C1E* 5 *sit copiosa transp. P1* 6 *tamen alter. in cum L3/et inter. a. m. C1/exempla: extra EL3P3* 7 *ordinatim alter. ex ordinati in ordinationis a. m. C1/et om. EP3R/ante errores add. que EP3 (inter. a. m. E); add. quoque R/post errores add. et C1* 9 *tantum inter. a. m. E/post sed add. a R* 10 *a: in P1S* 12 *posset corr. ex post L3/temperata ... et (13): distantia temperata etiam celeri visu vel R/longitudine: longe P1; om. EP3*

instantia manente. Et etiam in longitudine temperata non occultaretur motus si temperatum esset inspectionis tempus.

15 [7.281] Provenit igitur error ex duabus intemperantiis quarum neutra per se sufficit.

[7.282] Trium aggregatio errorem efficit. Si a magna longitudine, sub debili luce, in modico tempore opponatur visui corporis diversorum colorum revolutio non cita, existimabitur corpus stare.

20 [7.283] Et si ab eadem longitudine, sub eadem luce, tempore temperato adhibeatur intuitus, comprehendetur motus, qui similiter non latebit in temperata longitudine sub eadem luce et modico tempore. Et etiam percipi poterit in eadem
25 longitudine sub forti luce.

[7.286] Et generaliter ex omnibus erroribus visui accidentibus nec unus nec plures aggregati evadunt causas quas diximus. Quelibet autem rei vise forma ex eis que numeravimus est compacta, et cum visus non adquirat ex rebus visis nisi aliquas istarum, non accidet error in visu nisi in aliqua istarum.
30 Et omnis error qui accidit in scientia est quoniam intellectus similia efficit que percipit cum eis que percepit in modo aliquo aut dissimilia.

[7.287] Et omnis error in particularibus erit aut in sensu,
35 aut in scientia, aut in sillogismo, nec potest esse quin sit in aliquo istorum, aut duobus, aut ipsis tribus. Et quicumque error accidit in huiusmodi tribus non erit nisi per errorem visus in partibus.

[7.288] Et iam patuit quod error visus in partialibus non
40 erit nisi per causas quas assignavimus, aut ex una earum tantum aut ex pluribus.

13 *post instantia scr. et del. m E/et: etiam S/in inter. L3/post in add. illa R/temperata: intemperata R* 14 *si corr. ex se C1/temperatum: intemperatum P1* 15 *duabus: duobus S* 17 *post trium add. causarum C1/efficit corr. ex efficit P3/si: sed Er* 18 *debili corr. ex debi a. m. S* 21 *tempore (22) . . . luce (24) mg. L3* 22 *temperato: intemperato P3; corr. ex intemperato E/comprehendetur: comprehenditur L3* 24 *post poterit add. motus C1* 27 *aggregati: congregati EP3R/quas corr. ex que P3* 28 *eis: ijs R/post que scr. et del. in E/numeravimus: enumeravimus R* 29 *visis corr. ex visus P3* 30 *istarum¹: ista Er/accidet: accidit C1EL3P3R* 31 *omnis om. P1* 32 *ante similia scr. et del. silla P3/cum . . . modo mg. L3/percepit: percipit Er; corr. ex percipit a. m. E* 34 *particularibus: partialibus C1EL3P3; corr. ex partialibus a. m. C1/erit: est C1/sensu aut in (35) mg. P3* 35 *ante nec mg. et a. m. E/nec: non E/nec . . . tribus (36) om. P3* 36 *istorum mg. a. m. C1/et quicumque inter. P3/et . . . tribus (37) inter. a. m. S/et quicumque: si P3* 37 *nisi inter. a. m. E* 39 *quod error transp. C1* 40 *earum: illarum P1*

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Volume 91, Part 5**

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VOLUME 91, Part 5

Alhacen's Theory of Visual Perception:

A Critical Edition, with English Translation
and Commentary, of the First Three Books
of Alhacen's *De aspectibus*, the Medieval
Latin Version of Ibn al-Haytham's
Kitab al-Manazir

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CONTENTS

VOLUME II

ENGLISH TRANSLATION

Book One

| | |
|------------------------|-----|
| Topical Synopsis | 339 |
| Chapter 1 | 343 |
| Chapter 2 | 344 |
| Chapter 3 | 346 |
| Chapter 4 | 346 |
| Chapter 5 | 347 |
| Chapter 6 | 348 |
| Chapter 7 | 355 |
| Chapter 8 | 387 |
| Chapter 9 | 390 |
| Notes | 395 |

Book Two

| | |
|------------------------|-----|
| Topical Synopsis | 415 |
| Chapter 1 | 417 |
| Chapter 2 | 417 |
| Chapter 3 | 429 |
| Chapter 4 | 512 |
| Notes | 531 |

Book Three

| | |
|------------------------|-----|
| Topical Synopsis | 559 |
| Chapter 1 | 561 |
| Chapter 2 | 562 |
| Chapter 3 | 588 |
| Chapter 4 | 593 |
| Chapter 5 | 595 |
| Chapter 6 | 597 |
| Chapter 7 | 600 |
| Notes | 629 |

APPENDICES

| | |
|------------------|-----|
| Appendix 1 | 642 |
| Appendix 2 | 653 |
| Appendix 3 | 667 |
| Appendix 4 | 677 |

| | |
|------------------------------|-----|
| Latin-English Index | 681 |
| English-Latin Glossary | 747 |
| Bibliography | 785 |
| General Index | 799 |

ALHACEN'S
DE ASPECTIBUS

ENGLISH
TRANSLATION

BOOK ONE OF ALHACEN'S *DE ASPECTIBUS*

Topical Synopsis

CHAPTER 1: *That Light Affects Sight* 343

[4.1-4.7] The creation of afterimages by bright light and color shows that light and illuminated color affect sight.

CHAPTERS 2-5: *How Light Affects Visual Perception* 344

[4.8-4.17] Bright light interferes with proper visual perception. [4.18-4.19] Dim light interferes with proper visual perception. [4.20-4.26] Perception of colors depends upon quality of light shining upon them. [4.27-4.28] All visual perception therefore depends upon light and its quality.

CHAPTER 6: *The Physical Structure of the Eye* 348

[5.1-5.3] Origin of optic system in the brain; connection through hollow optic nerves. [5.4-5.5] Description of sclera. [5.6] Description of uvea. [5.7] Description of pupil. [5.8] Description of cornea. [5.9-5.11] Description of glacial sphere; division according to glacial and vitreous humors. [5.12-5.13] Succession of albugineous, glacial, and vitreous humors, all transparent. [5.14] Origins of visual spirit. [5.15-5.17] Eye as a whole constructed to rotate within eyesocket. [5.18-19] Cornea concentric with eye as a whole and intersects uveal sphere toward its front. [5.20] Center of uveal sphere anterior to center of eye as a whole. [5.21-5.23] Visual axis passes through both centerpoints and through middle of hollow optic nerve. [5.24-5.30] Anterior surface of glacial sphere concentric with surface of the cornea and thus with eyeball; visual axis therefore passes through eye's centerpoint. [5.31-5.36] None of the component parts of eye moves with motion of the eye. [5.37] Both eyes symmetrically disposed with respect to one another. [5.38] Attachment of eyes within the eyesockets along with lids and lashes. [5.39] Concluding statement.

CHAPTER 7: *The Selection of Visual Images* 355

[6.1-6.6] Forms of light radiate commingled in all possible directions through transparent media to affect sight; nature of transparency is to accept and transmit such forms. [6.7-6.12] Problem: Since each and every point on visible object's surface radiates its form to each and every point on eye's surface, then how does the eye get a distinct, coherent impression of individual objects? [6.13-6.23] Resolution: Anterior surface of glacialis—i.e., lens—accepts only forms reaching it orthogonally. [6.24] Justification in fact that perpendicular effects are naturally stronger than oblique ones. [6.25-6.26] Consequent formation of cone of radiation, its vertex at the center of the eye, its base in the object-surface. [6.17-6.32] Point-by-point image formed where cone of radiation cuts anterior surface of glacialis will therefore be in perfect correspondence to object-surface generating it. [6.33-6.39] If those images were formed by oblique rays, they would be inverted and reversed after refraction at the corneal surface. [6.40-6.42] Consequently, anterior surface of glacialis must share centerpoint with eyeball. [6.43-6.44] Such privileging of perpendicular rays has counterparts in other natural phenomena, such as free-fall. [6.44-6.46] Summary of salient points. [6.47-6.50] Further justification for previously described model of image-selections. [6.51-6.58] Arguments in favor of intromissionism and against visual ray model. [6.59-6.61] Although imaginary, rays provide a crucial analytic device and a means of reconciling the approaches of mathematicians (visual-ray theorists) and natural philosophers (intromissionists). [6.62-6.64] Recapitulation of salient points. [6.65-6.68] Reception of radiated forms by glacialis is not merely physical, it is also sensitive; hence, glacialis feels impingement of perpendicular forms as a low-level pain that is passed through the visual spirit pervading hollow optic nerve to the final sensor. [6.69-6.74] In binocular vision image-fusion occurs at the optic chiasma where final sensor apprehends it; under normal circumstances, final sensor perceives one rather than two images. [6.75-6.76] Inductive demonstration that visual sensation is conveyed through optic nerves. [6.77] Images appear double because of improper fusion at optic chiasma. [6.80-6.81] Final sensor senses not only the initial pain of visual impression on the glacialis' surface, but also the color-effect of that impression. [6.82-6.89] Radiated forms of light and color do not mingle or interfere with one another in air or other transparent bodies. [6.90-6.94] Glacialis not actually tinged by the impinging light- and color-forms, so it is not physically altered by them. [6.95-6.115] How vi-

sual perception of a given object's color and luminosity is affected by intensity of light and color shining upon it and also depends upon quality of ambient light or color. [6.116] Concluding statement.

CHAPTER 8: *The Functional Structure of the Eye* 387

[7.1-7.2] Protective function of cornea. [7.3] Protective function of albugineous humor. [7.4] Shading effect of uveal tunic. [7.5] Functional characteristics of glacial humor. [7.6] Protective function of aranea enclosing glacial humor. [7.7-7.8] Functional design of optic nerves. [7.9-7.10] Functional reasons for doubling of eyes. [7.11-7.13] Reasons for sphericity of eye and its component tunics. [7.14] Protective function of sclera. [7.15] Roundness of eye conduces to its mobility. [7.16-7.17] Protective function of eyelids and eyelashes. [7.18] Concluding statement.

CHAPTER 9: *The Preconditions of Sight* 390

[8.1-8.2] Introductory summary. [8.3-8.5] On the need for physical separation between eye and object. [8.6] On the need for light. [8.7] On the need for the visible object to be of perceptible size. [8.8] On the need for a continuous transparent medium between eye and object. [8.9] On the need for opacity in the visible object. [8.10] Opacity as color [8.11] Concluding statement.

[BOOK ONE]

[CHAPTER 1]¹

[4.1] We find that when our sight fixes upon very strong light-sources it will suffer intense pain and impairment from them, for when an observer looks at the body of the sun, he cannot do so properly because his vision will suffer from its light. By the same token, when he looks at a polished mirror flooded with sunlight, and his eye is placed at the spot to which the light from that mirror is reflected,² his vision will also suffer from the reflected light reaching his eye from the mirror, and he cannot open his eye to look at that light.³

[4.2] Furthermore, we find that when an observer stares at a pure white body illuminated by sunlight, and keeps staring for awhile, then shifts his focus from it to a dark, dimly lit location, he can scarcely make out the visible objects at that location. Instead, it will seem to him as if there were a screen between himself and them. Then, after awhile his vision will clear up and return to its normal state. So too, when an observer looks at a strong fire and continues to stare at it for a long time, if he then shifts his focus to a dark, dimly lit location, he will experience the same visual effect.

[4.3] We also find that, when an observer looks at a pure white body illuminated by intense daylight, even though there may be no [direct] sunlight, if he continues to look at that body for awhile and then shifts his focus to a dark location, he will see the form of its light, along with its shape, in that dark location. If he then closes his eyes and stares for a time, he will see the form of that light in his eye. In time this effect will wear off, and his vision will return to its normal state. The same thing will happen to his vision when he stares at an object illuminated by sunlight.⁴

[4.4] Likewise, if he looks at a bright white body illuminated by strong firelight and continues to stare at it, then refocuses on a dark location, he will experience the same visual effect. So too, when an observer is in a room with a large window open to the sky and continues to stare out at the sky during daylight, then shifts his focus to a dark spot in the room, he will see the form of the light that he perceived through the window along with the shape of the window in that dark spot. And if he closes his eye, he will also see that form in it.

[4.5] All of these occurrences therefore indicate that light may affect vision in some way.

[4.6] And we also find that when an observer looks at a thickly planted garden illuminated by sunlight and continues to stare at it, then shifts his focus to a dark location, he will see the form of that light tinged by the green of those plants in that dark location. Afterward, under the same circumstances, if he stares at white objects lying in shadow or in a weakly illuminated location, he will see those colors mixed with green. And if he closes his eye and stares, he will see the form of the light as well as the form of green in his eye.⁵ In time this effect will clear up and disappear. Likewise, if he looks at an object that is colored azure or red or any other bright hue illuminated by sunlight and continues to stare at it, then shifts his focus to white objects lying in a dimly lit location, he will find their colors mixed with the original hue.

[4.7] These instances therefore indicate that illuminated colors may affect vision.

[CHAPTER 2]⁶

[4.8] In addition, we see the stars at night but do not see them in daylight; and the only difference between the two times is that the intervening air between our eyes and the sky is illuminated during the day and dark at night. Hence, while the air is dark, we see the stars; but when the intervening air between our eyes and the stars is illuminated, the stars will be invisible to us.⁷

[4.9] Likewise, suppose that an observer looks during the night toward a location illuminated by the light of a fire and that the firelight shines upon the ground; suppose also that there are tiny objects or objects with subtle⁸ features in that location and that they lie in shadow that is not too intense; and suppose that the fire is not interposed between the observer's eyes and those objects and, accordingly, that the observer makes those objects out as well as the subtle features possessed by them. Let him then move from his [original] position until the fire is situated between his eyes and those objects. In that case, neither the objects [themselves], if they are tiny, nor the subtle features possessed by them will be visible to him, and he will scarcely make them out when the fire lies between his eyes and those objects. If, however, the fire is screened from his line-of-sight, he will immediately make out those objects that had been invisible to him; but if the screen between his eyes and the fire is lifted, those objects will again be invisible to him.

[4.10] These situations therefore indicate that intense lights that shine upon the eyes and upon the air lying between the eyes and the visible ob-

ject prevent the sight from making out certain objects that are dimly illuminated.

[4.11] Furthermore, when an observer looks at a polished body on which there are subtle engravings that are not of a different color but rather of the same color as the body, and when the observer is in a moderately lit place, and this place faces the sun or some walls that are illuminated by intense light, then, when that object faces the sky or the illuminated wall, some light will be reflected from it to the eye, and the observer will find the light that appears on the body's surface, as well as at the spot where the light reflects, to be quite intense and brilliant. Moreover, if the observer looks at that polished body under these circumstances, he will see none of the engravings in it where the intense, brilliant light is. Afterward, if the observer inclines that body away from the [original] location so that the reflection takes place to another spot outside the location of his eyes, and if in this case a moderate light shines upon that body, then the observer will make out the engravings in it that he had not made out when the light was reflected from the body to his eyes.

[4.12] By the same token, when light reflects to the eyes from a smooth page with subtle tracings on it, sight will not discern those tracings, nor will it perceive them distinctly as long as the light is reflected from that page to the eyes. But if the surface of the page is slanted so that its position is changed and the light no longer reflects from it to the eyes, then the visual faculty will make out those tracings and will perceive them distinctly.⁹

[4.13] Likewise, when there is a low fire in a dimly lit place, it will be visible and will be made out by sight, but when it lies in sunlight, the object that is on fire will appear as a solid body that is colored with a very bright hue.

[4.14] And if a bright white body is placed next to that [burning] body, and if that [white] body lies in shadow or is dimly illuminated, the color of the [burning] body will appear on it, as we discussed earlier.¹⁰ Then, if that white body is brought out into sunlight, the color that shines upon it will disappear, but if it is brought back into the shadow, that color will appear shining upon it. And if the white body lies in strong light so that the [color of the other] body no longer appears upon it, but if that [white] body is shaded by a solid body and remains in place while the light that shines upon it is attenuated, the color that shines upon it will [re]appear. And if the shading body is removed so that the light shining upon the white body intensifies, the color shining on it will disappear.

[4.15] Likewise, when we bring a brightly colored, transparent body next to a roaring fire and place a white cloth in the shadow of that body, the color of that transparent body will shine upon that cloth, as we pointed out earlier.¹¹ Then, if we bring another fire next to that cloth so that its light

shines upon that cloth, the color that appeared upon the cloth will disappear, and only the white of the cloth will be seen. But if we remove that second fire, the color will [re]appear upon the cloth.

[4.16] Also, certain marine animals have shells or membranes that will appear incandescent when they are in a dark location without light; but if an observer looks at them in daylight or in firelight, he will perceive them but will see no light or fire in them. By the same token, when the animal that is called a "firefly" flits about at night, it looks like a lamp, but when an observer examines it in daylight or in firelight, the animal will appear without fire.¹²

[4.17] Accordingly, all of the situations that we have detailed indicate that intensely luminous objects sometimes occlude features possessed by various visible objects, whereas feeble illumination sometimes reveals certain features possessed by various visible objects.

[CHAPTER 3]

[4.18] Oftentimes several characteristics of subtle tracings or tiny writing are invisible to sight when they are in dimly lit or dark locations, whereas, when they are brought out into intensely illuminated locations or are placed in sunlight, those features of theirs that were invisible in the dark or in feeble light will appear. Likewise, sight is incapable of making out subtle tracings in dark places or in feeble light; but when they are brought out into strong light, they are made out by sight.

[4.19] It is therefore shown by this example that strong light reveals many features of visible objects and that feeble light occludes many visible features.¹³

[CHAPTER 4]

[4.20] Furthermore, we find that many solid bodies that are tinged with such bright colors as azure, wine-red, or sky-blue appear of a dull color when they are in dark or dimly lit locations.¹⁴ But when they lie in strong light, their colors will appear bright and clear, and the more intense the light shining upon them, the brighter and clearer their color will be. And when any of these bodies is placed in a dark location with very little light, that body will appear dark, sight will not discern its color, and it will appear black. But when it is brought out into intensely illuminated locations, its color will appear and will be discerned by sight.

[4.21] We also find that, when strong light shines upon bodies whose

colors are dull, their colors brighten; and we also find that when strong light shines upon solid white bodies, their whiteness and brightness will be sensibly increased.

[4.22] So too we find that, when intensely colored transparent objects, such as robust wines of deep redness that are in transparent vessels, are in dark or dimly lit locations, they will appear black and dark, as if they were not transparent. But when they are in strong light or flooded by sunlight, their colors will brighten, and their transparency will become apparent.

[4.23] Likewise, when transparent colored stones are in dark locations, their colors will appear dull and dark; but when intense light shines upon them, or when they are placed against a light-source so that its light shines through them, their colors will appear bright, and their transparency will be revealed by the passage of light [through them].

[4.24] Furthermore, when colored transparent objects are put against the light and a white object is placed [facing them] on the side opposite the light, then, as we described it above,¹⁵ if the light is intense, the form of that color will appear in the shadow cast upon the facing white object. But if the light shining on the transparent object is feeble, only its shadow, not its color, will appear on the facing white object.

[4.25] In addition, we find that peacock feathers and the cloth called “amiliamon”¹⁶ vary in color according to sight at different times of the day, depending on how the light shines upon them.

[4.26] These phenomena involving color therefore indicate that the way the colors of tinted bodies are perceived by sight depends entirely upon the light that shines upon them.¹⁷

[CHAPTER 5]

[4.27] And since strong light [shining] from visible objects at times occludes certain features possessed by some visible entities and at times reveals certain features possessed by some visible entities, and since feeble light [shining] from visible objects at times reveals certain features possessed by some visible entities and at times occludes certain features possessed by some visible entities, and since the colors of tinted objects are sometimes altered by variation in the light that shines upon them, and since strong light shining upon the eye sometimes prevents sight from making out certain visible objects, and since in all these instances sight nonetheless perceives nothing about visible objects unless they are illuminated, the form of the visible object that sight perceives depends entirely upon the light possessed by that visible object, as well as upon the light that shines upon the eyes when that visible object is perceived, and upon [the light that illuminates] the aerial medium between the eyes and the visible object.

[4.28] Why, however, strong light prevents sight from perceiving certain visible objects will be shown by us when we discuss the way in which vision is carried out.¹⁸

[CHAPTER 6]¹⁹

[5.1] The eye is in fact composed of various membranes and bodies, and its origin and wellspring lie at the front of the brain.

[5.2] For two matching hollow²⁰ nerves emerge from the front [of the brain], each arising from a spot on one of the two sides of the anterior part of the brain. And it is said that each of them has tunics and that they both arise from the two membranes of the brain and reach the middle of the outer surface of the front of the brain. They then intersect and form a single hollow nerve, after which this nerve splits, and they again form two matching and equal hollow nerves. Finally, these two nerves continue until they reach both cavities of the two eyesockets that contain the eyeballs.²¹

[5.3] In the center of both of these eyesockets lie two openings of equal size, each one similarly disposed in relation to the common nerve. The [two] nerves therefore pass through these two openings and come out into the cavity of the two eye sockets where they expand and enlarge, and the endpoint of each of them forms something like the utensil used for pouring wine into jars. And each eye is attached to this endpoint on the nerve, which is like a funnel—i.e., the aforementioned utensil—and it forms a whole with it; and the location of each eye is the same in relation to the common nerve.

[5.4] And each eye as a whole is composed of several tunics.

[5.5] Accordingly, the first of these tunics is a white fat that fills the cavity of the bone, and it forms the majority of the eye and is called the sclera.²²

[5.6] And inside this [outer tunic of] fat is a round, concave sphere that is generally black, but green²³ or grey in some eyes, and the body of this sphere is thin yet nonetheless solid rather than loosely textured. And its outer surface is attached to the sclera, while its inner surface is concave; and on its concave side there is a sort of roughness. The sclera surrounds all but the anterior part of this sphere, for the sclera does not cover the front of this sphere but encircles it. And this tunic is called the uvea because it is similar to the [skin of] a grape.²⁴

[5.7] In the center of the anterior surface of the uvea is a round opening that passes into its hollow, and it lies opposite the end of the hollow of the nerve to which the eye is attached.²⁵

[5.8] This opening and the entire front part of the uvea that the sclera encircles are covered over by a tough, white, transparent tunic called the cornea, because it is like white, clear horn.

[5.9] Toward the front of the uvea's cavity lies a small, white, moist sphere that retains moisture, and, instead of a [perfectly] clear transparency it has some consistency. Its transparency, moreover, is like the transparency of ice, and therefore it is called the glacialis; and it takes this name because its transparency is like that of ice.²⁶ It is attached to the endpoint of the hollow [optic] nerve, and in the anterior part of this sphere there is a slight flattening of the surface, and it is like the flattening of the surface of a lentil. Thus, its anterior surface is a section of the surface of a sphere that is larger than the spherical surface containing its two openings, and its flattened section faces the opening that lies at the front of the uvea, and it is equally situated with respect to it.²⁷

[5.10] This humor is divided into two parts of different transparency: one of them toward the front and the other toward the back. The transparency of its rear part is like that of ground glass,²⁸ and this part is called the vitreous humor. The two parts together are surrounded by an extremely fine membrane called the aranea, because it is like a spider's web in texture.

[5.11] Furthermore, toward the front of the uvea's hollow there is said to be a round opening, and it lies upon the endpoint of the hollow of the nerve. The glacialis is affixed in this opening, and the circumference of this opening (which is formed by the extremity of the nerve) encompasses the midpoint of the sphere of the glacialis; and the uvea is conjoined with the glacialis by the circle forming this opening. And it is said that the uvea arises from the inner tunic of the two tunics forming both hollow [optic] nerves and that the cornea arises from the outer tunic of the two tunics forming this nerve.²⁹

[5.12] A serous, white, clear, transparent humor fills the hollow of the uvea, and it is called the albugineous humor because it is like the white of an egg in its fluidity, whiteness, and transparency. And this humor fills the hollow of the uvea, and it is contiguous with the front surface of the glacialis, and it fills the opening in the front of the uvea, and it is contiguous with the concave surface of the cornea.³⁰

[5.13] Now the sphere of the glacialis is affixed to the hollow of the [optic] nerve, and it is succeeded within that hollow by the vitreous humor. Thus, the cornea, the albugineous humor, the glacial humor, and the vitreous [humor] will lie one behind the other in that order, and all these tunics [and humors] are transparent. And the opening in the front of the uvea lies directly opposite the opening of the hollow of the [optic] nerve. Hence, between the surface of the cornea and the opening at the front of the hollow of the [optic] nerve there will be many straight-line connections since [all the intervening tunics and humors] are transparent and contiguous.³¹

[5.14] And it is said that visual spirit emanates from the front of the brain and fills the two hollows of the two nerves that are first joined with

the brain; and this spirit extends to the common nerve, fills its hollow, and continues to the two secondary hollow nerves. It then fills them and continues to the glacialis to endow it with the power of seeing.³²

[5.15] Between the circumference of the glacialis that is connected to the uvea and the opening in the hollow of the eye socket from which the nerve issues there is some space, and the nerve fills this space, from the very opening to the circumference of the glacialis as it expands and funnels outward. The farther from the opening it gets, the more it expands until it reaches the circumference of the sphere of the glacialis, and it is affixed to its circumference.

[5.16] The body of the sclera encompasses this expanded portion of the nerve, and it encompasses the uveal sphere, but the uveal sphere lies in front of the midpoint of the sclera toward the [front] surface of the eye. The body of the sclera is joined with the uveal sphere as well as with the endpoint of the expanding nerve and keeps it fixed in place. Hence, when the eye moves, it will move as a whole. And thus the nerve to which the eye is affixed will follow its movement and will flex at the opening in the hollow of the eye socket, because the hollow of the eye socket contains the entire eyeball, and the eyeball moves as a whole within this hollow.³³

[5.17] The sclera is also connected to the part of the nerve that lies toward the front [of the eye] as well as to the rest of the tunics, so it holds them [all] firmly in place. Thus, the flexing of the nerve with the motion of the eye occurs only at the back of the eye; so it happens at the opening in the hollow of the eye socket. Likewise, when the eye is still and the nerve is flexed, that flexing will occur only at the opening in the hollow of the eye socket. For the parts of the whole eye do not shift with respect to each other either when it is in motion or when it is still. Thus, the flexing of the nerve to which the eye is attached only happens at the opening in the hollow of the eye socket, whether the eye is moving or is still.

[5.18] The outer surface of the cornea is spherical and is therefore continuous with the surface of the entire eye and with the whole eyeball.³⁴ The eye as a whole forms a sphere larger than the uveal sphere, which is one of its parts. However, the outer surface of the cornea is continuous with the surface of the entire eye, which is larger than the surface of the uveal sphere. Its radius is therefore larger than the radius of the uvea.

[5.19] The inner surface of the cornea that is positioned over the opening in the uvea is a concave spherical surface parallel to its outer surface, for this section of the eye is of equal thickness. The center of this concave surface is therefore the same as the center of the outer, convex surface, and this concave surface intersects the surface of the uveal sphere at the circumference of its opening. Therefore its center lies deeper in the eye than the center of the uvea, for this follows inexorably from the properties of [inter-

secting] spheres.

[5.20] In addition, since the uveal sphere is not concentric with the sclera but lies in front toward the outer surface of the eye, and since the outer surface of the eye forms part of a sphere that is larger than the uvea, the center of the outer surface [of the eye] will lie deeper in the eye than the center of the uvea.

[5.21] Moreover, when it is extended, the straight line that connects the two centerpoints—i.e., the center of the cornea's [outer or inner] surface and the center of the uvea—passes through the center of the opening at the front of the uvea as well as through the midpoints of the two parallel corneal surfaces. For the concave surface of the cornea and the convex surface of the uvea are intersecting spherical surfaces. Now the line that joins their centers passes through the center of the circle of intersection, and it will be perpendicular to its surface, for a line dropped to the center of [such a] circle and perpendicular to its surface passes through the centers of the two [intersecting] spheres.³⁵

[5.22] The concave surface of the cornea is contiguous with the surface of the albugineous humor at the front of the uveal opening, and it covers it. Thus, the surface of the albugineous humor is also a spherical surface whose center coincides with the center of the surface that covers it. So the outer surface of the cornea, as well as its inner surface, and the surface of the albugineous humor contiguous with the concave surface of the cornea are parallel spherical surfaces. Moreover, their centers form a common point that is deeper inside [the eye] than the uvea's center.

[5.23] When the line passing through the center of the uvea, the center of the cornea, and the center of the opening at the front of the uvea is extended rectilinearly, it will pass through the middle of the hollow of the nerve to which the eye is attached, for the opening at the front of the uvea lies opposite the opening within the body of the uveal sphere that forms the extremity of the hollow of the nerve [where its expanded end attaches to the uveal sphere].

[5.24] The anterior surface of the glacialis is also a spherical surface, and it intersects the uveal sphere; so its center lies deeper [in the eye] than the center of the uvea. And the straight line connecting these two centerpoints passes through the center of the circle of intersection, so it is also perpendicular to it. But the circle of intersection between the surface at the front of the glacialis and the surface of the uveal sphere forms either the circle defining the boundary between glacialis and uvea or a circle parallel to that one. For the surface at the front of the glacialis is opposite the opening at the front of the uvea, and it is uniformly positioned with respect to it. Thus, the boundary of this surface—which is the circle of intersection between the two surfaces of the glacialis—is either the circle of attachment itself or a

circle parallel to that circle.³⁶

[5.25] Accordingly, if the circle of intersection between the two surfaces of the glacialis is the circle of attachment itself, then this circle forms the circle of intersection between the anterior surface of the glacialis and the [inner] surface of the uvea. But if the circle of intersection between the two surfaces of the glacialis is parallel to the circle of attachment connecting the sphere of the glacialis and the uvea (which is certainly the case if the attachment occurs at the rear portion of the glacialis), then, if it is imagined to enlarge beyond its present spherical limits, the anterior surface of the glacialis will intersect the uveal sphere to form a circle parallel to that circle—i.e., the circle of intersection between the two surfaces of the glacialis—on account of the uniform placement of this circle with respect to the circumference of the uveal sphere. And this circle is parallel to the circle of attachment. Hence, the circle of intersection between the front surface of the glacialis and the uveal sphere will be either the circle of attachment itself or a circle parallel to it. Accordingly, if this circle is the circle of attachment itself, then the straight line passing through the center of the anterior [surface] of the glacialis and the center of the uvea will pass through the center of this circle and will be perpendicular to it, because this circle will be the circle of intersection between two spherical surfaces. But if this circle is parallel to the circle of attachment and is parallel to the circle of intersection between the two surfaces of the glacialis, then it lies on the same spherical surface as the circle of intersection between the two surfaces of the glacialis—i.e., the anterior surface of the glacialis—and it is parallel to it. Consequently, the line that passes through the center of the uveal sphere and the center of the surface at the front of the glacialis passes through the center of the circle of attachment in all situations. And it will be perpendicular to that circle whether the circle of attachment is the [actual] circle of intersection between the front surface of the glacialis and the uveal sphere or whether it is parallel to that circle.³⁷

[5.26] Also, the anterior surface of the glacialis and the surface of the rest of the glacialis are two intersecting spherical surfaces. Thus, the center of the front surface lies deeper [within the eye] than the center of the rear surface;³⁸ and the straight line connecting these two centers passes through the center of the circle of intersection, and it will be perpendicular to it. And it has already been shown that this line passes through the circle of attachment and is perpendicular to it, for this circle [of intersection] is either the circle of attachment itself or is parallel to it. Thus, the line passing through the center of the uvea, as well as through the center of the anterior [surface] of the glacialis and the center of the circle of attachment (this line being perpendicular to this circle) passes through the center of the remaining portion of the glacialis.

[5.27] And since this line passes through the center of the remaining portion of the glacialis as well as through the center of the circle of attachment, and since it stands at right angles to the surface of the circle of attachment, then it extends through the middle of the hollow of the nerve to which the eye is attached, because the circle of attachment coincides with the extremity of the hollow of the nerve.

[5.28] And it has already been shown that the line passing through the center of the uvea, the center of the cornea, and the center of the opening which is at the outer or front [surface] of the uvea extends through the middle of the hollow of the nerve.³⁹ The line, therefore, that passes through the two centers of the surface[s] of the glacialis, as well as through the center of the uvea, is the very line that passes through the center of the cornea, the center of the uvea, and the center of the opening at the front of the uvea. So this line passes through the center of the cornea, the center of the uvea, the two centers of the surface[s] of the glacialis, the center of the opening at the front of the uvea, and the center of the circle of attachment. It also passes through the two centers of all the tunics facing the opening in the uvea,⁴⁰ and it is perpendicular to the surfaces of all the tunics facing the uvea's opening. It is perpendicular as well to the surface of the uvea's opening and to the circle of attachment, and it extends through the middle of the hollow of the nerve to which the eye is attached.

[5.29] And since it has been shown that both the center of the cornea and the center of the anterior surface of the glacialis lie upon this line and that both lie deeper [in the eye] than the center of the uvea, it is perfectly appropriate for the center of the anterior surface of the glacialis to be the same as the center of the cornea, so that the centers of all the surfaces facing the opening in the uvea form a single, common point. Hence, all the lines projected from that centerpoint to the surface of the eye will be perpendicular to all the surfaces facing the [uveal] opening.⁴¹ Accordingly, we will later show in our discussion of how vision takes place that the center of the corneal surface and the center of the anterior surface of the glacialis form a single, common center. Thus, the surfaces of the tunics of the eye that face the opening in the uvea form spherical surfaces that share a single, common centerpoint.⁴²

[5.30] In addition, because this centerpoint forms the center of the outer surface of the eye that is continuous with the surface enclosing the whole eye (and the entire eye is round save for the bit that the sphere of fat forming the sclera lacks at the front of the eye, and this shortfall makes no difference in the eye's motion since it is not in contact with the cavity in the eye socket), this centerpoint will be the centerpoint for the entire eye. Hence, it lies inside the eye as a whole. The centerpoint of the surfaces of the tunics of the eye facing the uveal opening therefore lies inside the eye as a whole.

[5.31] When the eyeball moves, then, the point within the eye that forms the center of the surfaces of the tunics of the eye will not shift [in relation to the eye socket], nor will it shift in relation to those surfaces. On the contrary, it stays fixed, for when the eye moves it moves only as a whole, and the parts of that whole do not move in relation to one another when it moves. But this centerpoint lies within [the eye as a whole], so it does not move with the motion of that whole. Likewise, the tunics of the eye do not move with the motion of the eye as a whole—i.e., with the motion of the eye itself—so this centerpoint does not move in relation to the surfaces of the tunics, whether [the eye is] in motion or at rest.

[5.32] And it has already been shown that the flexing of the nerve when the eye moves or when it is immobile occurs only at the opening in the cavity of the eye socket, because it only takes place at the very back of the eye.⁴³ It follows that the flexing of the nerve when the eye is moving or at rest only takes place behind the eye's centerpoint.

[5.33] Nor do the parts of the eye move with respect to each other whether [the eye is] in motion or at rest. Thus, the centerpoints of the eye's tunics do not move with respect to the eye as a whole, whether the eye is in motion or at rest. Accordingly, the straight line passing through the centerpoint does not move with respect to the eye as a whole or to its parts, no matter whether [the eye is] in motion or at rest. And since this line moves with respect neither to the eye as a whole nor to its parts, then this line does not move with respect to the surface of the circle of attachment or its circumference. But this circle forms the extremity of the hollow of the [optic] nerve. Thus, its surface and the surface of the nerve's hollow have the same orientation; and the inclination of the funnel-shaped portion of the nerve to the surface of this circle is constant, because the glacialis maintains a constant orientation with respect to this nerve.

[5.34] Since the parts of the eye do not move with respect to one another, the surface of the [optic] nerve's hollow, from the circumference of the circle of attachment to the place where the funnel-shaped part of the nerve begins to flare outward, moves with respect neither to the eye as a whole nor to the circle of attachment.

[5.35] Furthermore, it has already been shown that the line passing through the centers [of the ocular components] does not move with respect to the circle of attachment and that this line extends through the middle of the [optic] nerve's hollow.⁴⁴ But if this line does not move with respect to the circle of attachment, and if the surface of the nerve's hollow from the circumference of the circle of attachment to the place [in the eye socket] where it flexes does not move with respect to the circle of attachment, then this line does not move with respect to the hollow of the nerve up to the point where it flexes. Thus, the line that passes through the center of the

tunics of the eye passes through the center of the circle of attachment, and it will stand at right angles to it, and it extends through the middle of the hollow of the funnel-shaped portion of the nerve up to the point where the nerve flexes. It will always maintain a constant position with respect to the surface of the nerve's hollow within the eye, as well as [with respect] to all the parts of the eye and all the surfaces of the tunics of the eye, and it does not change that position whether the eye is moving or at rest.

[5.36] These, therefore, are the dispositions of the tunics of the eye, the dispositions of their centerpoints, and the disposition of the straight line passing through their centerpoints.

[5.37] Moreover, both eyes are similar in all respects, with regard to their tunics, as well as to the shape of their tunics and the situation of each of the tunics with respect to the eye as a whole. And given this fact, the location of each of the previously discussed centerpoints with respect to the whole of one eye as well as to its parts corresponds to that of the centerpoints of the other eye as a whole as well as to its parts. And since the location of the centerpoints in either eye corresponds to the location of the centerpoints in its mate, the line passing through the centerpoints of one eye will be similarly situated in respect to the eye as a whole, its parts, and its tunics as the line passing through the centerpoints of the other eye in respect to that eye as a whole, its parts, and its tunics. Thus, the two lines passing through the centerpoints of the tunics of both eyes are similarly situated in all respects.

[5.38] Each of the scleras is affixed with these components [into the eye-sockets], for two small muscles grow out of them, one toward the side of the tear ducts, the other toward the back edge. And lids and eyelashes cover both eyes.

[5.39] What we have thus shown is how the eye is composed, its [overall] structure, and the structure of its [component] tunics. And everything we have said about the tunics of the eye and their structure has already been shown by anatomists in books on anatomy,⁴⁵ and this is the way the eye is formed.

[CHAPTER 7]

[6.1] It has already been shown above that light emanates in every [possible] direction from any luminous body, however it is illuminated.⁴⁶ Thus, when the eye faces any visible object that shines with some sort of illumination, light from that visible object will shine on the eye's surface. And it was shown that it is a property of light to affect sight, whereas it is in the nature of sight to be affected by light. It is therefore fitting that sight sense the luminosity of a visible object only through the light that shines from it

upon the eye.

[6.2] It was also shown earlier that the form of the color of any tinted body that shines with any sort of illumination is always mingled with the light shining in every direction from that body, and light and the form of color will always correspond with one another.⁴⁷ Therefore, since the form of the color of the visible object will always coexist with the light shining from the visible object to the eye, and since light and color will reach the surface of the eye together, and since sight senses the color that is in the visible object by means of the light shining upon it from the visible object, it is quite fitting that sight sense the color of the visible object only from the form of [that] color reaching the eye along with the light [shining from the object].

[6.3] Also, the form of color is always mingled with the form of light and is not separable from it. So sight senses light only when it is mingled with color.⁴⁸ It is thus quite fitting that sight sense the color and light that are in the visible object only through a form that is composed of both the light and color shining upon it from the surface of the visible object.

[6.4] In addition, the tunics of the eye that are centered on the front of the eye are contiguous and transparent, and the first of these, i.e., the cornea, is in contact with the air that initially transmits the form. But it is among the properties of light to pass through any transparent body, and it is likewise a property of the form of color that it mingles with light in order to pass through a[ny] transparent body. Therefore, it extends through the transparent air in the same way as light. And it is in the nature of transparent bodies to receive the forms of light and colors and to transmit them in facing directions.⁴⁹ Hence, the form that comes from the visible object to the surface of the eye will pass through the transparency of the tunics of the eye from the opening that is at the front of the uvea. It will therefore reach the glacial humor and will also pass through it on account of its transparency. It is thus quite fitting for the tunics of the eye to be transparent for the sole purpose of letting the forms of light and colors that reach the eye pass through.

[6.5] At this juncture, then, let us summarize all of these points.

[6.6] And we will say that sight senses the light and colors that are in the surface of the visible object and that they pass through the transparency of the tunics of the eye. This is by now the accepted opinion of natural philosophers about how vision occurs.⁵⁰

[6.7] We will now say that this alone does not suffice to describe the way vision occurs, for, without some additional qualification, this explanation does not stand, for the form of light and color of any colored and illuminated body extends in all directions through the transparent air that is contiguous with it. However, the eye faces several visible objects of different

colors at the same time, and between each of them and the eye there are direct lines through the continuum of air that links them. And since the forms of light and color that are in a visible object facing the eye will reach its surface, the forms of the light and color belonging to any of the visible objects facing the eye at the same time reach the surface of the eye at the same time. And since the forms extend from the visible object to any facing point and reach the eye only when it faces [that object], the form that comes from the visible object to the eye reaches the entire surface of the eye. And since this is the case, when the eye faces any surface of a visible object, if the form of its color and light reaches the eye's surface, and if at that time the observer sees other visible objects of a different color that face the eye, then the form of the light and color of any of those visible objects will reach the eye's surface. And the form of all of those visible objects will reach the entire surface of the eye. On the whole, then, several different lights and several different colors will reach the entire surface of the eye, and each of them fills the surface of the eye. So a form composed of various colors and lights reaches the surface of the eye.

[6.8] If sight were then to sense that composite form, it would sense a color different from the color of any one of the objects, and it would not distinguish [any of the component] visible objects through it. Yet, if it were to sense one of those visible objects and were not to sense the rest, it would discern one visible object but not the others. But it discerns all of those visible objects at the same time, and it discerns them [all] distinctly.

[6.9] On the other hand, if it were unable to sense [any] one of those forms, it would sense none of the visible objects facing it. But it senses them all.

[6.10] Furthermore, in the same visible object there will be different colors and designs according to some arrangement, and from any spot on that object light and color emanate along every straight line that extends [from it] through the continuous air. Therefore, since the parts of a single visible object have different colors, from any one of those spots the form of color and light will reach the entire surface of the eye; and thus the colors of those parts will mingle on the eye's surface, whence sight will either perceive them mingled together or will perceive none of them. Yet if it perceives them mingled together, neither the parts themselves nor their colors will be discerned or perceived according to their proper arrangement. And if it fails to perceive any of their forms, it fails to perceive any of their parts; and if it fails to grasp any of their parts, it will fail to perceive the visible object [as a whole]. But sight does perceive any illuminated visible object facing it, and it perceives the parts of it that are of different colors distinctly and according to their proper arrangement.

[6.11] This being the case, it follows either that vision will take place in

some other way or that this account will only be part of the story. Therefore, we ought to consider whether this account can be suited to the circumstances under which the colors of visible objects are distinguished, and the parts of those objects are perceived by sight according to their proper arrangement, so they will correspond to reality.

[6.12] Accordingly, we will say that when the eye faces any visible object, the form of both the color and the light in that object will come from any point on its surface to the entire surface of the eye. Moreover, from every point on every visible object facing the eye under these circumstances the forms of the color and light in it will come to the entire surface of the eye. Hence, if the eye were to sense throughout its entire surface the forms of the color and light that come from any given point on the visible object's surface, it would sense throughout its entire surface the form of every point on the surface of the visible object as well as the form of every point on the surfaces of all the visible objects facing it in that situation. So the parts of any one visible object would not be perceived according to their proper arrangement, nor would they be properly discerned by it.⁵¹

[6.13] But if the eye sensed at only one point on its surface the form reaching its entire surface from one point on the surface of the visible object, and if it did not sense the form of that point throughout its entire surface, the parts of the visible object would be perceived by it according to their proper arrangement, and all the facing visible objects would be properly discerned. The reason is that when it perceives the color of a single point at only one point on its surface, it will perceive the color of one part of the visible object at one part of its surface, and it will perceive the color of another part [of the object] at another part of its surface. And it will perceive each part of visible objects at a spot on its surface different from the spot where it will perceive another visible object; so [different] visible objects will be perceived by it in proper arrangement and distinctly, as will the parts of each of them.⁵²

[6.14] So let us now consider whether this is possible and corresponds to reality. And we should say at the outset that vision takes place only through the *glacialis*, whether vision occurs by means of forms coming from the visible object to the eye or by some other means. Moreover, vision does not occur through one of the other tunics in front of it, for those tunics in front are only there to serve the *glacialis*. For if an injury happens to the glacial humor while the other tunics remain sound, vision will be extinguished; but if the remaining tunics suffer injury while retaining their transparency, and if the *glacialis* remains healthy, sight will not be disrupted. Likewise, if there is an obstruction in the opening of the uvea so that the capacity of its humor to transmit light is destroyed, sight will be extinguished, even when the cornea is healthy; but if the obstruction is removed,

sight will be restored. So too, if a crass, nontransparent spot develops within the albugineous humor, and if it lies directly in front of the glacial humor between it and the opening of the uvea, vision will be extinguished; but when that dense spot is removed or turned aside from the straight line between the glacialis and the opening in the uvea, sight will be restored. And medical science attests to all these points.⁵³

[6.15] Therefore, the destruction of [visual] sensation that ensues from degeneration of the glacialis while the tunics in front of it remain healthy is an indication that [visual] sensation occurs by means of this humor alone, not by means of the rest of the tunics in front of it. Furthermore, the destruction of [visual] sensation that ensues from the disruption of the transparency between the glacialis and the eye's surface by a crass, nontransparent body indicates that the transparency of these tunics exists only to link the transparency of the eye's tunics with the transparency of the air so as to form a continuum of transparent media between the glacialis and the visible object. Also, the destruction of [visual] sensation when the straight lines between the glacialis and the eye's surface are interrupted indicates that the glacialis will sense only along the straight lines between it and the surface of the eye.

[6.16] We shall therefore say that, if the visual sensation of the color and light that are in a visible object arises from the form coming to the surface of the eye from visible objects, and if this sensation occurs by means of the glacialis alone, then sight will not sense that form at the surface of the eye itself but only after it passes through the eye's surface and reaches the glacialis. And the form that reaches from the visible object to the eye's surface passes through the transparency of the eye's tunics, for it is among the properties of transparency that the forms of light and colors pass through it and continue rectilinearly. We have already made this point in regard to air; and if all transparent objects were to be tested, it would be found that light will extend through them only in straight lines.⁵⁴ And in our discussion of the refraction [of light] we shall show how this point is to be experimentally confirmed.⁵⁵ Therefore, if visual sensation of the light and color in a visible object is due to a form coming from that visible object to the eye, [that] sensation will arise [only] when that form itself reaches the glacialis. And it has already been shown that it is not possible for sight to perceive a visible object as it really exists unless it perceives the form of one point on the object at one point only on its own surface.⁵⁶ So it is not possible for the glacialis to perceive a visible object as it really exists unless, from the form reaching it from the object, it perceives the color of one point on that visible object at one particular point on the surface of the eye. Now a form comes from any given point on the surface of the visible object, and it passes through the entire surface of the eye into its interior. If, however, the glacialis per-

ceives only the form that reaches it at a single point on the surface of the eye from a single point on the visible object, this form having reached the entire surface of the eye and having passed through the tunics to the glacialis, and if it senses the color of that point alone that passes from the surface of the eye to [that] single point on its surface, and if it does not perceive that [same] point on the visible object from the rest of the form reaching its surface from the rest of the eye's surface, then vision will be achieved, the parts of the visible object will be perceived according to their proper arrangement, and the visible objects will be properly discerned by sight.⁵⁷

[6.17] Moreover, vision will be achieved in this way alone. And such cannot be the case unless [each] one of the points on the surface of the eye through which the form of any one point on the surface of the visible object passes is distinct from the remaining points on the surface of the eye, and unless the line along which the form is radiated to that point on the surface of the eye is distinct from the remaining lines along which the form is radiated. Accordingly, the glacialis can perceive the form arriving along that line through the point on the surface of the eye that lies upon that line but cannot perceive it along any other.

[6.18] And when lights are examined⁵⁸ and the way they pass into and continue through transparent bodies is experimentally determined, it is found that light continues through a transparent body along straight lines, as long as the body is of consistent transparency. But when it strikes a body whose transparency is different from the transparency of the body through which it previously extended, it will not continue upon the straight lines along which it had extended before unless those lines are perpendicular to the surface of the second transparent body. If, however, those lines are oblique rather than perpendicular to the surface of the second body, the light will be bent at the surface of the second body rather than continue straight.⁵⁹ And when it is bent, it will extend through the second body along those straight lines to which it has been inclined; and the lines along which the light has been bent in the second body will also be oblique rather than perpendicular to the surface of the second body. And if some of the lines along which the light reaches the first body are perpendicular to the surface of the second body and some inclined, the light that is orthogonally incident will extend straight through the second body. The light arriving along oblique lines, for its part, will be diverted along oblique lines at the surface of the second body, and it will extend rectilinearly through that body along those oblique lines into which it has been diverted. And we shall explain this in our discussion of bending, and we shall show how one can confirm this phenomenon experimentally, and it will [thus] be empirically ascertained.⁶⁰

[6.19] And since this is the case, when the form of the light and color that reach the surface of the eye from any given point on the visible object

arrives at the surface of the eye, only the light and color that are incident at right angles upon the surface of the eye will pass straight through the transparency of the tunics of the eye. The form incident along any other line will be refracted⁶¹ and will not pass straight through, because the transparency of the tunics of the eyes is not the same as the transparency of the air contiguous with the surface of the eye; and those forms that are refracted will also be refracted along oblique lines rather than continuing along lines perpendicular to the [refracting surfaces] at the points of refraction. And there is only one straight line that extends from any single point on the surface of the visible object to a given point on the surface of the eye so as to be orthogonal to the surface of the eye, whereas there is an infinite number of lines extending to the surface of the eye that are inclined to it. And the form that arrives straight along the perpendicular passes straight through the tunics of the eye along the perpendicular, whereas all the forms incident to that [same] point along oblique lines are refracted at that point, and they pass through the tunics of the eye along oblique lines as well. None of them passes through along the same lines that they followed in arriving, nor [do they pass] straight through along the perpendicular erected at that point [of refraction].⁶²

[6.20] Moreover, at any given time, the forms of all the points on the surfaces of all illuminated visible objects facing the surface of the eye arrive simultaneously at any point on it, for there is a straight line between that point and any point facing it. Also, the forms from any one of the points on the surfaces of illuminated visible objects radiate along every straight line that can be extended from that point, but of all the points facing the eye whose forms are incident upon a given point on the surface of the eye [at any given time], there is only one at that time that arrives along the perpendicular erected to that point on the surface of the eye. The forms of all the remaining points reach that point on the surface of the eye along oblique lines. Furthermore, through any point on the surface of the eye the forms of all the points on the surfaces of all the visible objects facing the eye pass simultaneously. But the form of only one point passes straight through the transparency of the tunics of the eye, and that point is the one that lies at the endpoint of the perpendicular extending from the given point on the surface of the eye. The forms of all the remaining points are refracted at that point on the surface of the eye, and they pass through the transparency of the tunics of the eye along lines that are oblique with respect to the eye's surface.

[6.21] Also, from any given point on the surface of the glacialis there extends only one line that is perpendicular to the surface of the eye. But there are an infinite number of lines extending from that point that will be oblique to the surface of the eye. Thus, besides the perpendicular itself, an

infinite number of lines extends from the point on the surface of the glacialis where the perpendicular to the surface of the eye originates, and this perpendicular passes through the opening in the uvea; the rest of the lines also pass through the opening in the uvea and reach the surface of the eye.

[6.22] Furthermore, if we suppose these lines to be refracted according to the way determined by the difference in transparency between the transparency of the corneal body and the transparency of the air, then the endpoints of all the lines that extend from any given point on the surface of the glacialis and pass through the opening of the uvea to reach the surface of the eye along oblique paths reach different locations and different points among the set of [all] points on the surfaces of visible objects that face the eye at any given time. And none of these lines intersects the point at the end of the perpendicular. So the forms of the points that lie on the surfaces of the visible objects at the extremities of all these lines are propagated rectilinearly along these lines, and they reach the surface of the eye where they are refracted to the same point on the surface of the glacialis, except for the form of the point lying at the extremity of the perpendicular, for it extends straight along the perpendicular and passes [straight through] to that point on the glacialis. Thus, if at any one of its points the glacialis senses all the forms reaching that point along all the lines of radiation,⁶³ at every point it will sense forms that are mixed together from many different forms and many [different] colors [extending] from the visible objects that face the eye at that time. Hence, on the basis of this [mixed form] it will discern none of the [individual] points on the surfaces of those visible objects, nor will the forms of those points that reach that point be perceived according to their proper arrangement. Yet if the glacialis were to sense at one of its points only the form that reaches it along one particular radial line, the [individual] points on the surfaces of the visible objects would be properly discerned by it.

[6.23] But none of the points whose forms reach the glacialis along refracted lines is more exceptional than any of the other points whose forms are refracted, nor is any refracted path more exceptional than any other; and the forms that are refracted at any given point on the glacialis at any given time are innumerable. On the other hand, the point whose form reaches any one point on the glacialis along the perpendicular is unique; no other form accompanies it straight along the perpendicular, for all the forms that are refracted are refracted along oblique lines alone. Moreover, since the center of the eye's surface coincides with the center of the glacialis' surface, any line that is perpendicular to the surface of the eye is perpendicular to the surface of the glacialis. Hence, the form that arrives along the perpendicular is distinguished from all the other forms in two respects, the first of which is that it extends from the surface of the visible object to the

point on the glacialis along a straight line, whereas the remaining forms reach [that point] along refracted lines. The second is that the perpendicular dropped to the surface of the eye is the very same perpendicular that is dropped to the surface of the glacialis, whereas the rest of the lines along which the remaining forms that are refracted reach [the eye] are oblique to the surface of the glacialis, because they are oblique to the surface of the eye.

[6.24] Furthermore, the effect of light arriving along perpendiculars is stronger than the effect of light arriving along oblique lines. Therefore, it is quite fitting that at any given point the glacialis senses only the form reaching it straight along the perpendicular and does not sense any form that strikes it at that point along refracted lines.⁶⁴

[6.25] In addition, since the center of the eye's surface and the center of the surface of the glacialis coincide, all of the perpendiculars erected to the surface of the glacialis as well as to the surface of the eye intersect at that common center, and they will form diameters for the tunics of the eye. And every perpendicular will strike the surface of the cornea at one point and will strike the surface of the glacialis at one point, but at that point on the cornea only one perpendicular can be dropped, and at that point on the glacialis no perpendicular other than that one can be dropped. So the form that extends from any given point on the surface of the visible object along the perpendicular dropped from it to the surface of the eye strikes the surface of the eye at one point, but none of the other forms arriving [from that point on the visible object] along nonperpendicular lines strikes [the surface of the eye at] that particular point. Furthermore, it has already been shown that from any point on any colored body that is somehow illuminated light and color emanate along every straight line that can be extended from that point.⁶⁵

[6.26] Therefore, one can imagine a straight line [extended] between any point facing a given surface and any point on that surface, and between that point and that whole surface a cone can be imagined with its vertex at that point and its base formed by that surface. And that cone contains all the straight lines that are imagined to lie between that [vertex-]point and all the points on that surface.⁶⁶

[6.27] Accordingly, since the form of light and color radiates from any point on the surface of a colored and illuminated body along every straight line that can be extended from that point to any point facing that illuminated and colored body, the form of the light and color on that body's surface is radiated from any point on the surface of that body to that facing point along a straight line extending between that same body and that point. The form of the light and color of any colored body that is somehow illuminated thus extends from its surface to any point facing that surface along a

line contained by the cone that is formed between that point and that surface. And the form will be arranged within that cone according to the lines that intersect at that point, which forms the cone's vertex, and that arrangement will be the same as the arrangement of the spots of color on the surface of that body.

[6.28] So when the eye faces any visible object, a cone can be conceived of as formed between the point that represents the center of the eye and the surface of that visible object, the vertex of that cone being the center of the eye and its base being the surface of that visible object. And if the intervening air between that visible object and the eye is continuous, if there is no opaque body interposed between that visible object and the eye, and if that visible object is somehow illuminated, the form of the light and color on the surface of that visible object will reach the eye along a line contained by that cone. And the form of every point on the surface of that visible object will radiate along the straight line connecting that point and the vertex of the cone, which lies at the center of the eye.

[6.29] Furthermore, since the center of the eye[*'s surface*] is the same as the center of the surface of the *glacialis*, all of these lines will be perpendicular to the outside surface of the eye as well as to the surface of the *glacialis* and all the surfaces of the eye that are parallel [to them]. And the cone that coincides with all these perpendicular lines will encompass all these perpendiculars and the air through which the form [in its entirety] extends along perpendicular lines from the whole surface of that visible object facing the eye. Also, the surface of the *glacialis* will intersect that cone, so the form of the light and color on the surface of that visible object reaches the section of the *glacialis* that is demarcated by the cone. At any point on this section of the surface of the *glacialis* the form of a corresponding point on the surface of the visible object will arrive along the perpendicular dropped from that point on the surface of the visible object to the surfaces of the tunics of the eye as well as to the surface of the *glacialis*.⁶⁷ And this form passes straight through the transparency of the tunics of the eye along that perpendicular, but no other form passes straight through in tandem with that form along that perpendicular line. That form, moreover, will reach this spot on the *glacialis* according to the arrangement determined by the lines along which it arrives there, those lines being perpendicular to the *glacialis* and intersecting at the center of the eye in an arrangement corresponding to that of the parts of the surface of the visible object.⁶⁸ Furthermore, under these circumstances several forms reach any point on this section of the *glacialis* from several points on the visible surfaces at the same time. Thus, several forms arising from several different colors reach this section of the *glacialis* that has been demarcated by the cone.

[6.30] If, therefore, the *glacialis* senses the form reaching it at one, dis-

tinct point along only one of the lines within that cone, and if at that [same] spot on its surface it senses no other form than the form reaching it along that line, then it will sense the form of that object as it actually exists, and it will sense it according to its arrangement [on the visible surface]. Moreover, under those circumstances, it will be able to sense the forms of visible objects other than that visible object on the basis of the cones that demarcate other sections upon its surface, and it will be able to sense the form of each of those visible objects as they actually exist as well as to sense their relative locations as they actually exist.

[6.31] But if the glacialis senses forms arriving at it along refracted lines, the forms it will sense at the same section on its surface that was cut by the cone will be mixed from the forms of parts of the given visible object as well as from the forms of many different visible objects, and those forms will represent mixtures of many different colors. Moreover, at some spot on its surface other than that one it will sense a form that is mixed from the forms of many different visible objects, and so it will not sense the form reaching it along the line within the cone as it actually exists, nor will it sense any of the forms reaching it along the perpendiculars as they actually exist, nor will it sense any of the forms reaching it along refracted lines [as they actually exist]. Hence, it will not sense the form of any individual visible object as it actually exists, nor will visible objects facing it at any given time be [individually] discerned by it.

[6.32] But sight will [in fact] perceive separate visible objects, and it will perceive the parts of an individual visible object according to their actual arrangement on the surface of the visible object, and it will perceive several visible objects together at the same time. And since vision is due to forms reaching the eye from visible objects, the glacialis will sense none of the forms of visible objects that reach it along refracted lines.

[6.33] Furthermore, none of the forms reaching the surface of the glacialis from visible objects will be arranged on the surface of the glacialis according to reality, and none of the forms reaching the surface of the glacialis from the parts of the individual object will be arranged on the surface of the glacialis according to reality except for the forms reaching it directly along the perpendiculars dropped to the surface of the eye. The forms, moreover, that are refracted at the surface of the eye reach the surface of the glacialis in reverse order. And in addition to that, the form of one point is spread out upon an area of the surface of the glacialis rather than arriving at a point, and this follows from the fact that when the form of a right-hand point with respect to the eye reaches a point on the surface of the eye, assuming that the line along which that form extends is oblique to the eye's surface, it will refract to the left of the normal dropped from the center of the eye to that point on its surface. And the form that is refracted in this way at the ex-

tremity of the normal [at the point of refraction] reaches a point to the left of the point on the surface of the glacialis where that perpendicular intersects it. So too, the form of a left-hand point with respect to the eye that extends to that same point [of refraction] on the surface of the eye and that is oblique to this surface will be refracted to a point on the right of the normal as well as on the right of the point on the surface of the glacialis that lies on that normal. For after refraction, refracted forms do not incline along the normal dropped to the point of refraction, nor do those forms coincide with the normal, nor do they pass through it or continue by it, for such is the property of refracted forms.⁶⁹

[6.34] Likewise, [when] the forms of two points on the same side of the viewer extend to one point on the surface of the eye and are bent in the same direction at that surface, [they] arrive at the surface of the glacialis in reverse order, for the two lines along which the two forms of the points extend intersect at the point on the surface of the eye where the two forms meet, and they meet the normal at the point to which it is dropped on the surface of the eye. Thus, if these two lines are oblique to the surface of the eye and lie on the same side of the normal dropped from the center of the eye to that point [of refraction], the forms of the two points are refracted to the side opposite that one. Also, because the two lines along which the two forms arrive at that single point on the surface of the eye intersect at that point, it follows that, as they continue along their respective straight lines after intersection, their position with respect to their source in the visible object, as well as to the normal, appears reversed. And of those two lines, the one that lay [farther] to the right before arriving at the surface of the eye ends up [farther] to the left after passing through the surface of the eye, whereas the one [farther] to the left [ends up farther] to the right.⁷⁰

[6.35] The same will hold for the [relative] position of the two lines along which the two forms are refracted at one point on the surface of the eye, for the two forms that are refracted at one point both approach the normal, and, after intersecting [the normal], the form that arrived along the line farther from the normal continues along a line that is also farther from the normal, but less so than before. Meantime, after intersecting [the normal], the form that arrived along the line nearer to the normal still continues along a line that is nearer the normal, but more so than before, and the same holds for all forms that are refracted at a single point.⁷¹

[6.36] And if this phenomenon is experimentally scrutinized with great care, the result will be found to agree with what we have claimed. And we shall show how to carry out this experimental confirmation properly in our section on refraction,⁷² and at that time everything to do with refraction will be revealed. But in that section we shall not avail ourselves of the discussion of matters that we have demonstrated in this book concerning such

phenomena.

[6.37] Therefore, when the forms of two points on one side of a visible object arrive obliquely at a single point on the surface of the eye, they will intersect [and continue] along two lines whose [relative] position with respect to the visible object from the perspective of the viewer will be opposite to the [relative] position of the two lines along which the two forms originally reached the surface of the eye. Accordingly, the position of the two points on the surface of the *glacialis* to which the two forms reach will be opposite the position of the two points [on the surface of the visible object] from which the two forms originate. All forms that are refracted at one point on the surface of the eye thus arrive in reverse order on the surface of the *glacialis*.⁷³

[6.38] Furthermore, the form of any point facing the eye reaches the entire surface of the eye; hence it will be refracted at the entire surface of the eye. And the form that is refracted at the entire surface of the eye is refracted to an area on the surface of the *glacialis* that has some dimension, not to a point, for if refracted forms were to meet at one point after refraction, they would either intersect or pass through the normals at whose endpoint they have been refracted, or the form would pass out of the plane within which it has been refracted.⁷⁴ But, after being refracted, no refracted form meets the normal at whose endpoint it was refracted, nor does it pass through it, nor does it pass out of the plane within which it was refracted. And all of these points become clear with experimentation. Therefore, [when] the form of a single point on a visible object reaches the surface of the *glacialis* through refraction, [it] will not reach it at a single point but, rather, at an area on the surface of the *glacialis* that has some dimension. Moreover, the relative positions of the forms of different points on the surface of the visible object that reach the surface of the *glacialis* through refraction will not be the same as their actual positions on the surfaces of [those] visible objects, but reversed. Thus, none of the refracted forms of visible objects reaching the surface of the *glacialis* represents the surfaces of the visible objects as they actually are. But it has already been shown that forms arriving along perpendiculars are arranged on the surface of the *glacialis* according to reality, because they extend orthogonally from the surfaces of visible objects to the surface of the *glacialis*. Except for the forms extending along perpendicular lines, then, none of the forms of visible objects that reach the surface of the *glacialis* is arranged on the surface of the *glacialis* according to its actual arrangement on the surfaces of visible objects.

[6.39] Hence, if visible objects are sensed by means of forms reaching the eye from the surfaces of visible objects, sight will perceive none of the forms of visible objects that reach it along lines other than those whose end-

points meet at the center of the eye, for sight perceives none of the forms of visible objects unless they are arranged [in sight] according to their actual arrangement on the surfaces of visible objects.

[6.40] Moreover, if the center of the eye[ball]'s surface is not [the same as] the center of the surface of the glacialis, then the straight lines originating at the center of the surface of the eye that extend through the opening in the uvea and reach visible objects will be oblique rather than perpendicular to the surface of the glacialis; and their [relative] positions on the surface of the glacialis will not be constant, except for one line alone, and that is the one that passes through both centers. Therefore, the glacialis can only sense the forms reaching its surface from the surfaces of visible objects along those lines alone—i.e., the lines that are perpendicular to the surface of the eye, which is the surface of the cornea. For only the forms that lie upon these perpendiculars are arranged on the surface of the glacialis according to their arrangement on the surfaces of visible objects.

[6.41] If, then, the glacialis perceives visible objects by means of forms reaching it and perceives only that form reaching it along these lines, and if these lines are not perpendicular to its surface, then it will perceive forms along lines that are oblique to its surface and whose [relative] locations are variable with respect to its surface. So it perceives forms along oblique lines that have different [relative] positions, and it will perceive all refracted forms along lines that have different [relative] positions with respect to its surface. But if it were to perceive all refracted forms along lines that have different [relative] positions, none of the visible objects would be [individually] discerned by it, according to what has been demonstrated above.⁷⁵ And if it is not possible for the glacialis to perceive refracted forms of visible objects along lines that have different [relative] positions, it is not possible for it to perceive the forms of visible objects along lines that are perpendicular to the surface of the eye unless those lines are perpendicular to its surface and unless their [relative] position on its surface is constant. But these lines will only be perpendicular to the surface of the glacialis if the center of its surface is the same point as the center of the surface of the eye. Thus, if the visual sensation of visible objects is due to forms reaching the eye from the colors and light of [those] visible objects, then the center of the eye's surface and the center of the surface of the glacialis must be a single, common point, and sight can perceive none of the forms of visible objects unless it does so exclusively along the straight lines whose endpoints meet at this centerpoint.

[6.42] Now it is not impossible for the two centers to coincide, for it has already been shown that the two centers lie behind the center of the uvea upon a single straight line that passes through all the centers [of the tunics of the eye].⁷⁶ And since it is not impossible for the two centers to be the

same and for the straight lines passing through the centers to be perpendicular to the two surfaces—i.e., the surface of the glacialis and the surface of the eye—then it is also not impossible for the visual perception of visible objects to be due to the forms of light and color coming to it from the surfaces of [those] visible objects, if the perception of those forms takes place along perpendicular lines alone. And this is so because it is in the nature of sight to receive forms that reach it from visible objects, and also because, in addition to this qualification, it is in the nature of sight only to accept those forms that reach it along specific lines, not along all lines; and these specific lines are the straight lines alone whose endpoints meet at the center of the eye, and these lines converge at the center because they are diameters (of the eye, that is) and are perpendicular to the surface of the sensing organ. And so [visual] sensation will be due to the forms that come from visible objects, and the perpendicular lines [along which they are sensed] will be, as it were, the instrument of sight by means of which visible objects will be [individually] discerned by sight and the parts of every visible object will be [properly] arranged [for visual perception].

[6.43] Moreover, the fact that sight functions according to particular lines has counterparts in [other] natural phenomena. For light originates at luminous bodies and extends along straight lines only rather than following curved or crooked lines; and heavy bodies fall naturally along straight lines, not along crooked, curved, or winding lines. Moreover, such bodies will follow not every straight line lying between them and the surface of the earth, but only those select straight lines that are perpendicular to the surface of the earth and to the earth's diameter.⁷⁷ Also, celestial bodies move along circular lines rather than along straight lines or lines of other kinds. And when we examine natural motions, we will find that each of them takes place according to specific lines. So it is not impossible for sight to be constituted in such a way as to suffer the effects of light and color along a specific set of straight lines that alone intersect at its center and are perpendicular to its surface. Furthermore, it is granted by mathematicians that sight perceives visible objects along only those straight lines whose endpoints meet at the center of the eye, and there is no disagreement among them about this point.⁷⁸ These lines are called "radial lines" by them.

[6.44] Since this is possible, and since forms of light and color reach the eye and pass through the transparency of the tunics of the eye, and since vision is achieved upon the reception of these forms only when the eye receives them along perpendicular lines, sight perceives the light and colors of the surfaces of visible objects only through forms reaching it from the surfaces of visible objects. Moreover, it perceives these forms only along those particular straight lines whose endpoints meet at the center of the eye.

[6.45] Let us now summarize what can be concluded from everything we have said.

[6.46] And let us say that vision senses the light and color on the surface of a visible object through the form of both the light and color that extend from the surface of the visible object through the transparent medium that lies between the eye and the visible object, and sight perceives the forms of visible objects only along the straight lines that are extended between the visible object and the center of the eye. And along with this it has been shown that this is possible rather than impossible.⁷⁹

[6.47] But we will expound on the issue by saying that vision can only occur in this way. For when sight senses a visible object after having not sensed it, something that was not affecting it before now affects it, but nothing will happen later that was not in effect earlier except through some cause. And we find that when the eye faces a visible object, it will sense it; but when it is removed from that facing position, it will not sense it, whereas when it is brought back to the facing position, the sensation returns. Likewise, we find that when the eye senses a visible object and then [the viewer] closes his eyelids, the sensation ceases; but when he opens his eyelids while the visible object faces him, the sensation returns. Now a cause is such that, when it ceases to operate, what it causes ceases to exist; and when it is brought back to bear, what it causes comes back into existence. Therefore, what causes the visible object to have an effect on sight is the fact that the visible object faces the eye. Hence, sight does not sense a visible object unless the visible object creates an effect on it as it faces the eye.⁸⁰

[6.48] In addition, sight does not perceive a visible object unless the intervening medium is transparent. Now the visual perception of a visible object through the air that lies between eye and object is not due to the moisture in the air but, rather, to its transparency, for if some [transparent] stone or any other transparent body is interposed between the eye and the visible object, sight will still perceive the visible object. And the [clarity of] perception will depend upon the transparency of the intervening body, so that the more transparent the intervening body the clearer the visual sensation of the visible object. Likewise, when clear, transparent water intervenes between the eye and the visible object, sight will perceive a visible object through the water; but if that water is tinged with some strong dye so that its transparency is destroyed, then, even though the water's moisture persists, sight will not perceive that visible object in the water.⁸¹

[6.49] It will therefore be clear from these circumstances that sight is achieved only because of the transparency of the intervening medium, not because of its moisture. Hence, the effect that the visible object creates in sight when it faces what arouses sensation in it is realized only through the transparency of the medium between the eye and the visible object. The

light and color of a visible object are therefore perceived by sight only by means of the effect of that light and color in the eye, and this effect is not created in the eye by color and light unless the medium between the eye and the visible object is transparent.

[6.50] In terms of its essential relationship to light and color, transparency differs from opacity only insofar as the form of light and color passes through a transparent object, whereas it does not pass through one that is not transparent, and insofar as a transparent body receives the form of light and color and transmits it in [all] directions facing the light and color; a body that is not transparent, on the other hand, does not possess this quality. And since sight senses the light and color in a visible object by means solely of an effect created by them in the eye; and since that effect is created in the eye only when the medium between the eye and the visible object is transparent; and since a transparent body is distinguished from one that is not transparent solely by the fact that, in regard to its essential relationship to light and color, it is suited to the reception of forms and colors as well as to their transmission in facing directions; and since it has been shown that, when the eye faces a visible object, the form of the light and color in the visible object are transmitted into the eye and reach the surface of the sensing organ, sight senses the light and color of a visible object by means solely of a form extending through the transparent medium between the visible object and the eye, that form creating in the eye the effect of the visible object that faces it across the transparent medium.

[6.51] Now we might claim that the transparent medium receives something from the eye and transmits it to the visible object, so that sensation comes about from the extension of this thing between the eye and the visible object. This is the opinion of the proponents of [visual] rays.⁸²

[6.52] Accordingly, let it be supposed that such is the case and that [visual] rays issue from the eye and pass through the transparent medium to reach the visible object, and [suppose] that [visual] sensation occurs by means of these [visual] rays. But if [visual] sensation occurs in this way, I ask whether something is transmitted back to the eyes through those [visual] rays or not. On the one hand, if [visual] sensation occurs by means of [visual] rays, but they transmit nothing back to the eye, then sight will perceive nothing. On the other hand, sight does sense the visible object, and if it senses the visible object but does so only by means of [visual] rays, then those [visual] rays that sense the visible object [must] transmit something back to the eye by means of which sight senses the visible object. Yet if the [visual] rays transmit something back to the eyes [and it is] by means of this [that] visual sensation of that visible object will occur, then sight will sense the light and color in the visible object by means solely of something coming from the light and color in the visible object to the eye, and the [visual]

rays [must] transmit it. Under all conditions, then, sight will only occur by means of some visible property reaching [the eye] from the visible object, whether or not [visual] rays issue from the eye.

[6.53] Now it has already been shown that vision is achieved only through the transparency of the medium intervening between the eye and the visible object, and it is not achieved when the medium between them is not transparent.⁸³ It is obvious, moreover, that a transparent body is distinguished from one that is not transparent in no way other than the aforementioned one. This being the case, as we have said, and since it has been shown that the form of the light and color in a visible object reaches the eye when it faces the eye, then what comes to the eye from the visible object to provide the means by which it perceives the light and color in the visible object, no matter the circumstance, is this very form [and this form] alone, whether [visual] rays issue [from the eye] or not.

[6.54] And it has already been shown that forms of light and color are continually generated in air and in all [other] transparent bodies, and these forms continually extend through the air, as well as through [other] transparent bodies, in various directions, whether the eye is present or not.⁸⁴ Hence, the extramission of [visual] rays is superfluous and useless.⁸⁵ Accordingly, the eye senses the light and color of the visible object only by the form coming from the light and color in the visible object.

[6.55] Furthermore, it has already been shown that the form of every point on a visible object facing the eye reaches the eye along several different lines and that sight can apprehend the form of the visible object according to its actual arrangement on the surface of the visible object only when the forms are received along straight lines that are perpendicular to the surface of the eye as well as to the surface of the sensing organ; [it has been shown] as well that [these] straight lines will not be perpendicular to [both of] these surfaces unless the centers of these surfaces form a single point and that this is possible. And since all this is true as claimed, the center of the surface of the glacialis and the center of the surface of the eye must lie at a single point. Sight therefore can perceive only those forms of visible objects [that reach the eye] along the straight lines whose endpoints meet at this center. And this is what, earlier in our discussion of the shape of the eye, we promised to show in this chapter, and this has now been demonstrated: i. e., that the center of the glacialis and the center of the surface of the eye form the same common point.⁸⁶

[6.56] Now that this has been demonstrated, it remains for us to consider the opinion of the proponents of [visual] rays and to show what is false and what is true about that opinion. Accordingly, we should say that if vision results from something passing from the eye to the visible object, then that thing is either corporeal or not. If it is corporeal, then when we

look at the sky and see the stars in it, at that moment physical substance must stream from our eyes to fill the space between the heavens and the earth without the eye's being diminished in any way; but this is illogical.⁸⁷ Therefore, vision cannot be due to the extramission of some physical substance by the eye to the visible object. But if what is emitted from the eye is not corporeal, it will not feel the visible object, for sensation can only occur in bodies. Thus, nothing issues from the eye to the visible object to sense that object.

[6.57] And it is obvious that vision occurs through the eye. This being the case, if sight perceives a visible object only when something issues from the eye to the visible object but what issues [from the eye] does not sense the visible object, then what issues from the eye to the visible object transmits nothing back to the eye to serve as the means through which it can perceive the visible object. Also, the idea that something issues from the eye is based not on empirical evidence but on supposition, and nothing should be supposed unless dictated by logic. Yet the proponents of [visual] rays posit them because they have found that sight perceives a visible object when eye and object are spatially separated; but it is a cardinal precept among men that sensation cannot occur without [physical] contact, so the proponents of visual rays have concluded that vision only occurs through something issuing from the eye to the visible object and thereby sensing the visible object where it is or taking something from the visible object and transmitting it back to the eye, at which time the eye will sense it.⁸⁸

[6.58] But since a sensitive body cannot issue from the eye to the visible object, and since only a body can sense a visible object, the only option left is to suppose that what issues from the eye to the visible object takes something from the visible object and transmits it to the eye. And since it has been shown that air and [other] transparent bodies receive the form of a visible object and transmit it to the eye as well as to every [other] body facing the visible object, what is assumed to transmit something from the visible object to the eye is nothing but the air or [other] transparent media intervening between the eye and the visible object. And since air and [other] transparent bodies transmit something from the visible object to the eye, they transmit it at any given moment and under all conditions when the eye faces the visible object [and they do so] without needing anything to issue from the eye. Thus, the reason that has led the proponents of [visual] rays to claim the existence of [such] rays is superfluous, because what has led them to claim that [visual] rays exist is their opinion that vision cannot be achieved except by something that extends from the eye to the visible object so as to transmit something back to the eye from the visible object. But since air and [other] transparent media fulfill this task without needing anything to issue from the eye, and, in addition, since they [already] extend

between the eye and the visible object, then, since there is no need to suppose that something else transmits anything from the visible object to the eye, the opinion [of the proponents of visual rays] is pointless. Hence, the claim that [visual] rays exist is nullified.

[6.59] Moreover, all the mathematicians who claim the existence of [such] rays use nothing but imaginary lines in their demonstrations, and they call them "radial lines." But we have already shown that sight perceives visible objects along such lines alone. The opinion of those who suppose that radial lines are imaginary is thus true, whereas the opinion of those who suppose that anything issues from the eye is false.⁸⁹ And we have now demonstrated that what actually obtains does not confirm [the existence of] visual rays, nor has reason led [us to accept] them.

[6.60] On the basis of everything we have said, then, it has now been demonstrated that the eye senses the light and color on the surface of a visible object by means solely of a form that extends from the surface of the visible object to the eye through a transparent medium intervening between the eye and the visible object, and [it has been demonstrated] that sight perceives only those forms [reaching the eye] along the straight lines that are conceived to extend between the visible object and the center of the eye, those lines alone being perpendicular to all the surfaces of the tunics of the eye. And this is what we wanted to demonstrate.

[6.61] This is therefore how vision takes place generally, because, in terms of naked sensation, sight perceives only the light and color that are in the visible object. The remaining characteristics of visible objects that sight perceives, e.g., shape, size, and the like, are perceived by sight not through naked sensation but through reason and defining features.⁹⁰ And we shall show this later in the second book after we finish discussing the various visible properties that sight perceives. But what we have shown—namely, how vision takes place—conforms to the opinion of those who have verified it on mathematical grounds as well as [those who have verified it] on physical grounds. It has been shown therefore that both parties have something true to say and that both opinions are correct and compatible, but neither is wholly satisfactory without the other [to complement it], nor can vision be properly accounted for without drawing upon what both have to say.

[6.62] Hence, [visual] sensation is due solely to the form and to the effect of the form on the eye as well as to the passion aroused in the eye by the form, and the eye is constituted in such a way as to be affected by this form according to a specific orientation, i.e., the orientation of perpendicular lines upon its surface. Moreover, it is in the nature of the eye to be so constituted only because individual visible objects would not be distinguished [by it], nor would the parts of any of them be properly arranged on the eye unless

the sensation [aroused in it] occurred exclusively along those lines. Therefore, radial lines are imaginary lines, and they define the specific direction according to which the eye is affected by the form.

[6.63] And it has already been shown that when the eye faces a visible object, a cone will be formed between the visible object and the center of the eye, its vertex being the center of the eye and its base the surface of the visible object.⁹¹ And between any point on the surface of the visible object and the center of the eye there will be an imaginary straight line that is perpendicular to the surfaces of the tunics of the eye, and the cone will thus contain all such lines. And the [anterior] surface of the glacialis will cut this cone, for the center of the eye, which forms the vertex of the cone, lies behind the [anterior] surface of the glacialis; and if the air that intervenes between the eye and the visible object is continuous, the form will extend from the visible object along this cone through the air enclosed by it, as well as through the transparent tunics of the eye, to the area on the surface of the glacialis that is demarcated by that cone. And the cone will contain all the radial links between the eye and the visible object by means of which the eye perceives the form of that visible object, and that form will be arranged within this cone as it actually exists upon the surface of the visible object as well as upon the area on the surface of the glacialis [that is demarcated by the cone].⁹²

[6.64] Furthermore, it has already been shown that [visual] sensation occurs only through the glacialis.⁹³ Hence, the visual sensation of the light and color on the surface of a visible object occurs only at the area on the glacialis that is demarcated by the cone formed between that visible object and the center of the eye. And it has been said earlier that there is some measure of transparency and some measure of opacity in this humor and, accordingly, that it is like ice in appearance.⁹⁴ Therefore, insofar as there is some transparency in it, it receives forms, and they pass through it by virtue of the transparency that is in it; but insofar as there is some opacity in it, it impedes the forms passing through it by virtue of the [modicum of] opacity it possesses. And the forms are [thereby] impressed on its surface and within its body.⁹⁵ Likewise, when it shines upon a transparent body possessing some measure of opacity, light will pass through it on account of its transparency, but the light is impressed on its surface according to its opacity.

[6.65] Also, the glacialis is constituted to receive these forms and to sense them. The forms thus pass through it according to its capacity to receive them sensibly.

[6.66] And when the form reaches the surface of the glacialis, it will create an effect in it, and the glacialis will suffer that effect, because it is a property of light to affect the eye, and it is a property of the eye to be af-

fectured by light. And this effect that light creates in the glacialis passes through the body of the glacialis along straight, radial lines exclusively, for the glacialis is constituted to receive the forms of light along radial lines. And as the light passes through the body of the glacialis, color passes along with it, for color is mingled with light. For its part, the glacialis accepts this effect and its passage, and from this effect and the passion [aroused by it] the glacialis will sense the forms of the visible objects that are [incident] upon its surface. And those forms pass through its whole body, and from the arrangement of the parts of the form on its surface, as well as within its whole body, it will sense the arrangement of the parts of the [visible body] affecting it.⁹⁶

[6.67] And the effect that light has upon the glacialis is in the form of pain. Now some pains can indeed be suffered without the [affected] organ's being distressed by them, and such pains are not perceptible to sense, so the sufferer does not recognize them as pain. An indication of this fact is that light arouses pain insofar as strong light, such as sunlight, when a viewer stares at the sun itself, or sunlight, when it is reflected to the eye from polished bodies, distresses the eye and clearly hurts it, for such [strong] light arouses obvious pain in the eye. But the effect of all light upon the eye is of the same kind, varying only in intensity. And since these effects are all of the same kind, and since the effect of stronger light is in the form of [manifest] pain, then every effect of light is in the form of pain, varying only in intensity. And because of the lightness of the effects of weak and moderate light upon the eye, the [visual] sense fails to recognize them as pain. Hence, the sensation aroused in the glacialis by the effect of light is of the same kind as sensible pain.⁹⁷

[6.68] After occurring at the glacialis, this sensation spreads through the hollow [optic] nerve and arrives at the front of the brain where sensation culminates and where the final sensor is located, this latter being the sensitive faculty at the front of the brain, and this faculty will perceive all sensibles. The eye, for its part, is nothing more than an instrument for this faculty, for the eye receives the forms of visible objects and transmits them to the final sensor, but the final sensor perceives those forms and perceives the visible properties possessed by them. And the form [impressed] on the surface of the glacialis extends through the body of the glacialis, then through the subtle flux [of visual spirit] in the hollow of the [optic] nerve until it reaches the common nerve. When the form reaches the common nerve, the visual process is complete, and from the form that arrives at the common nerve the final sensor will perceive the forms of visible objects.⁹⁸

[6.69] However, the viewer will perceive visible objects with two eyes; thus, since the form of a visible object must reach both eyes, two forms will reach the visual faculty from a single visible object. Nevertheless, the viewer

will perceive the visible object as single, and the reason is that, when the two forms reaching the two eyes from one visible object reach the common nerve, the two forms meet and are superimposed upon one another to make a single form. And it is from this form, which is united from the two [original] forms, that the final sensor will perceive the form of that visible object.⁹⁹

[6.70] That the two forms reaching both eyes from a single visible object are united and made into a single form before the final sensor perceives it and that the final sensor perceives the form only after the two [original] forms are united is indicated by the fact that, when a viewer moves one of his eyes while the other remains immobile, and when the motion of the eye that is moved is in an upward direction, he will see a facing visible object doubled. If, however, he elevates the one eye while covering the other, he will only see [the object] as single.

[6.71] Thus, if the [final] sensor were to perceive [an object as] single [just] because it is single, then it ought to perceive it as single all the time; and if two forms were always to come to it from one visible object, then it would invariably perceive the single object doubled. But since the final sensor will only perceive the visible object through a form reaching it, the fact that it will sometimes perceive a single object as double and sometimes as single indicates that, when it perceives the object doubled, two forms reach it, whereas when it perceives the single visible object as single, a single form reaches it. In both cases, since two forms reach the two eyes from a single visible object, and since what is transmitted to the final sensor is sometimes two forms and sometimes a single form, and since the form that is transmitted to the final sensor is transmitted only by the eye, then, when it perceives a single object singly, what is transmitted to the final sensor from that object is a single form [arising] from the two forms reaching the two eyes from the single visible object.

[6.72] Since this is the case, then the two aforementioned forms extend from the two eyes and meet before the final sensor perceives them, and it is after their juncture that the final sensor will perceive the form united from them. But when the final sensor perceives the two forms that reach the two eyes from a single object as double, those two forms extend from the two eyes but do not meet [in perfect superposition], so they reach the final sensor as two forms.

[6.73] Moreover, the fact that a single visible object is sometimes perceived as single and sometimes as double indicates that vision is not due to the eye alone, for if it were, then at the moment of its perception the two eyes would perceive the two forms reaching them from a single object as one and the same form. And if that were the case, then they would always perceive one form from those two.

[6.74] And the fact that a single visible object is sometimes perceived as single and sometimes as double, while in either case two forms are [impressed] in the two eyes, indicates that, besides the two eyes, there is some sensitive agent according to which the two forms extending from a single object that is perceived singly are perceived as one and according to which the two forms are perceived as two when the object is perceived as double, which indicates that [visual] sensation is fully achieved only by that sensitive agent, not by the eyes alone.

[6.75] In addition, [visual] sensation extends from the [sensing] organs to the final sensor only through the nerves that link those organs and the brain. Therefore, the two forms pass from the eye through the nerve that extends between the eye and the brain until it reaches the final sensor. These two forms thus pass from the two eyes and meet where the two nerves join.

[6.76] And clear evidence that the forms of visible objects extend through the hollow of the nerve to reach the final sensor and that vision is achieved [only] after [their] arrival there is that, when there is some obstruction in this nerve, vision is destroyed, but when the obstruction is removed, vision is restored. And medical science testifies to this fact.¹⁰⁰

[6.77] Now the reason that the two forms sometimes join and sometimes do not is that, when the two eyes are in their natural position, they will be similarly oriented with respect to the single visible object, and thus the form of the single object will reach two places [on the surfaces of the two eyes] that are similarly oriented. However, when one eye is displaced, the orientation of the eyes will differ with respect to that visible object, and thus the two forms of that object will reach [two places on the surfaces of the two eyes] with different orientations.¹⁰¹ But it has already been mentioned in [the section on] the structure of the eye that the common nerve is similarly oriented with respect to the two eyes,¹⁰² and so two spots at corresponding locations on the two eyes will be similarly oriented with respect to the same location in the common nerve, and the two hollows of the nerve are joined to form a single place where the two forms of the visible object are united.

[6.80] We might claim that the forms arriving at the eye do not reach the common nerve, but that the sensible effect [of those forms] will instead extend from the eye to the common nerve, just as the sense of pain and the sense of touch [extend through the nerves], and that at this time the final sensor perceives that sensible effect.

[6.81] And we shall respond that this sensation arising in the eye does indeed reach the common nerve; still, the sensation arising in the eye is not a sensation of pain alone; it is a sensation of the effect of a kind of pain along with a sensation of light and color as well as of the arrangement of the parts of the visible object. However, the sensation of different colors and of the

arrangement of the parts of a visible object is not of the nature of pain. And we shall show later how the visual sensation of all these qualities occurs.¹⁰³ Therefore, the sensation that reaches the common nerve includes the sensation of light and color and of the arrangement [of parts], and it is by means of some form that the final sensor perceives light and color.

[6.83] We are now left to address the following issue: When the forms of light and color extend through air as well as through [other] transparent bodies to reach the eye, since air and [other] transparent bodies accept all colors, and since the forms of any light that are present at the same time extend through the same air at the same time and pass through the transparency of the tunics of the eye when they reach a single eye, then these colors and light ought to mingle in the air and in the [other] transparent bodies and arrive at the eye completely mixed, and so the colors of visible objects will not be [individually] discerned by sight. And if this is the case, then visual sensation cannot be due to these forms.

[6.84] Let us reply, accordingly, that air and [other] transparent bodies are neither transformed nor altered by colors in a permanent way; rather, it is in the nature of color and light that their forms extend along straight lines, and it is in the nature of a transparent body that it not prevent the forms of light and color from passing through its transparency. And it accepts these forms only to transmit them, not to be transformed upon accepting them. Furthermore, it has been shown that the forms of light and color extend through air only along straight lines.¹⁰⁴ Therefore, the forms of the light and color in bodies that occupy the same air at the same time extend along straight lines, but [some of] those lines along which the different forms extend will be parallel, some will intersect, and others will have various [other] orientations; but each of these lines is distinguished by the body from which the form radiates along that line. Thus, each of the forms extending from different bodies through the same air extends along its own line and passes through to facing forms.

[6.85] Moreover, evidence that light and colors do not mingle in air or in [other] transparent bodies is [found in] the fact that, when several candles are at various distinct locations in the same area, and when they all face a window that opens into a dark recess, and when there is a white wall or [other white] opaque body in the dark recess facing that window, the [individual] lights of those candles appear individually upon that body or wall according to the number of those candles; and each of those [spots of light] appears directly opposite one [particular] candle along a straight line passing through the window. Moreover, if one candle is shielded, only the light opposite that candle will be extinguished, but if the shielding body is lifted, the light will return.

[6.86] And this can be tried anytime.

[6.87] In addition, if the lights were to mingle with the air, then they would mix in the air contained by the window; they ought, then, to pass through mixed so as not to be [individually] discerned afterward. But we do not find this to be the case. Therefore, the lights do not mix in air; instead, each of them extends along straight lines; and those lines are parallel, or they intersect, or they have various [other] orientations. And the form of each light-source radiates along all the [straight] lines that can be extended from it through the air, and in accord with this [the resulting forms of light] do not mingle in the air, nor is the air tinted by them; rather, they merely pass through its transparency, and the air does not thereby become transformed.

[6.89] And what we have said about light and color, as well as about the air, should be understood [to apply] to all transparent bodies, including the transparent tunics of the eye.¹⁰⁵

[6.90] However, the sensitive organ [of the eye], i.e., the *glacialis*, does not receive the form of light and color in the same way as air and other insensitive transparent bodies, but in a different way from that, for this organ is constituted for the [sensitive] reception of that form. Therefore, it receives the form both as a sensitive body and as a transparent body. And it has already been shown that the effect aroused in it by this form is a kind of pain. Thus, the way it receives this form is different from the way insensitive transparent bodies receive them. Nevertheless, although it receives this form as a sensitive body and is thereby altered or transformed, this organ is not tinted by the color of this form,¹⁰⁶ nor do the forms of color and light persist in it after it ceases to face them or they cease to face it.

[6.91] But this point can be countered with the following argument: It has already been maintained [not only] that intense and bright colors upon which strong light shines create an effect in the eye, but [also that] the changes they cause in the eye persist after they are removed, and the forms of the color persist in the eye for some time; moreover, whatever the eye perceives afterward will be mingled with those colors.¹⁰⁷ This is clear and indubitable. And since this is so, then the eye must be tinted by color and light, so it follows that [all] transparent bodies are tinted by colors and light.

[6.92] In response we shall say that this very phenomenon indicates that the eye is not tinted by color and light and that the alterations caused by color and light do not persist in it, for these alterations that we have mentioned only happen because of an excess in the intensity of light and color. And it is clear that these alterations persist in the eye only for a short time and disappear afterward, whereas weak alterations do not persist at all. The eye, therefore, is not tinted by these alterations in a permanent way, nor do they persist in it after they are removed. Accordingly, it will be evident that [moderate] light and colors affect the eye, but that after they are re-

moved the alterations they cause do not persist even for a short time. Hence, the glacialis is altered by light and colors only [at the time] it senses [them], but then the effect disappears after they are removed. It is therefore requisite that it be altered by color and light, but not in a permanent way.

[6.93] Moreover, the eye is constituted to suffer the effect of colors and light and to feel them, but the resulting alteration does not thereby persist in it. On the other hand, air, [other] transparent bodies, and the transparent tunics of the eye in front of the glacialis are not constituted to suffer the effect of light and color and feel them, nor are they constituted to do anything but transmit light and colors.¹⁰⁸

[6.94] It has therefore now been shown that the eye is not tinted by colors and the forms of light in a permanent way. It has also been shown that the forms of light and color do not mingle in air or in [other] transparent bodies but that the eye perceives many of them at the same time through the [same] air; and each of the eyes perceives them according to the cone that is formed between the visible object and the center of the sight.

[6.95] But why is it that not all the forms of all the colors appear on all those bodies [upon which they shine], but that some appear and some do not, depending on whether the color is intense, or the light that illuminates the color is intense, or the illumination of the body upon which the form appears is faint? The eye is responsible for this, because these forms [that do not appear] are not [just] shining upon bodies that face them but upon bodies that are illuminated by some colored light. For the form of any body's light and color continually shines upon all facing bodies when they do not lie too far away. As far as light is concerned, in fact, this is obvious, for, when any body that is somehow illuminated is tried (as long as the illumination is not very weak), and when the trial is carried out as we have described—i.e., when a white body is placed opposite it within a dark recess, and when there is a narrow opening between the illuminated object and that dark recess—[it is obvious] that the light will then appear upon that body.¹⁰⁹ On the other hand, colors will appear only under the proper conditions, for it has been shown by induction that the forms of colors are always weaker than the colors themselves, and the farther the forms are from their source, the weaker they will be.¹¹⁰

[6.96] It has also been shown by induction that, when intense colors are situated in dark places and the light that shines upon them is very weak, those colors will appear dark and will not be [properly] discerned by sight. But when they are situated in well-lit places and the light shining upon them is strong, the colors will appear and will be [properly] discerned by sight.¹¹¹

[6.97] Furthermore, it has been shown by induction that, when intense light shines upon the forms of colors appearing on bodies facing them, those

colors will disappear from sight, and they will only appear when the light is not intense or [its source] is far away.¹¹²

[6.98] It has also been shown that, when intense light shines on the eye, it will prevent it from seeing many visible objects that face it at that time but are not visible by themselves.¹¹³

[6.99] It has been shown as well that the eye does not perceive colors except by means of a form reaching it from that color and that it will be perceived along the appropriate [radial] lines.¹¹⁴ Therefore, when a viewer looks at an opaque object upon which the form of the color has shone, he will perceive that form by means only of a secondary form reaching him from that form [shining on the object]. But this secondary form is weaker than the primary form [shining] on that body, whereas that primary form is weaker than the color itself [in the source-object]. Now sight does not perceive the opaque body upon which the form appears unless some light appears in it, whether it be the light that accompanies the form of the color shining on it or that light along with some other light. Thus, the secondary form that reaches the eye from the primary form comes to the eye along with the form of the light in that opaque body. But the color of that opaque body upon which the form lies will also be perceived by sight in that situation. Hence, the form of its color arrives at the eye along with the secondary form reaching it from the form of the color that shines upon it, but the form of the color of this body that reaches the eye in this situation is a primary form. The eye, moreover, perceives what it perceives only along specific [radial] lines, and the specific [radial] line between it and the opaque body along which it perceives the form of the color of that opaque body is the same as the [radial] line along which it perceives the secondary form coming [to it] from the form of color shining upon that body, for that form [too] lies on the surface of that body. Therefore, the eye perceives this form along the [radial] lines that lie between it and that body, and it perceives the color of that body along the [radial] lines that lie between it and that body. Likewise, the eye perceives the light in that body along these same [radial] lines. Hence, three forms of that color reaching the eye are perceived by the eye along the same [radial] line.¹¹⁵

[6.100] And since this is so, they are perceived mingled together, and the secondary forms that reach the eye from the form of color that shines upon the body facing it will always be perceived by the eye mingled with the form of the color of that body, as well as with the form of its light. The eye thus perceives a form derived from the two colors [and] that [form] is different from the form of either of them. If, then, the opaque body upon which the form [shines] is of a bright color, the form it conveys to the eye will be bright, and it is a primary form, and it is mingled with the secondary form that reaches the eye from the form of the color shining upon that

body. But this form is weak, so it is not apparent to sight, because, when a bright color is mingled with a faint color, the bright color overwhelms the faint one. And the same things are invariably found [to obtain] in the case of colors and dyes when they are mixed together. However, the form of the color is invisible when the light that shines on it is intense only because the secondary form reaches the eye along with the form of intense light as well as with the whiteness of the body.

[6.101] Now it has already been shown that when intense light shines on the eye, it prevents the eye from perceiving weak forms.¹¹⁶ Therefore, when intense light reaches the eye along with the whiteness of the body upon which it shines, it will prevent the eye from perceiving the weak secondary form that reaches it along with that light. On the other hand, if the body upon which the form of the color shines is white, but if the light that shines upon it is weak and the form of the color that shines upon it is also weak, then, even though it is weak, the form of the light in that body, along with the body's whiteness, will overwhelm the form of the color, which is very weak. So when it reaches the eye, that form will not be [properly] discerned by the eye. If, however, the body upon which the light shines is white and the color whose form shines upon it is black or dark, that form will be outshone only by the whiteness of that body; so it will appear as shadow, and the eye will perceive that body as not very white, just as it will perceive a white body in shadow, so its form will not be [properly] discerned by it.

[6.102] All of this will obtain when the light that illuminates the colored body is intense and the whiteness of the form that shines from it upon the facing body is dull. If, however, the light in the colored body is weak, then the form that shines from it upon the facing body will be dark, and it will appear to the eye just like the colors it perceives in dark, poorly lit locations or the colors of transparent bodies upon which weak light shines. Hence, when the light that shines upon colored bodies is feeble and when the forms of their colors shine on facing bodies, they will only appear as shadows as far as visual sensation is concerned. And if such a body facing the color lies in a dark location, none of the color will appear on it on account of its darkness and the darkness of the form shining on it. But if the body facing this color lies in an illuminated location and there is light other than the light of its form shining on it, and if this body is illuminated, then its color will appear superimposed upon that form; and the color of that body will appear to the eye but not the form, because it acts just like a shadow, and its shadowing effect will not be [properly] discerned by the eye. However, if that body upon which the form shines is white and, moreover, is illuminated by some light other than the form's light, then, on account of its darkness, the form will merely dim the body's whiteness and luminosity in much

the same way as shadows are cast on white objects.

[6.103] And forms of this sort will only be perceived by the eye on bodies facing colors.

[6.104] Therefore the eye does not perceive the form of a color on a body facing that color except when the secondary form reaching it from the form of its color is more intense and more overwhelming than the primary form coming along with it from the light and color that are in the body upon which the form shines. But this situation is quite rare, and for that reason such a form is rarely seen; moreover, among those [that are seen] only the form of intense, brilliant colors appears when the light that shines upon those colors is intense, and when those forms shine upon facing, white bodies, and when the light shining upon those bodies is weak in relation to those forms. Whatever is not of this sort does not appear.

[6.105] Likewise, the failure of feeble light to appear upon a body facing it is due to the fact that, when the body facing the feeble light is lit by another [more intense] light-source, the two lights will mingle, and therefore the feeble light will not be [properly] discerned by the eye. But when the body facing the feeble light is dark, the form of the feeble light will not appear upon it because the form of the light is weaker than the light itself, and the secondary form reaching the eye from that form, by whose mediation the eye must perceive the form [shining] upon the body facing the light, is weaker than that form. Therefore, if the light is feeble and the facing body is dark, the form that shines upon the facing body will be very weak, and the secondary form that reaches from it to the eye will be weak to the point of vanishing. And the eye does not perceive light that is weak to the point of vanishing.

[6.106] Hence, the forms of all illuminated colors and the forms of every light shine upon facing bodies, but several of them do not appear to the eye for the reasons we have enumerated. But some of them do appear when they conform to the conditions we have discussed. Therefore, the reason why the eye does not perceive the forms of all the colors in colored bodies [shining] on all bodies facing them but perceives some and thereby perceives all the colors in the colored bodies has now been demonstrated. And the reason is that it perceives the colors in colored bodies from the actual form reaching it from them, that form being stronger than the secondary form reaching it from the forms of the colors that are on the bodies facing them. And it also perceives the [primary] form of the colors separately, not mingled with others, whereas it perceives the secondary form that reaches it from the forms of their colors mingled with others.

[6.107] And this is what we promised to show at the end of the third chapter,¹¹⁷ and it has now been shown that sight only perceives the colors of visible objects mingled with the forms of light that are in them and mingled

with all the forms shining upon them from the colors of facing bodies. Moreover, if there is some opacity in the transparent medium intervening between them and the eye, its color will also mix with those colors, and the eye does not perceive that color separately. Nonetheless, the forms that shine on colored bodies are, on the whole, very weak, and the secondary forms coming from them to the eye are weak to the point of vanishing. On account of this, the colors of the bodies themselves will generally overwhelm the forms [of color] shining upon them. Likewise, if there is a modicum of opacity in the transparent medium intervening between the eye and the visible object, its color will not be distinguished by the eye from the color of the visible object that comes with it when the color of the visible object that accompanies it is stronger than its color.

[6.108] But the reason intense light prevents the eye from perceiving certain visible objects is that the forms that reach the eye along one [radial] line are only perceived as mixed by the eye. And if some of the mixed forms dazzle while others are faintly radiant, the bright form will overwhelm the weak form, and the weak form will thus not be perceived by the eye. But when the forms that are mingled are of nearly the same strength, they will be perceived by the eye, but each of them will be perceived according to how the other forms that mingle with it will be mixed up with it, for mixed forms are perceived as mixed, not separately, by the eye.

[6.109] Hence, the stars are not perceived by the eye during daylight because the light that pervades the air [at that time] is more intense than starlight. When a viewer looks up into the sky during daylight, then, the air between him and the heavens will be illuminated by sunlight and will be perfectly contiguous with the [surface of the] eye, and the stars will lie behind that light.¹¹⁸ Thus, the form of a star and the form of the light in the air intervening between the eye and that star will reach the eye along one [and the same radial] line, so they will be perceived as mixed. But the form of daylight in the air is considerably stronger than the form of the starlight, so that the light in the air will overwhelm the starlight, and thus the form of the star will not be [properly] discerned.

[6.110] The same holds for a faint light that is in the midst of intense light—e.g., a faint fire in sunlight, or a firefly in daylight, or the like. When such visible objects are in sunlight or in daylight, their forms will come to the eye mixed with the form of the intense light shining upon them. And since the eye will perceive the form of such visible objects mixed with the form of the intense light, the form of the intense light will overwhelm the form of the faint light.

[6.111] Moreover, a faint light or a weak form of a visible object is frequently unseen when intense light shines on the eye, even though the two forms do not reach the eye along the same [radial] line. This will be the case

when the two forms radiate along neighboring [radial] lines and reach the eye at two neighboring spots [on its surface]. And this becomes clear at night in firelight, for, when the eye perceives the firelight and the firelight is near the eye so that its light is intense, and when there is some visible object facing the eye in that situation, and it is illuminated by faint, accidental light, and when that visible object is farther from the eye than the fire and lies along a line-of-sight near the fire's line-of-sight, then the eye will not perceive that visible object properly. If, however, the viewer shields the fire from his sight or moves his line-of-sight with respect to the fire so that the line-of-sight along which he perceives that visible object lies far from the fire's line-of-sight, then he will perceive that visible object more clearly [than before].¹¹⁹

[6.112] The reason for this is that the visible object possessing the faint accidental light has a dark form, and when the eye perceives that form without perceiving intense light along with it, it will sense the faint light, given that there is some darkness between the eye [and the object] or an absence of intense light on the side of it where the form of the weak light reaches. But when the eye perceives the form of faint light while it perceives the form of intense light along with it, then it perceives the intense light at a spot on the eye that is next to the spot at which it perceived the dark form. The eye will [therefore] not perceive the faint light in the dark form for two reasons: first, because when intense light reaches the eye, the entire eye is illuminated, and when the entire eye is illuminated, faint light will not appear in it, particularly when the [intensity of the] faint light is minimal in comparison to [that of the] intense light;¹²⁰ and second, [because] the faint light abuts on the intense light at the two neighboring spots on the eye. But the faint light is almost dark in comparison with the intense light, so when the [intense] light lies next to the weak, dark form while the form of the intense light floods the eye, then the eye will not perceive the form that is faintly illuminated, and all it will perceive of a dark form is its darkness; and so the form will not be [properly] discerned by the eye, nor will the eye perceive it properly.

[6.113] Moreover, the overshadowing of the forms of faint light because of the nearness of intense light has its counterpart in colors, for when spots of some relatively dark color are painted on a white body, the spots will appear black because of the intensity of the [body's] whiteness. But if identical spots are painted on a pitch-black body, they will appear almost white, and their darkness will go unseen. But when a color is painted on bodies that are neither intensely white nor pitch-black, the color will be seen as it really is.

[6.114] By the same token, when a grass-green color is painted on a yellow body, it will appear dark, but when it is painted on a black body, it will

appear the color of wild marjoram, and the same holds for all colors that lie midway between two extremes.¹²¹

[6.115] Thus, when neighboring visible objects differ sharply in the intensity or faintness of their color, the faint color will be unseen by the eye, because the qualities of light and color will be perceived only with respect to others around them. And intense light will prevent the eye from perceiving faintly illuminated visible objects only because of the mingling of the form of the weak light with its form, as well as because of the predominance of the forms of intense light over the forms of faint light and the inability of the sense to perceive anything whose intensity is minimal in comparison to that of something else.

[6.116] Accordingly, we have now accounted for all the subjects that bear on this chapter.

[CHAPTER 8]

[7.1] The tunics that we discussed in our account of the structure of the eye serve as instruments through which vision is achieved.

[7.2] Now the first tunic, which is called the cornea, is a transparent but tough membrane, and it extends over the opening in the anterior of the uvea. Its primary function is to cover the opening in the uvea so as to keep the albugineous humor, which lies in front of the uvea, in place. It is transparent so that the forms of light and color can pass through it into the interior of the eye, for they only pass through transparent bodies. Its toughness, moreover, is meant to keep it from deteriorating easily, for it is exposed to air and can easily be damaged by smoke, dust, and the like.

[7.3] The albugineous humor, for its part, is transparent, and it is quite fluid. It is transparent in order to let forms pass into it and extend through it to the glacial humor. It is moist, however, in order to keep the glacial humor continually moist so that it can maintain its proper condition, for the membrane that covers the glacialis is extremely thin, and the least dryness could damage it.

[7.4] Now the black tunic, i.e., the uvea, that contains the albugineous humor, is black, tough, thick, and spherical, and in its front there is a round opening, as we pointed out earlier.¹²² It is black in order to darken the albugineous and glacial humors so that the forms of faint light can appear in them, for faint light definitely appears in dark locations but is invisible in brightly illuminated locations. Moreover, it is somewhat tough in order to hold the albugineous humor in place so that none of it leaks out. It is thick in order to be opaque, for if it were thin, it would be translucent; but since it is thick, its inner side will be dark.¹²³ It is spherical because the sphere is the

most efficient of shapes and is least susceptible to injury, whereas figures that have corners are easily altered at [those] corners. There is an opening at the front of this tunic so that forms can pass through it into the interior of the eye, and this opening is circular because the circle is the simplest and most capacious figure of all figures having the same circumference.¹²⁴

[7.5] The glacial humor has many characteristics that help bring [visual] sensation about. For it is moist and subtle, and it possesses some transparency as well as some opacity. Covering it is a very thin membrane, and its surface takes shape as a composite of two different spherical surfaces, the anterior of which is more gradually curved than the posterior.¹²⁵ It is moist so that it can more easily suffer the effect of light, and it is subtle because such bodies are exquisitely sensitive. It is, moreover, somewhat transparent so that it can receive the forms of light and color and so that light and color can pass through it, but it is somewhat opaque so that the forms of light and color can persist in it for awhile in order to let the form of the light and color impressed in it be seen by the sensitive faculty.¹²⁶ If it were perfectly transparent, though, the forms would pass through it, but it would not feel the effect of the forms, which is of the nature of pain, and so it would not perceive those forms.

[7.6] The membrane that covers this humor is there to constrain it so that it does not flow, for unless something constrained them, the humors would flow and would not maintain a constant shape. But this membrane is exceedingly rare so that it will not block out the incoming forms. It is spherical for the same reason we mentioned earlier, and its anterior surface is formed from a great sphere so as to be parallel to the anterior surface of the eye in order that the centers of both [surfaces] form a single point.

[7.7] The hollow nerve to which the whole eye is attached is hollow so that the visual spirit can flow through it from the brain to reach the glacialis and thereby endow it in turn with sensitive power, and so that the forms can also pass through the subtle substance flowing through its hollow until they reach the final sensor at the front of the brain.

[7.8] And the wellsprings of the two nerves to which the two eyes are attached lie on both sides of the anterior part of the brain so that the location of the two eyes will correspond with the location of their two wellsprings. Their wellspring was not in the middle of the anterior part of the brain because this location is more appropriately designated for the sense [of smell].¹²⁷

[7.9] Indeed, there are two eyes because of the beneficence of the Creator¹²⁸ [who chose to double the eyes] so that, if one of them were to be injured, the other would remain [functional], and also so that the face would look more comely [than it would with only one eye].

[7.10] The reason, moreover, that the two [optic] nerves join has already

been given in [the section on] how vision occurs.¹²⁹

[7.11] The surfaces of the tunics of the eye are spherical and parallel, and their centers coincide at one point so that [any line] perpendicular to the first of them is perpendicular to all. And they are spherical so that [all their] perpendiculars may issue from the single point that forms their center and then diverge as they part from the center in order that the cone projected from that center can contain all the perpendiculars extending from any visible object [to that centerpoint] and can demarcate a small spot on the surface of the eye as well as on the sensitive organ, that spot, no matter its smallness, being able to encompass the entire form reaching from the visible object to the eye. If, however, the surfaces of the tunics of the eye were flat, the form of the visible object would not reach the eye along perpendiculars unless the eye were the same size as the object. But there is no other figure than the sphere in which the perpendiculars come together and meet at a single point and upon whose surface those perpendiculars fall in perfect order.

[7.12] According to this disposition many cones can extend at the same time to many visible objects from the center of the eye, and each of them will demarcate a small section on the surface of the sensitive organ that encompasses the [whole] form of that visible object. And all the tunics have a single center for the reason we have given before, that reason being so that the perpendiculars issuing from the visible object to one of those tunics will be perpendicular to all of them and so that forms may pass through all of them along a single [radial] line.

[7.13] Now the reason sight perceives visible objects only along such perpendiculars is that it is only according to such perpendiculars that the parts of the visible object are properly arranged on the surface of the sensitive organ. And it was already shown earlier that the form of a visible object cannot be properly arranged on the surface of the sensitive organ unless the form is received along these [radial] lines alone.¹³⁰ Accordingly, this is an intrinsic characteristic of the eye, so it is naturally constituted not to receive any form except along these [radial] lines. And the fact that the eye is endowed with this property is one of the things manifesting the incredible perspicacity of the Creator and the providence of nature in designing the instruments of sight and the arrangement according which [visual] sensation is achieved and visible objects are discerned.

[7.14] The sclera encloses all of these tunics; and there is some moisture in it, yet it also has some firmness, and is somewhat tough. It encloses all of these tunics in order to keep them together and to preserve them, and it is somewhat moist so that the locations of the tunics can thereby be prepared and so that those tunics cannot be quickly dried out. It is somewhat firm and tough so that it can keep the tunics in place and have them maintain

their [spherical] shape so that they will not be readily subject to change. It is white so that the face will be comely on that account.¹³¹

[7.15] The entire eyeball is round because roundness represents the best, most capacious, and most easily moved of shapes. The eye, however, needs to move, and to move quickly, so that by moving it can face many visible objects at the same time and so that, by moving, the viewer's central [line-of-sight] can face all parts of a visible object in order to perceive it with a true and consistent perception, for sensation through the middle of the sensitive organ is most clear (we will demonstrate this later in a suitable place).¹³² The eye moves quickly so that in very short order it can see all the parts of a visible object as well as [all] the visible objects facing it.

[7.16] The eyelids are designed to preserve the eye during sleep and to keep the eye still when it is fatigued by light, for intense light harms the eyes, and if the eyes are continually open to it, they will be debilitated. This is obvious when the eyes stare at an intense light for a long time. Likewise, when there is smoke or dust in it, air harms the eye. Thus, the eyelids shield the eye from light when the eyes need it, and it protects them from the air and wipes away many harmful residues from them. Then, when the eyes are tired, the eyelids are closed over them so that they can finish resting, and the eyelids move quickly so that they can close over the eyes as soon as anything harmful approaches the eyes.

[7.17] The eyelashes are there, however, to mitigate some of the light when it will hurt the eye because of its intensity, and for this reason the viewer squints his eye and narrows it so that he can see from a narrow field of vision when intense light would hurt it.

[7.18] These things we have discussed cover the functions of the instruments of vision, from which the great perspicacity of the Creator is manifest. Let his name therefore be blessed, along with the goodness of nature in its providential order.

[CHAPTER 9]

[8.1] It has been demonstrated earlier¹³³ that the eye perceives none of the visible objects that occupy the same air with it (provided that it does not perceive them by means of broken rays) unless the following conditions are met, namely: (1) that there be some space between eye and object, (2) that the object face the eye—i.e., that a straight line can be imagined extended between any point on the surface of the visible object perceived by the eye and some point on the surface of the eye, (3) that the object possess some illumination, (4) that it have some [perceptible] size with respect to the eye's sense-capacity, (5) that the aerial medium be continuous and transparent

and that there not be any opaque body in it [between eye and object], and (6) that the visible object block sight—i.e., that there be no transparency in it, or if there is, that it be more opaque than the air intervening between it and the eye; but this can only happen with color or the like. Furthermore, sight will not perceive a visible object unless these six conditions are met as a whole; if the visible object fails to meet any one of these conditions, it will not be perceived by sight.

[8.2] Each one of these conditions is necessary to sight for some specific reason.

[8.3] Accordingly, the reason that the eye perceives a visible object only when there is some separation between eye and object but does not perceive it when it is placed directly upon it eye is twofold. First, the eye does not perceive a visible object unless there is some light in it. But if that object is placed directly upon the eye and has no intrinsic luminosity, there will be no light on its surface where it touches the eye, for, by its position, the body of the eye will be prevented from seeing it.¹³⁴ On the other hand, an object that is intrinsically luminous cannot be placed upon the surface of the eye because intrinsically luminous bodies include the stars and fire, which cannot be placed upon the eye.¹³⁵ The second reason is that vision will only occur on the side facing the opening in the uvea at the center of the eye's surface, but when a visible object is placed on the eye, the area of the object that touches the eye will only be the size of the area it touches on the eye. But if the eye perceives the visible object through direct contact, it will perceive only that part directly touching the opening but will not perceive the rest of the visible object. And if the visible object is passed over the surface of the eye until the eye touches the entire surface of the visible object at the center of its own surface, it will perceive the object one part at a time, and when it perceives the second part it will not perceive the first part, so it will be unable to perceive the whole object at once. Further, if that is the case, the form of the [entire] visible object will not be delineated in it [but will appear] much as [would be the case] if some visible object were placed on an opaque body, and there were an aperture smaller than the visible object in that opaque body, and the visible object were placed at the opening; [for] in that case only the part of the object placed at the aperture would be perceived. Then, if the visible object were moved over the aperture until it was perceived bit-by-bit by the eye, its whole form would not be delineated in the eye.

[8.4] Hence, if vision were [to take place] through physical contact, the eye would not perceive the entire visible object nor [would it perceive] its shape and arrangement unless the visible object were the same size as the central spot on the eye through which vision would occur; and, in addition, it could not perceive several visible objects at the same time. But when

there is some space between the eye and the visible object, the eye can at once perceive the entire visible object at a small spot [on its surface], even if the visible object is large; and it can perceive several visible objects at the same time. Furthermore, when the visible object is separated from the eye, it will be possible for light to shine on the surface of that object facing the eye.¹³⁶ For these two reasons, then, sight does not perceive visible objects unless there is some space between them and the eye.

[8.5] That sight perceives a visible object occupying the same air as the eye while facing it only if a straight line can be [imagined extended] between any point on the object and some point on the area of the eye's surface where vision occurs is due to the following. It has already been shown that vision will not occur except through forms reaching the eye from the visible object and that forms are perceived only along straight lines.¹³⁷ As a result, the eye does not perceive an object unless there is a straight line between it and the object. And if opaque bodies are interposed to cut all the [straight] lines between them, objects will disappear from sight, whereas if an opaque body interrupts [only] some of those straight lines, a certain part of the visible object at the endpoints of the [straight] lines interrupted by the opaque object will disappear from sight.

[8.6] Sight does not perceive a visible object unless it is illuminated for two reasons: either because the forms of the color in the visible objects do not radiate through the air except when light accompanies the color, or because the form of the color does radiate through the air, even though no light accompanies it, but does not make a perceptible effect upon the eye except by means of [accompanying] light. Now it is clear that the form of light is stronger than the form of color, that light has a more noticeable effect than color, and that, because it is weak, the form of color cannot affect sight the way that light does. But the form of color in an illuminated body is invariably mingled with the form of light, and, when it reaches the eye, it affects sight by virtue of its intensity as well as by virtue of the disposition of the eye to suffer its effect. But since light is mingled with the form of color and is not discerned separately from it, the eye only senses the form of light mingled with the form of color. Therefore, the eye senses the color of the visible object only on the basis of that color mingled with the form of the light reaching it from the visible object, and consequently, as far as sight is concerned, the colors of many visible objects vary according to variations in the light shining upon them.¹³⁸ Therefore, since the form of color does not affect sight unless it is mingled with light, and since color does not generate a form unless it is illuminated, sight perceives no visible object unless it possesses some illumination.

[8.7] Why sight does not perceive a visible object unless it has some [appreciable] size is explained in the following way. It has been shown that

the form of a visible object reaches the eye by means only of cones whose vertex lies at the center of the eye and whose base is formed by the surface of the visible object and that such a cone demarcates a small area on the surface of the sensitive organ where the form of the visible object will be arranged.¹³⁹ If the visible object is extremely small, the cone formed between it and the center of the eye will be extremely small. Accordingly, the area demarcated upon the sensitive organ will be so small as to be virtually a point. But the sensitive [organ] does not sense a form unless the area on its surface to which the form comes has a perceptible size in proportion to the whole [of the surface]. Moreover, sensitive powers are finite, so when the area of the sensitive organ to which the form comes does not have a perceptible size in proportion to the whole sensitive organ, it will not feel the effect made there because of its smallness, the result being that it does not perceive the form.¹⁴⁰ Therefore, a visible object can be perceived by sight if the cone that is formed between the object and the center of the eye will demarcate an area on the surface of the glacialis that has a perceptible size in proportion to the whole surface of the glacialis. But the resulting sensation will depend entirely upon the extent of [the eye's] sensitive power, which does not go on to infinity, and that power varies with the capacity of the [given] eye. But if the cone that is formed between the visible object and the center of the eye demarcates an area on the surface of the glacialis that has an imperceptible size in proportion to the entire surface of the glacialis, sight cannot perceive that object. It is for this reason that sight will not perceive an extremely small object.

[8.8] That the eye does not perceive a visible object unless the medium intervening between that object and the eye is transparent is because vision only occurs by means of a form reaching from the visible object to the eye. But forms only extend through transparent bodies, so vision is achieved when the visible object occupies the same air as the eye (provided that the perception does not take place through broken rays) only if the air between the visible object and the eye is continuous and an opaque body does not interrupt the straight lines extending between them, for a form extends through air of uniform transparency only along straight lines. For this reason the eye perceives a visible object that occupies the same air with it and faces it only when the air between eye and object is of uniform transparency.

[8.9] There are two reasons why sight does not perceive a visible object unless it is [completely] opaque or possesses some opacity. One reason is that whatever is opaque is colored, and [it is] from color [that] the form by means of which sight perceives the color of a visible object comes to the eye. Whatever is absolutely transparent, however, lacks color, so it is not perceived by the eye. The second reason is that sight does not perceive a vis-

ible object unless it is illuminated and a secondary form of the light in it reaches the eye along with the form of its color. But there will be no secondary form of light shining on any object unless it is fixed in the object upon which it shines. Therefore, if the light is fixed in that body, a secondary form will radiate from it; but when light shines upon an exquisitely transparent body, it will not be fixed in it but will pass through its transparency. When a transparent body faces the eye, then, and when light shines upon it from the direction of the eye, it will pass through it and not be fixed on its surface.¹⁴¹ Accordingly, there will be no light on the surface of that body facing the eye and sending its form to the eye. On the other hand, if that light-source whose light shines upon that transparent body faces the eye, its light will pass through the transparent body and will reach the eye, but it will carry with it no color from the transparent body to the eye, for a transparent body that is absolutely transparent has no color. From that direction, then, sight will perceive the light-source from which the light shines upon the transparent body from behind it, but it will not perceive the transparent body [itself] insofar as sight does not perceive any visible object that is absolutely transparent. Furthermore, if the transparency of the body is the same as the transparency of air, that body will be disposed just like the air, so it will not be perceived by sight, just as air and transparent bodies whose transparency is no less absolute than the transparency of air will not be perceived by sight, for there is no form extending from them to the eye that can affect sight. And the same will hold if some transparent body other than air intervenes between the eye and the visible object and the transparency of the visible object is no less attenuated than the transparency of the intervening body.

[8.10] And if a visible object is opaque, it will be colored, and when light shines upon it, it will be fixed upon its surface, and a form of its color, as well as of the light shining upon it, will extend through the air and through transparent bodies. And when this form reaches the eye, it will affect it, and from that effect the eye will sense the visible object. Moreover, when the visible object is transparent, but less so than the air, it will possess [some] color according to its opacity, and when light shines upon it, that light will be fixed in it somehow according to the opacity it possesses but will pass through it according to its transparency. There will thus be a form extending from it through the air according to the color and light on its surface, and when that form reaches the eye, it will affect the eye, and the eye will sense that visible object. For this reason sight perceives no visible object unless it is [completely] opaque or unless there is some opacity in it.¹⁴²

[8.11] The reasons why sight perceives nothing unless the aforementioned conditions are met as a whole have now been set forth, and what we have explained is what we intended to explain in this book.

NOTES TO BOOK ONE

¹As was pointed out in “Introduction,” p. xxiii above, the opening of chapter 1 in the Latin version of this treatise is actually the opening of chapter 4 in the Arabic version, the first three chapters in all likelihood never having been rendered into Latin.

²Note that in the Latin text to this point two forms of “light”—*lux* (lines 1 and 4) and *lumen* (line 7, as well as line 9)—are used. Roughly speaking, *lux* should be understood as the essential, inherent light in a self-luminous body, whereas *lumen* can be understood as the illuminative effect of *lux* on other bodies as well, by extension, as of its physical manifestation in transparent media. As Bacon puts it, “we say that the *lumen* of the sun in the air is the species [i.e., formal replica] of the solar *lux* in the body of the sun” (*De multiplicatione specierum* I, 1, trans. Lindberg, *Roger Bacon’s Philosophy*, pp. 2-5). As Bacon points out subsequently (p. 5), this differentiation reflects the distinction drawn by Avicenna in his commentary on the *De anima*; for a Latin edition of this work, see *Liber de anima seu sextus de naturalibus I-II-III*, ed Simone Van Riet (Louvain: E. Peeters, 1972), pp. 169-171. According to Sabra, *Optics*, 2, pp. 21-23, the two Arabic terms at issue are *daw* (= *lux*) and *nur* (= *lumen*), both of which Ibn al-Haytham uses, but not consistently nor to draw precisely the same distinction that Avicenna does.

³This example shows that light causes a sensation (or “passion”) of pain in the eye; this pain is the root cause of, and thus necessary for, visual sensation; and it is usually at such a low level that we do not recognize it as such; see 6.67, p. 376 above.

⁴This example shows that an inordinately intense light-effect can create a briefly lasting impression in the eye in the form of an afterimage, which overrides subsequent visual effects and thus interferes with normal vision. Alhacen also establishes that bright color can create this effect, a point upon which he will elaborate in short order.

⁵According to Alhacen, light and color are ontologically distinct, but color requires illumination to affect the eye visually. Hence, like pure light, illuminated color, if too intense, can create a briefly lasting impression in the eye in the form of an afterimage. Note that, for Alhacen, the afterimage is the same color as the original color-stimulus rather than its complement, as we now understand it.

⁶This chapter-break, along with the next three, was imposed arbitrarily by the Latin translator; see “Introduction,” pp. xxiii-xxiv above, for a discussion.

⁷Note that the illumination of the atmosphere is caused by the retention of sunlight by the matter of the air, which has some opacity in it. Thus, the air, while acting as a transmitter of light, is also capturing light and thereby acting as a screen; see I, 3, 44, in Sabra, *Optics*, vol. 1, p. 29.

⁸The Latin term *subtilis* can be rendered into English in various ways: e.g.,

"tiny," "fine," "delicate," even "exquisite." I have chosen here and, with few exceptions, throughout the rest of the text to render it by its direct derivative, "subtle," in order to allow it the broadest range of meanings. Accordingly, features may well be subtle by virtue of their minuteness, but they may also be subtle by virtue of their delicacy or understated nature.

⁹Here Alhacen implies that two different sorts of illuminative effect are at play. On the one hand, the paper retains some of the incoming light by virtue of its whiteness; on the other hand, it reflects some of that incoming light by virtue of its polish, which is a function of its smoothness. Thus, according to Alhacen's definition in book 4 of the *De aspectibus*, "politum est lene multum in superficie, et lenitas est ut sint partes superficiei continue sine pororum multitudine . . . et finis lenitatis est privatio pororum et privatio divisionis partium," *De aspectibus*, IV, 3, *Opticae thesaurus*, p. 104; see also II, 3.193, p. 502 below.

¹⁰I, 3.113-114, in Sabra, *Optics*, vol. I, p. 44.

¹¹I, 3.124, in Sabra, *Optics*, vol. I, p. 46.

¹²This example crops up again in 6.110, p. 385 above, as well as in III, 6.12, p. 598 below, where the firefly is referred to as "a certain flying creature called 'aluerach' in Arabic"—a fairly clear indication that the task of translation had changed hands—and for the worse—between book I and book III; see "Manuscripts and Editing," pp. clxviii-clxix above.

¹³The ulterior point in this section and its complement in 4.17, p. 346 above, is that, as far as visibility is concerned, light is subject to threshold conditions. Hence, either an excess or a deficiency in luminosity can cause vision to malfunction. Alhacen goes on to say, however, that the amount of light necessary for proper visibility is proportionate to a variety of other factors, including the size of the object and its distance from the viewer. As we shall see, Alhacen has much more to say on this score in the third book, where he discusses the threshold conditions of visibility at length.

¹⁴By "bright" color, Alhacen seems to mean "strong" color—that is, a color that is deep rather than dazzling; see note 37, p. 537 below for further discussion of this point.

¹⁵See 4.15, pp. 345-346 above.

¹⁶According to Sabra, *Optics*, vol. 2, p. 45, the Arabic term for this cloth is *abu qalamun*, among whose meanings is included "chameleon." In II, 3.218, p. 506 below, the same Arabic term is rendered "alburalmon" in the Latin text. The variation in color that the peacock feathers and the cloth manifest is, of course, due to the variable refraction, reflection, and interference of light which creates the effect of a spectrum, the same effect that can also be seen in the feathers at the neck of a pigeon. The assumption here is that these colors are somehow actually in the objects but are only revealed under certain light-conditions; see note below.

¹⁷In order to demonstrate that color is a real, inherent property of physical objects, Alhacen devotes considerable attention in I, 3.132-137 to refuting the idea that color is some sort of mediate effect created by light in the eye; see Sabra, *Optics*, vol. 1, pp. 48-49. In other words, color is essentially objective, not subjective. In taking this realist position, Alhacen is following both Aristotle and Ptolemy; see, e.g., Ptolemy, *Optics*, II, 14-16, in Smith, *Ptolemy's Theory*, pp. 75-76. As Sabra ob-

serves in *Optics*, vol. 2, p. 39, one of the objects of Alhacen's argument is the atomists, who supposed color to be a psychological state created by the physical interaction of atoms. Another could well be Plato, whose account in *Timaeus* 67d-e reduces color to an effect of the physical interaction of outgoing visual flux and incoming particles emitted by various visible sources; see Smith, *Ptolemy and the Foundations*, pp. 28-29. The fact that colors have an absolute, objective existence, however, does not mean that they are always perceived as they truly are; a variety of factors, such as intensity of illumination, surrounding color-context, and the physical state of the optic system can cause colors to vary in both hue and clarity.

¹⁸Alhacen's explanation of how the visual process occurs occupies the whole of chapter 6; within this context, Alhacen's account of why inordinately bright light or color impedes proper vision is to be found in 6.108-115, pp. 385-387 above.

¹⁹This is chapter 5 in the Arabic original of the text, so the succeeding chapters of the Latin text will deviate accordingly in numerical designation from their Arabic counterparts.

²⁰The modifier *obticus*, conjoined with *nervus*, is found in that form in all the manuscripts. While it could easily be taken as an orthographic variant of *opticus*—in which case it would seem natural to render it as “optic”—context makes it clear that its proper English rendering is “hollow.” Indeed, Roger Bacon makes this point clear in referring to the “nervi optici, id est concavi” in *Perspectiva* I.2.1, ed. and trans. Lindberg, *Roger Bacon and the Origins*, p. 22, line 36.

²¹Alhacen's description of the optic system is essentially Galenic and, as is indicated by his continual use of *dicitur* (“it is said”), seems to be based on authority rather than on first-hand observation. The two cerebral membranes out of which the two tunics of the nerves supposedly arise are the *dura mater*, which forms the tougher, outer membrane, and the *pia mater*, which forms the softer, inner membrane of the brain. The crossing of the nerves, which forms the optic chiasma, is henceforth designated in the text as the “common nerve” (*nervus communis*). For a discussion of Galen's account of ocular anatomy and Hunayn Ibn Ishaq's later adaptation of it, see “Introduction,” pp. xxxvii-xxxix and xlvii-xlix above. Figure 1.1, taken from ms P3 (f 4v), illustrates the complex of optic nerves springing from the brain at left, passing through the optic chiasma, and emerging through the eyesockets.

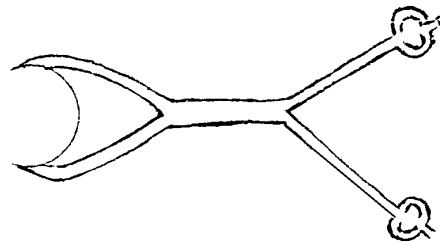


figure 1.1

²²The Latin term rendered here as “sclera” is *consolidativa*, so called because its primary function is to hold the eye together (*consolidare*) and maintain its essential structure. This tunic is also called *conjunctiva* (see, e.g., Bacon, *Perspectiva* I.2.2), and is, in fact, designated as such by Sabra in *Optics*, I, 5.5. That term, however, is misleading, since in modern usage it refers only to the mucous membranes enclosing the eye in front. Alhacen's “consolidativa” corresponds to Galen's “scleral tunic” (*chiton skleros*); see “Introduction,” p. xxxviii above.

²³According to Sabra's translation, the Latin text has substituted “green” (*viridis*)

for "blue" in the Arabic version; see I, 5.6 in Sabra, *Optics*, vol. 1, p. 56.

²⁴Alhacen's "uvea" corresponds to Galen's "choroid tunic" (= *chiton choroeides*); see "Introduction," p. xxxvii above.

²⁵This opening is, of course, the pupil, and the part of the uvea that shows through the cornea is the iris. As will become clear later on, the assumption (incorrect) that the pupil lies directly in line with the opening in the nerve at the back of the eye is mandated by Alhacen's theory of visual imaging.

²⁶The reason that Alhacen denies perfect transparency to the *glacialis* is that, if it did not have something to block or impede the passage of light or illuminated color, it could not be affected by them. Thus, it has a modicum of consistency (*spissitudo*) or opacity (*densitas, soliditas*) that enables it to take on the impression of light and color physically for a very brief time (see 6.64, p. 375 above). For a more detailed account of Alhacen's understanding of transparency and its optical properties, see note 59, p. 404 below.

²⁷Being "equally situated" with respect to the pupil means that all the rectilinear lines drawn from the circumference of the pupil tangent to the sphere of the *glacialis* will be equal in length. Thus, as will be established later, the straight line perpendicular to the plane of the pupil and passing through its centerpoint will also pass through the centerpoint of the sphere of the *glacialis*. As Alhacen implies in 5.26, p. 352 above, the *glacialis* is spherical only in the ideal sense; in reality it is composed of two intersecting spheres, the anterior one being of a larger radius and thus of a more gradual curvature than the posterior one. It is this relative moderation of curvature that constitutes the "flattening" (*compressio*) to which Alhacen adverts here. Note, by the way, that the sphere Alhacen designates as *glacialis* in this case includes both the lens and the vitreous body behind it and, therefore, both the "crystalline" (*krystalloiedes*) and "vitreous" (*hyaloeides*) humors of Galen's anatomical description; see "Introduction," p. xxxvii above.

²⁸As Sabra points out in *Optics*, vol. 2, p. 51, note 10.2, Galen, and Hunayn ibn Ishaq following him, liken the vitreous humor to melted, rather than ground or crushed, glass. What Alhacen meant by likening this humor to ground glass (*vitrum quasi frustatum*) is unclear at best. The important point is that, by so characterizing this humor, Alhacen has established that the *glacialis* is divided front and back into two portions that are distinguished by their particular transparencies. The front portion of the *glacialis* that is filled with glacial humor constitutes the crystalline lens. Rather than render the Latin term *glacialis* as "crystalline lens," however, I have chosen to leave the term untranslated in order to reflect the fact that, in adverting to the *glacialis*, Alhacen has the entire sphere in mind, even though the effectively sensitive part of it consists of its anterior portion.

²⁹Presumably, the "opening" (*foramen*) in the uvea referred to here is simply the insertion-point for the sphere of the *glacialis*, it being at this point that the *glacialis* is attached around its equator to the uvea. Note the distinction of tunics by their origin in the two cerebral membranes: *pia mater* for the uvea and *dura mater* for the outer casing of the eye (i.e., the sclera) of which the cornea forms the frontmost part; see 5.18, p. 350 above.

³⁰According to Alhacen's account, then, there are three tunics (or four if the *aranea* is included) and three humors in the eye. The tunics, in order from outer-

most to innermost, are the *consolidativa* or sclera, the cornea, the uvea, and the *aranaea*. The humors, in order from front to back, are albugineous (i.e., aqueous), glacial, and vitreous. Note that Alhacen omits the retina, although perhaps the *aranaea* is somehow meant to substitute for it.

³¹Figure 1.2, taken from ms P3 (f 6r), offers a schematic representation of the eye according to Alhacen's description. The small circle at the top is the pupil (*foramen uvee* = "opening in the uvea"); enclosing it is the *spera cornea* = "corneal

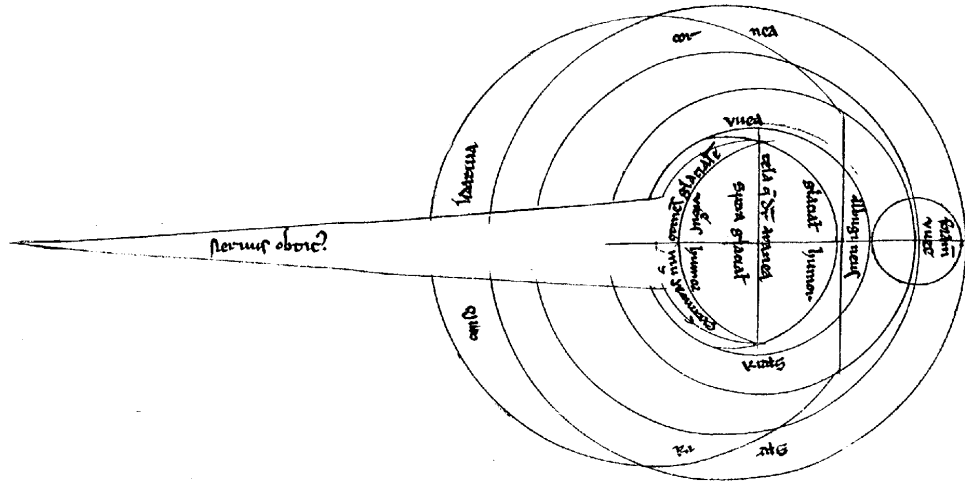


figure 1.2

sphere," which is intersected by the *consolidativa* = sclera. Inside the corneal sphere is the *spera uvea* = "uveal sphere," which encloses, in order from top to bottom, the *albugineus* = "albugineous humor," the *glacialis humor*, and the *vitreus humor* = "vitreous humor"—these latter two humors filling the *spera glacialis* = "glacial sphere," and separated by the *tela que dicitur aranea* = "the net called 'spider's web,'" so called because of its exquisite fineness. The funnel-shaped insertion at the back of the glacial sphere is the *nervus opticus* = "hollow [optic] nerve," and where it joins the sphere of the *glacialis* at the rear the text reads *exterioris nervi continens glaciale* = "the outer side of the nerve that encloses the *glacialis*."

Figure 1.3 on the following page illustrates the same thing in a somewhat less abstract way. In this representation, the eyeball is contained within the outer sphere of the *consolidativa* or sclera which is centered on **C**, its anterior portion constituting the cornea. Inside the sclera is the smaller uveal sphere, whose center is **C1**. The opening at its front, just behind the cornea, forms the pupil. Contained within the uveal sphere is the sphere of the *glacialis*, whose "flattened" anterior surface, **AB**, is concentric with the sclera. The entire surface of the *glacialis* is covered by the exquisitely thin membrane of the *aranaea*. The space between the inside of the cornea and the anterior surface of the *glacialis* is filled with albugineous humor. The *glacialis* itself is filled with glacial humor toward the front and vitreous humor toward the rear. At this point of the description, Alhacen does not discuss the interface be-

tween the two humors, although the rendering of the eye in figure 1.2 on the previous page shows it as flat and separated by an offshoot of the *aranaea*; cf 5.10, p. 349 above. This entire system is attached to the hollow optic nerve, which flares out to form the uveal tunic on the inside of the eye and the scleral tunic on its outside. The inner sheath of the nerve thus forms the uveal tunic, which ultimately arises from the *pia mater* of the brain, and the outer sheath of the nerve forms the scleral tunic, which ultimately arises from the *dura mater* of the brain. The axis of the eye, which passes through both C and C1, passes through the very middle of the nerve's hollow.

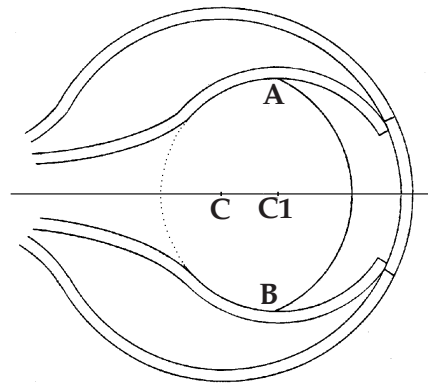


figure 1.3

³²Alhacen's visual spirit is a localized form of the animal spirit produced in the ventricles of the brain and responsible for all sensitive and intellectual functions. In that capacity, it clearly parallels Galen's *pneuma psychikon*. For a further discussion of the anatomical and physiological model to which Alhacen subscribes in his theory of vision, see "Introduction," pp. lvii-lx above.

³³It is thus by maintaining the constituent tunics of the eye rigidly in place (i.e., by "consolidating" them) that the *consolidativa* lives up to its name. Accordingly, the only motion proper to the eye is rotational motion up-or-down or side-to-side in place.

³⁴Although Alhacen makes it clear here that the cornea forms a perfect continuation of the sclera, the representations of the eye in various manuscript-sources tend to show the sclera and cornea as distinct, intersecting spheres. Such representational ambiguities reflect various differences among such later theorists as Roger Bacon, John Pecham, and Witelo about the structure of the eye, those differences deriving from the various sources upon which they relied. Not surprisingly, as a very close follower of Alhacen, Witelo is in essential agreement with him about the eye's structure and components; see *Perspectiva* III, prop. 4, in Unguru, ed. and trans., *Witelonis Perspectivae liber secundus et liber tertius*, pp. 294-298 (Latin), 105-111 (English). Pecham, too, is in essential agreement with Alhacen, although he mentions a slightly different arrangement, championed by Bacon, that includes the retina, which is a continuation of the *aranaea* in the back of the eye; see *Perspectiva communis* I, props. 31-32, in Lindberg, ed. and trans., *Roger Bacon and the Origins*, pp. 112-117. Bacon shows the most signal departure from Alhacen in terms of his detailed account of the tunics, which he subdivides into the following: the innermost tunic, which consists of the retina at the back and the uvea in front; the middle tunic, which consists of the secundina at the back and the cornea in front; and the third tunic, which consists of the sclera (*sclyros*) at the back and the *consolidativa* or *conjunctiva* in front; see *Perspectiva* I.2.2, in Lindberg, ed. and trans., *Roger Bacon and the Origins*, pp. 27-31. Bacon goes on in *Perspectiva* I.3.3 to make the puzzling claim (which he attributes to Alhacen) that the *consolidativa* is not spherical but bulges

outward at the front; see Lindberg, *Roger Bacon and the Origins*, pp. 40-43.

³⁵This follows as a corollary from Euclid, *Elements*, III, 11 and 12.

³⁶In other words, according to the conditions specified in 5.11, p. 349 above, since the *glacialis* is attached at its equator to the expanded optic nerve, and thus the uvea, then, if the intersection of the “flattened” anterior portion and the more acutely curved posterior portion of the *glacialis* occurs at the equator of the *glacialis*, as defined by the sphere containing the posterior portion, the *glacialis* will be attached where those two portions intersect. Otherwise, the circle of intersection for those two portions will be posterior or anterior to the circle of attachment and parallel to it, as is illustrated in figure 1.4, in which **AB** represents the plane in which the circle of attachment lies, that plane passing through the equator of the *glacialis*.

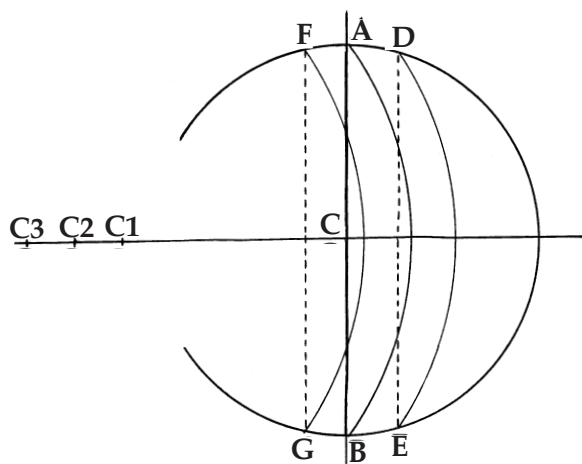


figure 1.4

C represents the center of the *glacialis*, CC3 the axis of the eye, and C1, C2, and C3 possible centers of curvature for the anterior surface of the *glacialis*. Those centerpoints therefore lie farther within the eye than centerpoint C of the eye itself, and no matter which of those centerpoints is taken, the resulting surface—whether DE, AB, or FG—will intersect the sphere of the *glacialis* in a plane parallel to, or coincident with, the plane of attachment.

³⁷Alhacen seems to be responding in this lengthy discussion to two anatomical schools having differing views on precisely where the *glacialis* attaches to the uvea. Accordingly, Alhacen is at pains to establish that, no matter where that circle is, the axial line passing through it from the center of the pupil to the center of the optic nerve at the back of the eye will always be perpendicular to it. This point will be crucial to his account of the visual selection of coherent images in II, 2.19-25, pp. 423-428 below.

³⁸As is clear from figure 1.4, since the center of the anterior surface of the *glacialis* coincides with the center of the eyeball, and since the center of the uveal sphere containing the posterior part of the *glacialis* (and thus the primary defining sphere

for the *glacialis*) is anterior to the eyeball's center, then the center of the anterior surface of the *glacialis* necessarily lies deeper in the eye than does the center of the posterior surface of the *glacialis*.

³⁹5.21, p. 351 above.

⁴⁰These consist of the centerpoint of the scleral/corneal sphere; the centerpoint of the uveal sphere; and the centerpoint of the sphere containing the anterior surface of the *glacialis*, which turns out to coincide with the centerpoint of the scleral/corneal sphere; see 5.29, p. 353 above.

⁴¹Projected through the circular pupil, these lines, taken *in toto*, form a cone whose vertex lies at the centerpoint of the eye and whose axis passes straight through all of the established centerpoints to the very center of the hollow of the optic nerve at the back of the eye.

⁴²Alhacen's demonstration that the eye as a whole and the anterior surface of the *glacialis* share a common centerpoint is to be found in 6.23-29, pp. 362-364 above. Under the conditions specified to this point, then, the anterior portion of the *glacialis*, which constitutes the so-called crystalline lens, must lie toward the front of the eye as a whole, as indeed must the entire glacial sphere. It is worth noting, however, that Hunayn ibn Ishaq located the *glacialis* dead center in the eye and that, following him, a long succession of Latin "medical" authorities, including the likes of Leonardo da Vinci and Andreas Vesalius, continued this tradition; see Eastwood, *Elements of Vision*, pp. 5-7; see also A. Mark Smith, "Ptolemy, Alhazen, and Kepler and the Problem of Optical Images," *Arabic Sciences and Philosophy* 8 (1998): 8-44, esp. 30-32.

⁴³5.17, p. 350 above.

⁴⁴5.23, p. 351 above.

⁴⁵See "Introduction," pp. lii and lxxxi above, for some identification of these anatomical authorities, which certainly include Galen and Hunayn ibn Ishaq.

⁴⁶I, 3.1-3.110, in Sabra, *Optics*, vol. 1, pp. 13-43.

⁴⁷I, 3.113-131, in Sabra, *Optics*, vol. 1, pp. 44-48.

⁴⁸Although up to this point Alhacen has treated light as if it were not only absolutely distinct from color, but also *per se* visible, he makes it clear here that this distinction is more analytic than real, light being inextricably linked with color as the cause of its visibility. Hence, although Alhacen, unlike Aristotle, Ptolemy, and Galen, seems to accord light independent physical existence at a theoretical level, he reduces it to a catalyzing agent at a practical level insofar as its primary function is to render color effectively visible; see "Introduction," pp. liv-lv above.

⁴⁹That is, in the same general direction as, but not necessarily in a direct line with, the original line of incidence. Thus, although transparent and reflective bodies are similar in that they break (*reflectere*) incident light-rays, in not breaking them completely, transparent bodies allow them to pass through and thus not to reverse their original direction.

⁵⁰Among such "natural philosophers" we can of course include Galen, Hunayn ibn Ishaq, and Avicenna.

⁵¹Alhacen has thus set up the problem: since each point on any object facing the eye radiates its form to every point on the eye's surface, and since every point on any such object radiates its form to each point on the eye, then the resulting

impression should be confused to absolute indistinction. Why, then, do we see things distinctly? It is this question that Alhacen addresses in the analysis that follows, from 6.13 to 6.45.

⁵²Here Alhacen lays out his basic approach in resolving the above problem: i.e., it is necessary to reduce the *effective* light- and color-impressions on the eye's surface to the point where a perfect point-by-point representation of the visual field is projected onto the eye's surface.

⁵³Cataract surgery, particularly in the form of couching (i.e., pushing the crystallized obstruction aside, out of the line of vision) was practiced not only in the Arabic Middle Ages, but also antiquity; see Thomas Shastid, "History of Ophthalmology," in Casey A. Wood, ed., *The American Encyclopedia of Ophthalmology*, vol. XI (Chicago: Cleveland Press, 1917), pp. 8524-8904, esp. pp. 8580-8722. It should be noted, however, that most of these "cataracts" actually involved obstructions in the aqueous or albugineous humor rather than in the crystalline lens itself (Shastid, "History," pp. 8580-8584). The supposition that the *glacialis*, or crystalline lens, is the true organ of visual sensation, all the remaining tunics designed to serve it, harks back to Galen, whose influence was carried into the Arabic tradition by various theorists, of which the most significant was Hunayn ibn Ishaq; see "Introduction," pp. xlvii-xlix above.

⁵⁴Alhacen's discussion of the rectilinear propagation of light through air is found in I, 3.1-8 *et passim*: Sabra, *Optics*, vol. 1, pp. 13-15. Note Alhacen's effort to establish the universality of this fundamental property of transparency (i.e., that it allows rectilinear propagation of light and color) for any and all transparent objects. That he felt the need to establish this point seems to indicate a keen awareness on his part that transparency might somehow be object-specific—i.e., that light might radiate through glass, for instance, along a different kind of trajectory than it would through water or diamond. Thus, whereas we today take for granted that light, whether it be moonlight, starlight, or sunlight, has absolutely constant attributes, Alhacen feels compelled to establish this point; see, e.g., I, 3.9-19, in Sabra, *Optics*, vol. 1, pp. 15-20).

⁵⁵This experimental verification that light passes rectilinearly through refractive media is to be found at the very beginning of the seventh book of the *De aspectibus* (see Risner, *Opticae thesaurus*, pp. 231-235). Note that the word for "refraction" in this instance is *obliquatio*; indeed, *obliquare* in its various derivative forms is by far the most common term for "refract" in the Latin version of this treatise.

⁵⁶6.12, p. 358 above.

⁵⁷Figure 1.5 on the following page is provided in ms P3 (f 12v) to illustrate the point that one, and only one, set of rays must be selected at the eye's surface if the visual faculty is to get a distinct view of the visual field. Points **A** and **B** on the right hand arc represent points of light (**A** being labeled *punctus lucis*), the larger circular segment to the left represents the surface of the eye (*superficies visus*), and the smaller circle inside it and concentric with it represents the *glacialis*. The legend below the figure reads: *Id est, licet ab A puncto lucis veniat lux ad totam superficiem oculi, tamen glacialis non comprehendit eum a tota superficie oculi sed a puncto in quo cadit perpendicularis super glaciale; similiter intelligendum est de B puncto lucis alio* ("That is, even though the light [emanating] from luminous point **A** reaches the eye's en-

tire [exposed] surface, still, the *glacialis* does not perceive it according to the entire surface of the eye but according to the point where the [light-ray] is perpendicular to the *glacialis*; and the same holds for the other luminous point B").

⁵⁸Note the use of the plural form (*luces*) for light. In using that form, Alhacen is presumably underlining the fact that all light, whatever its source, acts in a uniform manner; cf. note 54, p. 403 above.

⁵⁹In this case, transparencies are assumed by Alhacen to differ according to their refractive power—or, as we would have it today, their optical density. Overall, according to Alhacen's account, transparency varies in terms of thickness or consistency (*spissitudo*), density (*densitas*), or compactness (*soliditas*). Thus, there is a spectrum of transparencies ranging upward from perfect (a theoretical but not practical maximum) to perfectly imperfect (i.e., completely opaque or reflective). Accordingly, *spissitudo*, *densitas*, and *soliditas* confer a measure of opacity upon transparent media that allows them to trap some of the light and color radiating through them (see note 26, p. 398 above). Such is the case with misty air or somewhat turbid water, which are thereby rendered more opaque and, as a result, more visible. The problem, of course, is how to relate refractivity—as a function of *spissitudo*, *densitas*, or *soliditas*—to relative opacity—as a function of the same variables: after all, somewhat turbid water has essentially the same refractivity as clear water, even though the two vary considerably in terms of their ability to transmit light.

⁶⁰This experimental verification is to be found in the seventh book, directly after the experimental verification that light passes rectilinearly through refractive media (see Risner, *Opticae thesaurus*, pp. 325-240).

⁶¹Note that the Latin term *reflectere* is used interchangeably to denote "reflect" or "refract" throughout the first three books of the *De aspectibus*; nowhere is *refringere* or any of its forms, such as *refractus*, used in the Latin manuscript tradition, except by Risner, who imports it into his 1572 edition of the *De aspectibus* to clarify the distinction between reflection and refraction.

⁶²The point Alhacen is making here is that, after refraction, it is impossible for any ray to follow a path perpendicular to the surface of refraction. Alhacen returns to this point somewhat more explicitly toward the end of 6.33, pp. 365-366 above.

⁶³The Latin term *verticatio*, which I have translated as "line," carries a strong implication of directionality and, on that basis, might as easily be translated as "vector;" see notes 1 and 101 to book 2, pp. 531 and 545 below.

⁶⁴Here Alhacen endows the radiated light-form with the dynamic qualities of physical projectiles striking resistant surfaces. As we have already seen in the "Introduction," pp. xxix-xxxi above, Ptolemy provides the obvious precedent for this

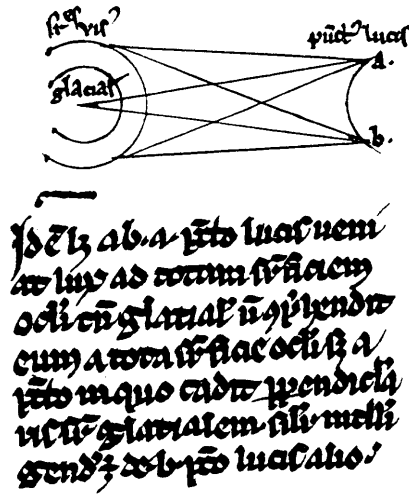


figure 1.5

dynamic model in his likening of visual radiation to projection and his use of this analogy to account for variations of visual acuity within the visual cone as well as according to distance. As Alhacen explains it, then, the more directly the rays/projectiles strike resistant surfaces, such as that at the front of the *glacialis*, the more powerful their impingement upon them; see 6.43, p. 369 above, for an even more overt analogy between the dynamics of light-radiation and the dynamics of physical projection in the form of free-fall. On the basis of this dynamic model, Alhacen isolates those rays that are *effectively* sensed by the *glacialis*—i.e., those that strike it most forcefully—from all the rest. Those that strike it most forcefully, of course, are the ones that strike it orthogonally. The capacity to sense these impinging forms, and to do so selectively, is due to the charge of visual spirit continually suffusing the *glacialis* from the brain; see 5.14, pp. 349-350 above.

⁶⁵I, 3.141-143: Sabra, *Optics*, vol. 1, p. 50. The qualifier “somehow” used with “illuminated” is presumably meant to distinguish bodies that are self-luminous from those that are illuminated from some external source.

⁶⁶Mathematically equivalent to the visual cone of Euclidean-Ptolemaic optics, the cone of radiation described here is the one adverted to obliquely in 5.29, p. 353 above.

⁶⁷The result, therefore, is a mosaic of light- and color-forms that are in perfect point-to-point correspondence with the generating object-surface. Notice, however, that the resulting mosaic conforms to the shape of the anterior surface of the *glacialis*, not that of the generating object-surface.

⁶⁸Figure 1.6 shows that, if the forms passing through the cornea to the anterior surface of the *glacialis* are perpendicular, then the rays **DC**, **AC**, and **BC** along which they continue unrefracted through the *glacialis* will intersect at center **C** of the eye to form a cone. Those rays that strike the same points on the cornea (or the anterior

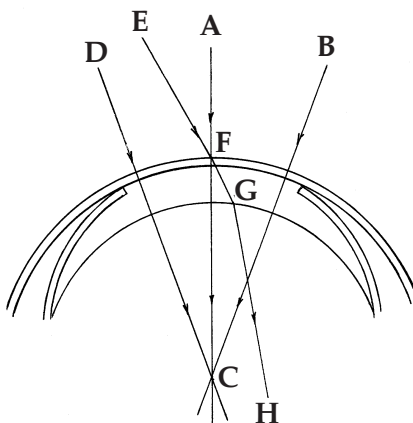


figure 1.6

surface of the *glacialis*) at an angle, on the other hand, will not make an effective impression and will also be refracted so as not to reach the center of the eye. Thus,

ray **EF** strikes the cornea obliquely and is refracted toward the normal. Passing thence through the aqueous humor, it strikes the anterior surface of the *glacialis* obliquely along **FG**. At point **G** it will again be refracted toward the normal to pass into the *glacialis* along **GH** so as to miss centerpoint **C**.

⁶⁹Figures 1.7a and 1.7b are provided in ms P3 (f 17r) to illustrate the two points in this paragraph: i.e., that if rays are refracted at the cornea, the image projected on the surface of the *glacialis* will be inverted, and that refracted rays will never reach or pass beyond the normal. The first figure is explained by the accompany-

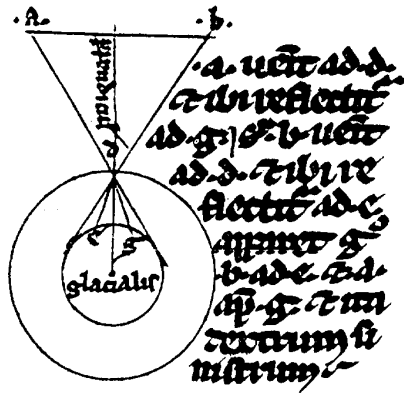


figure 1.7a

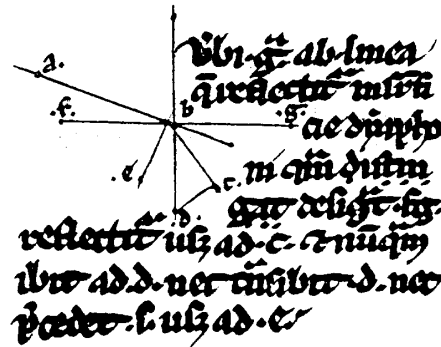


figure 1.7b

ing legend: *A venit ad D et ibi reflectitur ad G; similiter B venit ad D et ibi reflectitur ad E; apparet ergo B ad E et A apud G, et ita dextrum sinistrum* ("A reaches D and at this point is refracted to G; likewise B reaches D and at this point is refracted to E; hence B appears at E and A at G; so the right-hand [point B appears to the] left-hand [side of the *glacialis*, and vice versa]"). The second figure is explained thus by its accompanying legend: *Verbi gratia, AB linea que reflectitur in superficie dyaphoni quam distingat designat FG reflectitur usque ad C et nunquam ibit ad D nec transibit D nec precedet, scilicet, usque ad E* ("For instance, line AB, which is refracted at the transparent surface that FG designates is refracted to C and will never continue to D or pass through D or proceed on to E").

⁷⁰In other words, as figure 1.8 illustrates, when the rays from object-points A and B in the left-hand sector of the visual field reach point C on the eye's surface and refract toward normal DC, then ray AC will refract toward the normal to point E on the surface of the *glacialis*, whereas ray BC will refract toward the normal to point F on the surface of the *glacialis*. In that case, not only will the two points

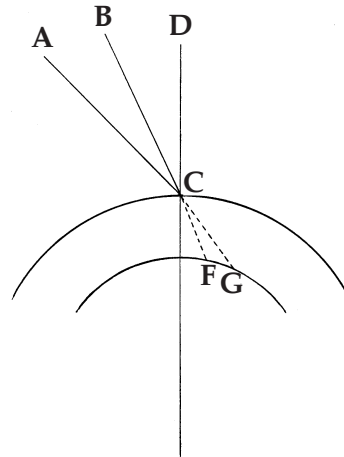


figure 1.8

be seen on the right-hand side of the *glacialis* (i.e., the side opposite to where they lie in the visual field), but, being seen at **F**, the more leftward of the two points **A** and **B** (i.e., **A**) will appear farther to the right (i.e., at **E**) on the surface of the *glacialis*.

⁷¹The point here seems to be that, no matter how closely the incident rays or the resultant refracted rays approach the normal, the refracted ray will never coincide with the normal, nor will they cross one another to interchange their relative locations. Accordingly, no matter how close the neighboring spots on the surface of the visible object, and no matter how close to perpendicular the rays along which they reach the surface of the cornea, after refraction they will invariably be projected in reverse order on the *glacialis*.

⁷²That is, in book 7.

⁷³Alhacen is appealing to common experience, which tells us that such an image-reversal cannot occur because, if it did, we would see things reversed and inverted. Alhacen makes the same appeal to common experience in order to justify his account of how the visual image abstracted at the surface of the *glacialis* continues in proper, upright order into the hollow of the optic nerve; see II, 2.6-7, p. 419 below.

⁷⁴Here Alhacen has recourse to a point he has yet to demonstrate: namely, that in refraction the incident and refracted rays, as well as the normal to the point of refraction, all lie in the same plane. In fact, he defers this demonstration to the third chapter of book 7 (see Risner, *Opticae thesaurus*, pp. 242-243).

⁷⁵Alhacen seems to be forwarding two arguments in 6.40 and 6.41: (1) if the *glacialis* and the cornea did not share the same center, then rays passing orthogonally through the cornea would reach the *glacialis* in distorted order, so the resulting image would be distorted, and (2) if one set of oblique lines could be sensed by the *glacialis*, then it should be sensitive to all oblique lines, in which case every point on the *glacialis* would sense all the forms reaching it, the resulting visual impression being reduced to absolute indistinction, as claimed in 6.17-21, pp. 360-362 above.

⁷⁶In 5.21 *et passim*, p. 351 above.

⁷⁷This analogy between light-radiation and free-fall has crucial implications for the dynamic analysis of light. Accordingly, light-radiation can be thought of in terms of upward projection, its power decreasing continually the farther out from its point-source it gets, just as a body thrown upward loses momentum the farther from the center of "gravity" (i.e., the earth's center), it gets. Cf. Ptolemy's account as described in the "Introduction," p. xxx above.

⁷⁸These mathematicians certainly include Euclid and Ptolemy, as well, perhaps, as al-Kindi and Ahmad ibn Isa, all of whom subscribed to some form of the visual-ray theory. They also include Galen, who gives a detailed description of the visual cone in the *De usu partium*; see the discussion in the "Introduction," pp. xli-xliii above. Alhacen has much to say about the "mathematicians" in I, 1.3-5 (Sabra, *Optics*, vol. 1, pp. 4-5), but, as Sabra warns us in his commentary (*Optics*, vol 2, pp. 8-10), in referring to various "mathematicians," Alhacen may have in mind not particular historical figures but particular theoretical positions.

⁷⁹Note the systematic (and laudable) caution Alhacen displays in acknowledging that to this point he has only shown that the theory of image-formation on the *glacialis* so painstakingly described to this point is not necessarily true, simply

not untrue. The demonstration that it is, in fact, necessarily true begins in the next paragraph.

⁸⁰Alhacen's purpose in this section is to establish that visible objects are the ultimate source of vision and that when such objects do not face us, or when we block them from view, they disappear from sight. In the process, however, he has provided an inductive demonstration of something that might at first blush seem intuitively obvious: that the objects we see lie physically outside the eye, beyond the eyelids. Implied therein is a pretty clear distinction between objective (physical) reality and its subjective (perceptual) counterpart. For a more explicit elaboration on Alhacen's part of this point, see II, 3.73, p. 450 above.

⁸¹Against whom, if anyone in particular, Alhacen is arguing here is unclear. In *De sensu et sensato* 2, 438a5-24, Aristotle raises something resembling the issue when he takes Democritus to task for claiming that the eye owes its peculiar nature to its being composed of water; see also Theophrastus, *On the Senses*, 49, in George M. Stratton, trans., *Theophrastus and the Greek Physiological Psychology Before Aristotle* (London: Allen and Unwin, 1917), p. 109. "True," Aristotle agrees with Democritus, "the visual organ proper is composed of water, yet vision appertains to it not because it is water but because it is transparent—a property common alike to water and to air, . . . whence the necessity of the interior of the eye being transparent, i.e. capable of admitting light" (trans. J. I. Beare, in Jonathan Barnes, ed., *The Complete Works of Aristotle: The Revised Oxford Translation* [Princeton: Princeton University Press, 1984], p. 696). Thus, Aristotle concludes in *De sensu* 3.439a20-24, "what we call transparent is not something peculiar to air, or water, or any other of the bodies usually called transparent, but is a common nature and power, capable of no separate existence of its own, but residing in these" (trans. J. I. Beare, in Barnes, *Complete Works*, p. 697); see also *De anima* 2, 7.418b4-9. Alhacen's argument against the idea that water is the principle of transparency may, therefore, have been prompted by the implications of Aristotle's account. Note, incidentally, that the transparencies cited by Alhacen in this passage (i.e., of clear versus dyed water) differ in terms of translucency rather than of refractivity; see note 59, p. 404 above.

⁸²That is, those within the Euclidean-Ptolemaic visual-ray tradition.

⁸³6.49, pp. 370-371 above.

⁸⁴I, 3.141, in Sabra, *Optics*, vol. 1, p. 50.

⁸⁵Here, of course, we see that "Ockham's Razor" was already well honed and in full use long before Ockham's day. Despite the logical force of Alhacen's refutation, Roger Bacon argues that, in order to bring the visual act to completion, the eye must send out "species" to external objects. In short, eye and object must provide complementary radiation. Citing a range of authorities, from Ptolemy to al-Kindi to justify his position, Bacon goes on to claim that Alhacen was merely arguing against the extramission of a *material* agent from the eye, whereas the radiation he has in mind is formal; see *Perspectiva* I.7.2-4, in Lindberg, ed. and trans., *Roger Bacon and the Origins*, pp. 101-107. For a complete discussion of Bacon's conception of "species" and its radiation/multiplication in the *De multiplicatione specierum*, see Lindberg, *Roger Bacon's Philosophy*, pp. liii-lxxi.

⁸⁶6.23-29, pp. 362-364 above.

⁸⁷Here Alhacen is hoisting Euclid by his own petard, since Euclid claims in the

very first postulate of his *Optics*, that the visual rays proceed (or diverge) indefinitely outward. In *Catoptrica* 1, Hero of Alexandria (fl. mid-first century) cites the fact that we see the distant stars as soon as we open our eyes as a demonstration not only that our visual flux fills the intervening space, but that, in order to do so, it must move with unbelievable swiftness.

⁸⁸In defense of the visual-ray theory, its proponents point out that we “see” objects in space, physically removed from us, and are able to apprehend their actual spatial disposition through a sense of visual touch. We are thus able to determine more-or-less intuitively how and where objects exist in physical space. Without some sort of physical contact, analogous to that which occurs when we extend our arms out to distant objects, we would be unable to reach such a determination. As we shall see later on in the second book, Alhacen offers a counter-explanation based on perceptual inference and estimation that itself is ultimately based on repeated experience and what we learn from it; see note 80, p. 408 above.

⁸⁹There is no doubt that Ptolemy subscribes to the first opinion, i.e., that the visual ray is an imaginary construct. Galen, al-Kindi, and Ahmad ibn Isa seem to follow him in this opinion. Euclid, on the other hand, is unequivocal in his acceptance of the physical reality of individual visual rays. All four theorists seem to support the second opinion (i.e., that something issues from the eye) in one form or another.

⁹⁰Like Aristotle and Ptolemy, Alhacen believes that sight has a proper object or special sensible that distinguishes it from the four other senses. In Alhacen’s case that proper sensible consists of color, along with its complement in light. Thus, when it exercises its peculiar capacity to sense that object, without any ulterior interpretation, sight is acting in its “naked” form (or *solo sensu* [“by brute sensation”] as the Latin text phrases it later in book 2). The resulting sensation is extremely low-level—i.e., perception that what is being sensed is color or light—and does not even include the perception that the given color is of such-and-such a kind. This latter sort of perception (i.e., of specific type or kind), which is inferential and interpretive, requires a higher level of processing, as does the perception of such nonvisible characteristics (that is, characteristics that cannot be grasped *solo sensu*) as shape, size, and so forth. As Alhacen will establish later on, as well, many of our general perceptions (e.g., of “horse”) depend on inferential short cuts, conclusions drawn on the basis of “signs” or key defining features (four legs, long neck, long face, particular gait) that are recognized through experience.

⁹¹6.28, p. 364 above.

⁹²The point made in note 67, p. 405 above, is worth reiterating here: the pointillist image projected on the anterior surface of the *glacialis* is not a perfect replica of the object-surface because the *glacialis* is spherical in shape; therefore, there will be some distortion because of the disparity in surfaces.

⁹³6.4, p. 356 above.

⁹⁴5.9, p. 349 above.

⁹⁵The Latin term that I have rendered by the verb “to impress” in this passage is *figere*, which means “to fix” in a variety of senses, perhaps the most apposite of which in this case is “to implant” or “to affix by piercing.” One of its corollary meanings is thus “to impress.” Furthermore, the use of this particular verb, “to

impress," is in keeping with the analogy Aristotle offers in *De anima* II, 12 between sensation and the stamping of a seal in wax (see also III, 12, 434b29-435a10); see III, 2.82 and 84, pp. 587-588 below.

⁹⁶*Sensu spoliato*, then, the *glacialis* fulfills its proper function by selectively sensing the point-forms of impinging light and color, which form a light- and color-mosaic at its surface, and by transmitting that mosaic, as a sort of visual image, in proper order and arrangement into and through the eye to the optic nerve.

⁹⁷Alhacen is following in a long tradition, one that includes Ptolemy in particular, that reduces sight to a form of touch. Thus, just as in touch, so in sight, the basic stimuli range in intensity from a feather touch, which barely registers at all, to an extremely sharp blow, which registers as extreme pain. As Sabra points out (*Optics*, vol. 2, p. 56), Alhacen could have learned through Theophrastus of Anaxagoras' belief that all perception entails pain. Whether he was actually made aware of Anaxagoras' theory in this way and, if so, was brought his own view by it, is open to question. A more probable source is Ptolemy, who supposes that vision is due to a passion aroused in the visual flux by illuminated color and, furthermore, that if the stimulus is too strong, the passion "hurts and offends" (*nocet et ledit*) the eye; see *Optics* II, 23 in Smith, *Ptolemy's Theory*, p. 79.

⁹⁸Here the "visual process" is taken in its "pure" sense, without any perceptual interpretation. Thus, seeing in the proper sense is a matter solely of creating and transmitting the visual image referred to in note 96 above that visual image forming the basis for perceptual adjudication by the final sensor. Alhacen's final sensor has a clear counterpart in Ptolemy's *virtus regitiva* (Governing Faculty), which is responsible for all higher-level perceptual functions; see Smith, *Ptolemy's Theory*, pp. 28-29. It has another (perhaps common) counterpart in the Aristotelian faculty of "common sensibility," which is located by later Arabic commentators at the very forefront of the first cerebral ventricle; see "Introduction," pp. xlv-xlvi above, for a discussion of this issue.

⁹⁹Alhacen thus follows Ptolemy in explaining image-fusion in physical rather than psychological terms; see Smith, *Ptolemy's Theory*, pp. 29-31. The assumption that image-fusion takes place at the optic chiasma is explicitly articulated by Galen, although Ptolemy seems to follow it implicitly in his account of binocular vision; see "Introduction," pp. xxxiii-xxxiv above.

¹⁰⁰This claim about the destruction of sight by blockage in the optic nerve is quite common and, moreover, makes sense, but surely the supporting claim that removal of such blockage restores sight reflects theoretical imperatives rather than actual surgical experience.

¹⁰¹The underlying explanation of diplopia as described here is essentially the same as Ptolemy's: i.e., the two "visual" cones imagined between the center of the eye and the object do not share the same base, so they do not the same visual field. Nor, for that matter, do they demarcate corresponding areas on the surface of the cornea or *glacialis*. Both cones will thus provide different images for the ultimate delectation of the final sensor or Governing Faculty.

¹⁰²5.3, p. 348 above.

¹⁰³In chapter 2 of the second book, pp. 417-429 below.

¹⁰⁴I, 3.1-8 *et passim*: Sabra, *Optics*, vol. 1, pp. 13-15.

¹⁰⁵Alhacen's argument may be summarized as follows: Insofar as they are transparent, transparent media allow light and color to pass perfectly freely through them. Thus posing no resistance to such passage, they provide no way for light and color to become "fixed" in them (on this notion of "fixing" see note 95, pp. 409-410 above and note 126, p. 413 below). Accordingly, the forms of light and color can cross paths within transparent media without ever interfering or even interacting with one another. Note Alhacen's emphasis here on the fact that transparency is an essential and general quality whose nature is absolutely independent of the object in which it inheres; see note 54, p. 403 above.

¹⁰⁶Alhacen means that the eye does not take on color in the way that, say, white cloth would take on dye; it is, of course, tinged by color accidentally, in the way that a shaded white wall facing a brightly colored object is, as described, for instance, in 4.14, p. 345 above.

¹⁰⁷4.1-4.6, pp. 343-344 above.

¹⁰⁸The persistence of afterimages seems therefore to be due not to the retention of the causal agent—i.e., bright light or color—but, rather, to the lingering sense-effect that continues to excite the visual spirit suffusing the optic complex. Accordingly, as a merely transparent body, the *glacialis* does not retain the incoming light, no matter how intense, but as a sensitive body it may retain the effect of that light if it is intense enough.

¹⁰⁹The previously described trial Alhacen seems to have in mind involves a fully enclosed chamber with one opening through which light is allowed to stream inward and illuminate the opposite wall or various objects placed inside. This set-up is adverted to at various reprises throughout the third chapter of the Arabic version.

¹¹⁰I, 3.121: Sabra, *Optics*, vol. 1, p. 45. Note the general statement that, "the farther the forms [of light and color] are from their source, the weaker they will be." The most obvious way to translate this statement mathematically is according to a simple inverse relation between light-intensity and distance (i.e., $I = 1/d$), and, indeed, this seems to have been the general understanding of the relationship between light-intensity and distance until the time of Kepler; see Smith, *Descartes's Theory*, pp. 32-40, esp. p. 36, n. 13.

¹¹¹4.20, p. 346 above.

¹¹²4.14, p. 345 above. What Alhacen has in mind here are the forms of bright colors (e.g., sunlit vegetation) that shine on nearby white bodies and tinge them, provided that those white bodies are not themselves brightly illuminated.

¹¹³4.9, p. 344 above.

¹¹⁴6.39, pp. 367-368 above.

¹¹⁵By "primary form" Alhacen means a form that is radiated directly from a given color- or light-source. Secondary forms therefore derive from primary forms that have been "fixed" at the surface of some opaque body upon which they radiate (e.g., sunlight on a white wall). Accordingly, the three forms at issue in this passage are (1) the primary form of the inherent color of the opaque body being looked at, (2) the primary form of that body's inherent light, and (3) the secondary form of the illuminated color shining upon that body from an external source and radiating to the eye in tandem with those two primary forms.

¹¹⁶4.9, p. 344 above.

¹¹⁷I, 3.144: Sabra, *Optics*, vol. 1, pp. 50-51. This reference to the third chapter in the Arabic original (and missing in the Latin version) provides one of very few clues to the fact that the Latin text—or the Arabic exemplar upon which it was based—was deficient; see “Introduction,” p. xxiii above.

¹¹⁸See note 7, p. 395 above.

¹¹⁹This example harks back to 4.9, p. 344 above.

¹²⁰This explanation would seem to belie Alhacen’s carefully crafted theory of visual selectivity; after all, if the *glacialis* is constituted to feel only those forms that impinge on it orthogonally, then why should the flood of intense light matter, since all but one of the component rays of that flood will necessarily be refracted at the surface of the eye and will thus strike the *glacialis* obliquely?

¹²¹As Sabra points out in his commentary on this passage, in *Optics*, vol. 2, pp. 57-59, many of the color-terms Alhacen uses are difficult to interpret for a variety of reasons, not the least of which is their being keyed to unfamiliar substances (e.g., the “red” associated with the head of a particular bird). Such difficulties of interpretation seem to have carried over into the Latin. Accordingly, while the phrase “grass-green color” (*color viridis segetalis*) seems to be a proper rendering of its Arabic counterpart, “black body” (*corpus nigrum*) in Latin is “dark-blue body” in Arabic (the list of Arabic-Latin color-equivalents Sabra provides on p. 59 is misleading because the order of comparisons [i.e., grass-green on yellow looks dark; grass-green on black looks light] is reversed in the Latin version). The basic point, of course, is that a given color will change its apparent hue when it is seen against the background of other colors, depending on their brightness or darkness, so that color-perception depends not just upon the quantity and quality of illumination but also upon ambient color. This latter point is crucial to Aristotle’s account of the yellow band in the rainbow, its appearance being due to the “whitening” of the stratum of the red band that is juxtaposed against the green of its brighter neighboring band; and Aristotle goes on to claim that in woven and embroidered cloth apparent hue depends heavily upon color-juxtaposition; see *Meteorology* III, 3, 375a6-26.

¹²²5.6-7, p. 348 above.

¹²³By this account, then, the primary function of the uvea is to darken the interior of the eye so that light (and color) of virtually any intensity can remain visible within the area between the pupil and the hollow of the optic nerve at the back of the *glacialis*. Accordingly, the eye is somewhat like a camera, although, as will become clear later, it has no focusing function whatever.

¹²⁴Both here and at the beginning of this passage, the perfectly round shape of the constituent element (be it the pupil or the uvea) is dictated by a sort of metaphysical necessity: it must be shaped for the best, and the best—in terms of design efficiency—is circular or spherical because those are the simplest and most capacious planar and three-dimensional shapes possible. According to Alhacen, then, the sphericity of the eye is not just functionally, but mathematically, determined; cf. Hunayn ibn Ishaq’s account as described in “Introduction,” pp. xlviii-xlix above.

¹²⁵The thin membrane mentioned above is the *arana* or “cob-web,” which, according to this description, encloses both the glacial and vitreous humors; see 5.10,

p. 349 above. Overall, the *glacialis* (both humors included) comprises a sphere from whose anterior surface a portion is cut off by a surface-segment that is part of a sphere of gentler curvature; see 5.9, 5.24 and 5.26, pp. 349 and 351-352 above. Hence, the primary form of the *glacialis* is spherical, even though its sphericity is rendered imperfect by the flattening of the anterior surface.

¹²⁶On the implications of *figere*, rendered here by “to impress,” see note 95, p. 409-410 above. Alhacen’s claim here that the glacial humor’s opacity allows it to retain light and color for a short time seems to contradict his explicit denial of such retention in 6.90-94, pp. 380-381 above.

¹²⁷The Latin text does not specify smell as the sense appropriate to this location, but the Arabic version does. Moreover, it is a commonplace within the Galenic tradition that the olfactory system originates at this middle spot in the forefront of the brain; see, e.g., *De usu partium*, VII, I. 469, in May, p. 405.

¹²⁸The Latin term I have rendered as “Creator” is *operator*, a term that carries with it the connotation of “craftsman” or “one who physically manipulates.” Assuming, then, that Alhacen is referring to God here (cf. 7.18, p. 390 above), he is emphasizing His capacities as designer and implementer, much in the mold of the Demiurge described in Plato’s *Timaeus*. The accompanying notion that the optic system is perfectly suited by design to fulfill its basic functions is, of course, a Galenic commonplace that is echoed by such key Arabic followers as Hunayn ibn Ishaq; see, e.g., Eastwood, *Elements of Vision*.

¹²⁹6.69-72, pp. 376-377 above.

¹³⁰6.27, pp. 363-364 above.

¹³¹Note the aesthetic judgments Alhacen makes here and in I, 7.9, claiming that the doubling of the eyes and the whiteness of the sclera reflect the intention of the “Creator” (*operator*) to make the optical system as aesthetically pleasing as it is functional. While such a claim may seem to reflect mere bias on Alhacen’s part, it is in fact consistent with (and thus justifiable according to) the experientially based account of perceptual judgment he offers later in the second book.

¹³²The “suitable place” is II, 2.24-30, pp. 427-429 below. Note how Alhacen’s discussion of the spherical shape of the eye and the circular shape of the pupil (see 7.4, pp. 387-388 above) is informed both theoretically (metaphysically) and pragmatically (physically). On the one hand, the sphere and circle are the most perfect of figures on rational grounds: they are perfectly simple, and they are perfectly efficient in spatial compass. Yet the sphericity of the eye is also dictated by its need to move as freely and quickly as possible in order to scan the visual field for the clear and swift visual perception. Ptolemy argues for the sphericity of the universe and the circularity of celestial motion along much the same line: “The motion of the heavenly bodies is the most unhampered and free of all motions, and freest motion belongs among plane figures to the circle and among solid shapes to the sphere; similarly, since of different shapes having an equal boundary those with more angles are greater [in area or volume], the circle is greater than [all other] surfaces, and the sphere greater than [all other] solids,” *Almagest* I.3, trans. G. J. Toomer, *Ptolemy’s Almagest* (New York: Springer), pp. 39-40.

¹³³I, 2.1-12, in Sabra, *Optics*, vol 1, pp. 6-9.

¹³⁴The Latin text is obviously confused here; evidently, the point to be made is

that the body of the eye blocks light from reaching the surface of the object that is in contact with it so that the object cannot be rendered visible by extrinsic light.

¹³⁵It is not clear from this passage whether Alhacen means to equate stars and fire according to a shared nature—i.e., being hot—which of course is why fire, put in direct contact with the eye, will burn it and thus destroy rather than induce vision. On the other hand, he may simply mean that the stars, being absolutely unreachable, cannot possibly be put into physical contact with the eye or anything else in the sublunar realm.

¹³⁶This passage makes evident the intent of the garbled account at the beginning of 8.3.

¹³⁷6.39, pp. 367-368 above.

¹³⁸See also 6.96 and 6.113-114, pp. 381 and 386 above.

¹³⁹6.63, p. 375 above.

¹⁴⁰Alhacen's argument here seems circular: the reason that objects of a certain size fall below the threshold of visual perceptibility is that their forms make an imperceptibly small impression on the *glacialis*. The gist of the argument seems clear enough, though. As we will see later on in the third book, where Alhacen discusses the threshold conditions of sight at some length, perceptibility also depends on the intensity of the impression made on the *glacialis*. Hence, a light-source of moderate size can be too feeble, or too distant, to make itself felt by the *glacialis*.

¹⁴¹Here I have chosen to translate the Latin term *figere* as "to fix" rather than "to impress," as in 7.5, p. 388 above. The point Alhacen is making here is that, when exposed to light, opaque objects actually take on that light by resisting it and thus preventing it from passing through their substance. Since a perfectly transparent body poses absolutely no resistance to this passage, such a body cannot take on any light whatever and therefore cannot radiate the secondary form of that light by means of which the body can be seen.

¹⁴²In this passage Alhacen seems to be saying that color is the principle of opacity—or vice versa. If so, then perhaps he is attempting, on that basis, to make sense of Aristotle's rather cryptic claim that color is "the limit of the transparent in determinately bounded body" (*De sensu* 3, 439b12, trans. J. I. Beare, in Barnes, *Complete Works*, p. 698).

BOOK TWO OF ALHACEN'S *DE ASPECTIBUS*

Topical Synopsis

CHAPTER 1: *Preliminary Observations* 417

CHAPTER 2: *Transmission of Visual Images through the Eye to the
Common Sensor* 417

[2.1-2.5] Review of previous discussion of image-selection by the *glacialis*. [2.6] Rays passing into the eye from the *glacialis* cannot intersect at centerpoint of eye because the image would be inverted. [2.7-2.10] How such intersection is forestalled by refraction of the rays at the interface between glacial and vitreous humors. [2.11-2.18] For the visual image to reach the common sensor in proper order, it must be transmitted both physically and sensitively through the optic complex. [2.19-2.23] The visual axis must be perpendicular to the interface between glacial and vitreous humor if the image is to reach the common sensor in proper arrangement. [2.24-2.30] Visual clarity is greatest along the visual axis and diminishes with increasing angular distance from it.

CHAPTER 3: *How Sight Perceives Specific Visible Attributes*. 429

[3.1-3.25] Visual perception involves more than brute sensation; it also requires intellectual judgments that are based on differentiation and recognition. [3.26-3.36] Such judgments are essentially syllogistic, but they usually occur so fast that we are unaware of the inferential process. [3.37-3.41] From infancy humans are innately disposed to reason and to perceive syllogistically, and they generally do so easily and unconsciously. [3.42] Repeated perceptions lead to virtually instant recognition of visible objects through memorization. [3.43-3.44] List of the twenty-two visible intentions. [3.45-3.48] Perception of these intentions is ultimately based on brute sensation of illuminated color that is transmitted to the final sensor for subsequent judgment and differentiation. [3.49-3.66] How light and color are sensed and perceived. [3.66-3.93] How the fact of remoteness is perceived and how distance is perceived and reckoned. [3.94-3.120] How spatial disposition is perceived.

[3.121-3.126] How corporeity is perceived. [3.127-3.134] How shape is perceived. [3.135-3.171] How size is perceived. [3.171-3.174] How the separation between bodies, or the parts of bodies, is perceived. [3.175-3.176] How continuity is perceived. [3.177] How number is perceived. [3.178-3.187] How motion is perceived. [3.188] How rest is perceived. [3.189-3.191] How roughness is perceived. [3.192-3.194] How smoothness is perceived. [3.195-3.196] How transparency is perceived. [3.197] How opacity is perceived. [3.198] How shadow is perceived. [3.199] How darkness is perceived. [3.200-3.231] How beauty is perceived. [3.232] How ugliness is perceived. [3.233] How similarity is perceived. [3.234] How difference is perceived. [3.235] Conclusion.

CHAPTER 4: *The Selection of Visual Images* 512

[4.1] No visible characteristic is actually perceived by itself because no object is defined by a single such characteristic. [4.2-4.4] Proper perceptual determination of what an object is requires a full scrutiny of its visible characteristics. [4.5-4.11] How visual certification occurs through a complete scrutiny of the object by the visual axis as it scans its surface. [4.12-4.15] How repeated perceptions of the same object, or the same kind of object, yield a definite mental impression of that object and how such impressions are stored in the imagination for mnemonic retrieval. [4.16] How the universal form is perceptually derived from repeated impressions of particular kinds of objects and the individual forms they yield. [4.17] How perception by means of recognition occurs through a process of assimilation. [4.18] How objects are perceived through visual scrutiny alone. [4.19] How objects are perceived through visual scrutiny along with recognition. [4.20-4.22] Both kinds of perception take time, but perception through visual scrutiny along with recognition is generally faster. [4.23-4.28] Perception of what kind of thing an object is takes less time than perception of its individual nature, but the time for each kind of perception is variable; the same holds for the perception of specific visible characteristics. [4.29-4.36] Visual perception that involves recognition is subject to error and can only become determinate with subsequent close scrutiny of the object.

[THE SECOND BOOK]

[CHAPTER 1]

[1.1] It has been shown how vision takes place, and it does so [by means of a] sensation in the eye [produced] by a form of the light and color in a visible object arranged as they actually exist in the surface of the visible object. However, sight perceives many characteristics of visible objects besides light and color.

[1.2] It has also been shown in the first book that vision will occur only along radial lines, but radial lines vary in their dispositions, and likewise the dispositions of the forms reaching along them to the eyes vary.¹

[1.3] Moreover, the visual perception of a visible object does not occur the same way every time, nor does it occur the same way for all visible objects. Instead, the way sight perceives visible objects varies, and the visual perception of the same visible object varies [even] when it is in the same situation and lies the same distance [from the eye].

[1.4] And in this book we shall show the various dispositions of the radial lines, and we shall specify their characteristics along with all the visible properties that are perceived by sight. And we shall show how sight perceives each of them as well as how visual perception varies for each of them.

[CHAPTER 2]

[2.1] It has already been shown in the first book that the radial lines along which the eye perceives visible objects are straight lines whose endpoints meet at the center of the eye.² And it has been shown in [the section on] the structure of the eye that the sensitive organ, which is the *glacialis*, is attached at the end of the hollow of the nerve to which the entire eye is attached, and [it has been shown] that, when this nerve flexes, it only flexes behind the center of the eye in the back of the whole eye, at the opening in the eye socket.³

[2.2] It has also been shown that the straight line passing through all the centers of the tunics of the eye extends through the middle of the nerve's

hollow, reaches straight to the middle of where the nerve's hollow flexes, and passes through the center of the opening in the anterior of the uvea.⁴ It has been shown, moreover, that the position of this line does not change with respect to the eye as a whole, nor with respect to the surfaces of the tunics, nor with respect to the component parts of the eye.⁵ Therefore, the straight line passing through all the centers of the tunics of the eye invariably passes straight through to the hollow of the nerve to which the eye is attached where that nerve flexes, [and it does so] under all conditions, whether the eye is in motion or at rest. And since this line passes through the center of the eye as well as through the center of the opening in the front of the uvea, it extends through the middle of the cone whose vertex lies at the center of the eye, and the circumference of the opening in the front of the uvea circumscribes that cone; hence, let us call this line the "axis" of the cone.

[2.3] Furthermore, it has been demonstrated in that same first book that the cone formed between the visible object and the center of the eye demarcates an area on the surface of the *glacialis* that encompasses the entire form of the visible object at the base of that cone.⁶ And the form will be arranged on that area of the surface of the *glacialis* by the radial lines extending between the visible object and the eye according to the [actual] arrangement of parts on the surface of the visible object. Thus, when the eye perceives some visible object and that object's form reaches the area on the surface of the *glacialis* demarcated by the aforesaid cone, every point on the aforesaid form lies on the radial line that extends between that point [on the surface of the *glacialis*] and a point facing it on the surface of the visible object, and [it is] along this line that the form comes directly to that point on the surface of the *glacialis*. Therefore, if the form of the visible object lies at the middle of the surface of the *glacialis*, the aforesaid axis will be one of the lines along which the forms of the points on the surface of the visible object extend, and the point on the surface of the visible object where the endpoint of this axis touches will be the point whose form comes [to the eye] along the axis.

[2.4] It has been shown in the first book, as well, that the forms perceived by the eye extend through the body of the *glacialis* and into the hollow of the nerve to which the eye is attached, and they reach the common nerve which is centered at the front of the brain—and this is where the forms of visible objects will be perceived by the final sensor—and [it has been shown] that vision is not fully realized until the form reaches the common nerve and that [such] forms will extend from the surface of the *glacialis* into the body of the *glacialis* along straight radial lines only, for the *glacialis* only receives these forms along radial lines.⁷

[2.5] And the final sensor perceives the locations of the [constituent]

parts of the visible object only according to their locations on the surface of the visible object itself. And since the relative locations of the parts of the form, i.e., of the form reaching to the surface of the *glacialis*, are [the same as] the relative locations of the parts of the surface of the visible object, and since these forms are propagated as has been described, and since all these things obtain, vision will not be fully achieved until after the form on the surface of the *glacialis* reaches the common nerve, and its parts are situated as they actually are on the surface of the *glacialis* without any confusion.

[2.6] But the form reaches from the surface of the *glacialis* to the common nerve only by continuing through the hollow of the nerve to which the eye is attached. Thus, if the form does not extend through the hollow of this nerve with the same arrangement it has on the *glacialis*, it will not arrive at the common nerve in proper order. But the form cannot extend from the surface of the *glacialis* to the hollow of the nerve along straight lines and still preserve the proper arrangement of its parts, for all of those lines meet at the center of the eye. In that case, when they are extended along straight lines past that centerpoint their relative positions will be reversed, so the rightward [radial lines] will fall to the left, and vice versa, and the higher ones [will be] lower and the lower ones higher. Therefore, if the form extends along straight radial lines, it will contract at the center of the eye to form a virtual point; and since the center of the eye [in terms of its visual components] lies at the center of the entire ocular globe and in front of where the hollow of the nerve flexes, if the form is extended from the center as a single point along a single line, it will arrive at the place where the hollow of the nerve flexes as a single point. Accordingly, the whole form will not reach the place where the hollow of the nerve flexes, because it will arrive only as a single point, i.e., the one at the extremity of the axis of the [visual] cone.⁸ But if it extends along straight radial lines to pass through the center [of the eye], it will be reversed according to the reversal of the lines along which it arrived after intersection. Hence, the form cannot reach from the surface of the *glacialis* to the hollow of the nerve so as to have its parts arranged as they actually are [in the object]. The form can therefore only reach from the surface of the *glacialis* to the hollow of the nerve along refracted lines that intersect the [original] radial lines.⁹

[2.7] Since this is the case, then, vision will not be fully achieved until after the form that arrives at the surface of the *glacialis* is refracted so as to extend along lines intersecting the [original] radial lines. So this refraction must occur before the form reaches the center [of sight], for if it is refracted after passing through that centerpoint, it will be reversed.

[2.8] And it has already been shown that this form passes through the

body of the *glacialis* along straight radial lines, and since the form can reach the hollow of the nerve only after it has been refracted along lines intersecting the [original] radial lines, the form is refracted only after it passes through the body of the *glacialis*. And it has already been claimed in [the section on] the structure of the eye that the body of the *glacialis* varies in transparency and that its posterior portion, which is called the vitreous [body], differs in transparency from its front portion.¹⁰ Moreover, in the *glacialis* there is no body, other than the vitreous [body], that is different in form¹¹ from the form of the anterior portion. But it is among the properties of the forms of light and color to be refracted when they meet with another body that differs in transparency from the first body [through which they were first radiating]. Thus, the forms are refracted only when they reach the vitreous humor, and this body differs in transparency from the body at the front of the *glacialis* only so that the forms can be refracted in it.¹²

[2.9] Furthermore, the surface of this body must lie in front of the center [of eye] so that the forms can be refracted at it before they pass through that centerpoint.¹³ And this surface must be uniform in shape, for if it were not uniform in shape, the form would appear distorted after refraction. But a surface of uniform shape is either plane or spherical.¹⁴ Now this surface cannot be formed from a sphere whose center is the center of the eye, for if it were, the [incoming] radial lines would always be perpendicular to it, so the form would extend along those straight lines and would not be refracted. Nor can [this surface] be formed from a small sphere, for if it were formed from a small sphere, then when the form is refracted at it and continues on, it will be distorted. Hence, this surface is plane, or it is spherical [and formed] from a sphere that is the right size not to have its curvature affect the arrangement of the form.¹⁵

[2.10] Hence, the surface of the glacial humor that forms the common section between that [vitreous] body and the anterior body of the *glacialis* is a surface of uniform shape that lies in front of the center of the eye. And all the forms reaching the surface of the *glacialis* extend through the body of the *glacialis* along straight, radial lines until they arrive at this surface, but when they arrive at this surface, they are refracted at it along uniformly arranged lines that intersect the [original] radial lines. Therefore, radial lines conduce to the proper arrangement of the forms of visible objects only at the *glacialis*, for it is at this organ that [visual] sensation will begin. And it has also been shown in the first book that, given the size of the visible object and the smallness of the sensitive organ, it is impossible for the form of a visible object to be properly arranged on the surface of the eye except along such lines.¹⁶ Hence, these lines exist solely to be the instrument of sight through which visible objects are finally per-

ceived as they exist in reality. However, in reaching the final sensor [in proper order], the forms do not need to continue along such straight lines.¹⁷

[2.11] Now the reception of forms by the sensitive organ is not like the reception of such forms by transparent bodies. For the sensitive organ receives these forms while sensing them, and they pass through it according to its transparency, but the sensitive power it possesses receives these forms in a sensitive way. Transparent bodies, however, receive these forms only for the purpose of transmitting them, but they do not sense them. And since a sensitive body does not receive these forms in the same way as nonsensitive transparent bodies do, the forms need not continue through the sensitive body along the same [radial] lines that transparent bodies require. Therefore, the eye is constituted to receive forms along radial lines only insofar as it is a property of forms to extend through transparent bodies along all straight lines. But if these forms reach the sensing organ in proper order and are perceived by the sensing organ in proper order, there will be no need for such [radial] lines afterward.

[2.12] Accordingly, only the front portion of the *glacialis* is constituted for the reception of forms along radial lines; the posterior portion, which is called the vitreous [body], along with the receptive capacity that is in this body, is constituted with its sensation of these forms only to maintain their arrangement. And since this is so, the way the vitreous [humor] receives the forms is not the way that the anterior portion of the *glacialis* receives them, and the receptive capacity of the vitreous [humor] is not the [same as] the receptive capacity in the anterior portion [of the *glacialis*].

[2.13] Moreover, since the way the vitreous [humor] receives forms is not the way the anterior portion of the *glacialis* receives them, the refraction that the forms undergo at the surface of the vitreous [humor] can only be due to the difference in the receptive sensitivity of these two bodies. Thus, the refraction of forms at the vitreous [humor] has two determinants, one being the difference in transparency between the two bodies, the other being the difference in receptive sensitivity between these two bodies.

[2.14] Now if the transparency of the two bodies were uniform, the form would extend through the vitreous body along straight, radial lines on account of the uniformity of transparency, but it would be refracted on account of the difference in sensitivity. Under these circumstances, then, the form would be distorted after refraction, or else there would be two forms [created] on account of this [disparity in the] nature [of the two media]. But since the difference in transparency prompts refraction, i.e., bending, and since the difference in sensitivity prompts [such] bending, the form will remain single after refraction, and it is for this reason that the transparency of the vitreous humor and the transparency of the gla-

cial humor are different. Therefore, the forms reach the vitreous humor arranged as they actually are on the surface of the visible object, and this body receives them and senses them. Then they are refracted according to the difference in transparency and the difference in sensitivity possessed by this body, and so the form arrives according to its proper arrangement.¹⁸ The resulting sensation, as well as the resulting form, will then extend through this body until the sensation and form reach the final sensor. But the passage of the sensation and the passage of the form through the body of the vitreous and through the sensitive body that fills the hollow of the optic nerve to the final sensor will be like the passage of the sensation of touch or the sensation of pain to the final sensor.

[2.15] However, the sense of touch and the sense of pain extend from the [sensing] organ only through the fibers of the nerves and through the spirit pervading those fibers. And when the forms of visible objects reach the body of the vitreous humor, the sensation will extend from that organ through the sensitive body pervading the hollow of the nerve and linking the eye to the front of the brain. In tandem with sensation, moreover, the forms extend [through this nervous channel] in their proper arrangement, for the sensitive body naturally conserves the arrangement of such forms. And this arrangement is conserved in the sensitive body, because the arrangement of the parts of the sensitive body that receive the parts of the form, as well as the arrangement of the receptive power in the parts of the receiving body, is uniform throughout the vitreous humor and the whole of the subtle matter pervading the hollow of the nerve. Since this is the case, when the form reaches a given point on the surface of the vitreous [humor], it will run along a continuous line, and it will not change its [relative] position in the hollow of the nerve through which the sensitive body extends. And all the lines along which all the points in the form run will be uniformly arranged with respect to one another, and all these lines will bend at the bend of the nerve, and at the point of bending all will be arranged as they were before bending, and afterward as well, because of the sensitive quality of this body. Accordingly, the form will reach the common nerve properly arranged, and it is not possible for the forms of visible objects to extend to the final sensor in any way other than this, for it is not possible for forms to reach the common nerve properly arranged unless their passage occurs in this way.¹⁹

[2.16] And since forms extend according to this arrangement, the form reaching any point on the surface of the *glacialis* must always extend along the same line to the same point at the common nerve where the form [as a whole] reaches. But the form reaching any given point on the surface of the *glacialis* also invariably reaches the same point on the surface of the vitreous [humor]. From this it follows that from any two points that are

correspondingly situated on [each of] the two eyes two forms extend to the same point in the common nerve.²⁰

[2.17] It also follows that the sensitive body pervading the hollow of the nerve should be somewhat transparent so the forms of light and color can appear in it, and it follows, as well, that its transparency should be like the transparency of the vitreous humor so that the forms are not refracted when they reach the posterior surface of the vitreous humor at the hollow of the nerve, for when the transparency of two bodies is identical, the forms will not refract. And it is not possible for the forms to be refracted at this surface, because this surface is spherical and is formed from a sphere. However, if the forms were to refract at this surface, they would not get very far from it before they were distorted.²¹ So there can be no refraction of forms at this surface.

[2.18] If the transparency of the sensitive body pervading the hollow of the nerve is no different from the transparency of the vitreous humor, there will be no variation [in transparency] to cause a variation in the form. And although the form extends in tandem with sensation, the transparency of the sensitive body that pervades the hollow of the nerve is no different from the transparency of the vitreous body. However, the transparency of this body is intended only to let forms extend through it along the lines that transparency requires. So it is transparent only so that it can receive the forms of light and color and so that those forms can appear in it, for a body does not receive light and color, nor do the forms of light and color pass through it, unless it is [completely] transparent or there is some transparency in it. And light and color do not appear in a transparent body unless there is some opacity to go along with its transparency, and for this reason the *glacialis* is neither exquisitely transparent nor inordinately opaque. Hence, the sensitive body that pervades the hollow of the nerve is transparent, but along with that there is some opacity in it. So the form passes through this body on account of the transparency it possesses, and forms are revealed to the sensitive power in it on account of the opacity it possesses. And the final sensor perceives the forms of light and color only from the forms reaching through this body when they arrive at the common nerve, and it perceives light from the illumination of this body and color from its coloring.²² This, then, is how forms will reach the final sensor and how the final sensor will perceive them.

[2.19] Having shown that forms are refracted at the surface of the vitreous [humor], we should add that the axis of the cone of radiation cannot be obliquely incident upon this surface, nor can any other line be perpendicular to that surface.²³ For if the [visual] axis were to intersect this surface obliquely, then, when forms arrived at this surface, they would vary in arrangement and would change their orientations. But forms can

reach the surface of the vitreous humor properly arranged only when the axis of the cone is perpendicular to this surface. For when the eye faces some visible object and the visual axis reaches the surface of that visible object, the form of that visible object will reach the surface of the *glacialis* arranged according to the actual arrangement of the parts on the surface of the visible object, and the form of the point on the surface of the visible object at the extremity of the [visual] axis will reach the point on the surface of the *glacialis* intersected by that axis. Furthermore, the forms of all the points on the surface of the visible object that are equidistant from the point at the extremity of the [visual] axis will extend to points of the forms on the surface of the *glacialis* that are equidistant from the point where the [visual] axis intersects it, for all of the points reaching the surface of the *glacialis* lie on radial lines extending from the center of the eye to the surface of the eye, and the visual axis is perpendicular to the surface of the *glacialis*. Therefore, all the planes containing the [visual] axis and intersecting the surface of the *glacialis* will be perpendicular to its surface.

[2.20] And it has already been shown that the surface of the vitreous humor is either plane or spherical and that its center is not the center of the eye. Therefore, if the visual axis intersects that surface obliquely rather than orthogonally, only one of the planes containing the [visual] axis will be perpendicular to that surface, so all the remaining planes containing the [visual] axis will be oblique to it, for such is a property of lines that are oblique to plane and spherical surfaces. Let us then imagine a plane containing the [visual] axis and perpendicular to the surface of the vitreous humor [and let it be] extended beyond the [visual] axis. It will therefore intersect the surface of the vitreous [humor] and the surface of the *glacialis* and will describe two different common sections in them. Then let us imagine two points on the common section of this plane and the surface of the *glacialis*, and let them be equidistant from the point where the [visual] axis intersects the *glacialis*. Let us also imagine two lines extending from the center of the *glacialis* to these two points. Therefore, the two lines will lie along with the [visual] axis in the same plane that is perpendicular to the surface of the vitreous humor, for, along with the centerpoint, the two points form three points on this surface. Moreover, the two angles formed by these two lines with the [visual] axis will be equal, and these two lines will intersect the common section on the surface of the vitreous [humor] at two points. Likewise, the [visual] axis will intersect this common section at the point midway between these two points. Therefore, if the surface of the vitreous [humor] is plane, the common section will be a straight line.²⁴ But if the [visual] axis is oblique to the surface of the vitreous [humor], and the plane forming the common section is perpendicular to this surface, then the [visual] axis will be oblique to the common sec-

tion [of the two planes], i.e. to this line. So the sides of the two angles will be unequal, because, if the [visual] axis were perpendicular to this common section, it would be perpendicular to the surface. But since the two aforementioned angles are unequal while the two angles at the center of the *glacialis*, which is the endpoint of the [visual] axis, are equal, then the two segments of the line forming the common section will be unequal. Thus, the two points at the end [of those segments] will lie at different distances from the point on the [visual] axis that intersects this line.²⁵ But it is to these two points that the forms of the two points that are equidistant from the [visual] axis on the surface of the *glacialis* reach, for they lie at the endpoints of the two radial lines passing through these two points. Now the point lying on the [visual] axis at the surface of the vitreous [humor] is the one to which the form of the point on the [visual] axis at the surface of the *glacialis* extends. Granted that the [visual] axis is oblique to the surface of the vitreous [humor], granted that the surface of the vitreous [humor] is plane, granted that the two points of the form that reaches the surface of the *glacialis* are equidistant from the point reached by the [visual] axis, and granted that these two points lie on a plane that is perpendicular to the surface of the vitreous [humor], then, when they extend onward to the surface of the vitreous [humor], they will lie at unequal distances from the point reaching along the [visual] axis.²⁶

[2.21] If the axis is oblique to the surface of the vitreous [humor] and the surface of the vitreous [humor] is plane, the common section of any plane containing the [visual] axis and intersecting the surface of the vitreous [humor] will form two unequal angles with the [visual] axis, except for a single plane, and that is the plane that intersects the surface of the vitreous [humor] orthogonally, for the common section formed by it will subtend two right angles with the [visual] axis. But the [visual] axis will be oblique to the common sections of every other [intersecting] plane. And if the two aforesaid angles are unequal while the two angles opposite the two portions of the common section—i.e., the angles at the center of the surface of the *glacialis*—are equal, then the two portions of the common section on the surface of the [vitreous] humor will be unequal, and the two endpoints of this common section will lie at different distances from the point on the [visual] axis. However, the two portions of the common section on the surface of the *glacialis* will be equal, and the two endpoints of this common section will be equidistant from the point where the [visual] axis intersects the surface of the *glacialis*. This being the case, when the form passes from the surface of the *glacialis* to the surface of the vitreous [humor], its arrangement will not be the same as it is on the surface of the *glacialis* or as it is on the surface of the visible object.

[2.22] The same will also hold when the vitreous surface is spherical

and the [visual] axis strikes it obliquely, for when the points on the surface of the *glacialis* that lie equidistant from the [visual] axis reach the surface of the vitreous [humor], their distance from the axial point will be unequal. For when the [visual] axis is not perpendicular to the surface of the vitreous [humor], and when the surface of the vitreous [humor] is spherical, this axis will not pass through the center of [the sphere that defines the surface of] the vitreous [humor], but it will pass through the center of [the sphere that defines] the surface of the *glacialis*. Therefore, the lines that extend from the center of the *glacialis* to points that are equidistant from the point of [intersection of] the [visual] axis on the surface of the *glacialis* subtend equal angles with the axis at the center of the *glacialis*. And if this is so, but the center of the *glacialis* is not the center of the vitreous [humor], then these lines will demarcate unequal arcs on the surface of the vitreous humor.²⁷ And only two lines lying in the same plane as the [visual] axis and subtending right angles with it mark off equal arcs on the surface of the vitreous [humor], and those are lines that lie on a plane that intersects the surface of the vitreous [humor] orthogonally. Thus, if the [visual] axis is oblique to the surface of the vitreous [humor], the forms that reach the surface of the vitreous [humor] will be improperly arranged, whether that surface is plane or spherical.

[2.23] But if the axis is perpendicular to the surface of the vitreous [humor], it will be perpendicular to all the common sections [on it], and any two lines that extend from the center of the *glacialis*, which is a point on the [visual] axis, will subtend right angles with the [visual] axis and will mark off two equal segments on the common section on the surface of the vitreous [humor]. Moreover, the two endpoints of the two equal segments will be equidistant from the point of [intersection of] the [visual] axis on the surface of the vitreous [humor], whether the surface of the vitreous [humor] is plane or spherical. Under all circumstances, then, the form reaches the surface of the vitreous with its parts arranged as they are on the surface of the eye only when the [visual] axis is perpendicular to the surface of the vitreous [humor]. Moreover, the [final] sensor only senses the form as it actually is when that form reaches it, and the [final] sensor perceives the arrangement of the parts of the visible object as it really exists on the surface of the visible object. It is therefore not possible for the forms to reach the surface of the vitreous [humor] without having their parts arranged as they really are [on the surface of the visible object]. It is not possible, then, for the visual axis to be oblique to the surface of the vitreous [humor]; so it will be perpendicular. Thus, all the remaining radial lines will be oblique to this surface, whether it is plane or spherical, because they intersect the [visual] axis at the center of the *glacialis*. However, none of these lines, except the [visual] axis, passes

through the center of the surface of the vitreous [humor], assuming it is spherical, because it is perpendicular to this surface, but the center of the surface of the *glacialis* is not the [same as the] center of the surface of the vitreous humor. And since it has been shown that forms reaching the surface of the *glacialis* only reach the hollow of the nerve after having been refracted along oblique lines, and since their refraction happens only at the surface of the vitreous [humor], and since the [visual] axis is perpendicular to this surface while all the remaining radial lines are oblique to this surface, then, when the forms reach the surface of the vitreous [humor], all of the points on them except for the axial point will be diverted, for this point extends straight along the [visual] axis until it reaches the bend in the hollow of the nerve. Therefore, no form other than [that of] the point on the [visual] axis that reaches the surface of the *glacialis* extends to the hollow of the nerve along a straight line; all the rest of the [forms of the] points reach the hollow of the nerve along oblique lines.

[2.24] Thus, when the eye perceives a visible object that faces the middle of the eye, and since the [visual] axis lies inside the cone of radiation that encompasses that visible object, the form of that visible object will reach the surface of the *glacialis* along straight radial lines. From this surface forms then extend along straight, radial lines as well, until they reach the surface of the vitreous [humor]. Then, from this surface the [form of the] axial point will reach straight along the axial line until it reaches the place where the hollow of the nerve bends. Meantime, all the remaining points are refracted along lines that intersect the [original] radial lines, and they maintain the same arrangement until they reach the place where the hollow of the nerve bends. Thus, the form will arrive at this place arranged according to its order on the surface of the *glacialis* as well as its order on the surface of the visible object [itself]. However, the disposition of refracted forms is not like the disposition of forms that pass straight on, for refraction will necessarily change them in some way.²⁸ Therefore, it follows from this circumstance that the point extending straight along the [visual] axis to the place where the hollow of the nerve bends is more clearly perceived than all the [other] points of [such] forms.²⁹

[2.25] Also, the refraction of points reaching the surface of refraction nearer the axial point is less, and [that of those reaching it] farther [from that point] is greater, for refraction depends entirely upon the angles that are formed by the [radial] lines along which the forms arrive and the normals to the surface of refraction. And refraction of lines forming smaller angles with the normals will occur at smaller angles, whereas refraction of lines forming greater angles with the normals will occur at greater angles. But radial lines that are nearer the [visual] axis are less oblique to the surface of refraction, so they form smaller angles with the normals to

the surface of refraction. Those, on the other hand, that are farther from the [visual] axis are more oblique to the surface of refraction, so they form greater angles with the normals. And forms that suffer less refraction are clearer [to sight], whereas forms that suffer greater refraction are less so.³⁰ Thus, the point on the [visual] axis [whose form] reaches the place where the hollow of the nerve bends is more clear[ly seen] than all the rest of the points, and whatever point is nearer it is more clear[ly seen] than one lying farther from it.

[2.26] Now these forms are the ones that extend to the common nerve, and it is from these that the final sensor perceives the form of the visible object. And since this form arrives at the place where the hollow of the nerve bends with varying dispositions—i.e., in such a way that its axial point is clearer than all the remaining points and that whatever point lies nearer it is clearer than one farther from it—the form that reaches the common nerve [and] on the basis of which the sensitive faculty perceives the form of the visible object will vary in disposition. So the point on it that corresponds to the axial point on the surface of the visible object is clearer than all the other points of the form, and the nearer to it any point lies, the clearer it is.

[2.27] And when the dispositions of visible objects are examined, and when the way sight perceives [several] visible objects at the same time is determined along with how it perceives the parts of a single visible object, the results will be found to agree with what we have shown. For when a viewer faces several visible objects at the same time, and when his eye remains steady, and he does not shift it, he will find that the visible object directly along his central line-of-sight is clearer than those to the side of it, and [he will find] that what lies nearer his central line-of-sight will be clearer. By the same token, when the viewer looks at a large visible object, and his line-of-sight is aimed directly at the midpoint of that visible object and remains steady, he will perceive the middle of that visible object more clearly than he will the outer edges of that object. This will become eminently clear when several visible objects are adjacent to one another, and the viewer faces one of the objects that is in the midst of the rest, for in that case, if his focus remains steady, he will perceive that middle object with clarity; and along with that he will also perceive those that surround it, but not clearly. This is especially obvious when those visible objects occupy considerable space, for then there will be a significant difference between the perception of the middle object and the perception of the outer ones.

[2.28] Subsequently, if he shifts his viewpoint under these conditions so that he looks directly at an object other than the visible object he faced before, he will perceive this second object more clearly. The first one,

however, he will perceive more dimly. And if he faces the one at the end and focuses on it, he will perceive it more clearly than he did under the original condition because of its distance from his line-of-sight [at that time], and at the same time he will perceive the middle object more dimly, even though it is nearer to him. Moreover, there will be a significant difference [in clarity] between his perception of the middle object when he focuses on the object at the end and his perception of the middle object when he focuses on it.

[2.30] From this experiment it will therefore be clear that vision [taking place] through the center of the eye, along the [visual] axis as defined by us, is clearer than vision at the edge of the eye, along lines surrounding the [visual] axis. It has therefore been shown that vision [taking place] along the axis of the visual cone will be clearer than vision [taking place] along all [the other] radial lines and, moreover, that vision [taking place] along a line nearer the [visual] axis is clearer than [vision taking place] along a line that is farther [from the visual axis].

[CHAPTER 3]

[3.1] The sense of sight, in fact, perceives none of the visible properties unless they are embodied.³¹ Moreover, many inherent properties, as well as many accidental properties combine together in a body, and sight perceives many of the inherent and accidental properties possessed by bodies.³² Color is one of those properties that occur in bodies, and light as well, and the sense of sight perceives both of these in bodies. It also perceives other properties besides these two, e.g., shape, spatial disposition, size, motion, and other properties that we shall specify later.³³ It also perceives similarities and differences among colors, as well as similarities and differences among lights. So too, it perceives similarities among shapes, and spatial dispositions, and motions.

[3.2] Furthermore, these properties are not all perceived in the same way, nor is it through brute sensation that every one of them is perceived.³⁴ For, when the eye perceives two individuals at the same time, and when they are similar in structure, it will perceive [that they are] individuals, and it will perceive that they are similar. But the similarity of the two forms of the two individuals is neither the [two] forms themselves nor either one of them.

[3.3] But since sight perceives the individuals by means of forms coming to the eye from the two individuals, it therefore perceives the similarity of the two individuals on the basis of the similarity of the two forms reaching from the form [of each of those individuals]³⁵ to the eye. But the

similarity of the two forms is neither the forms themselves nor a third form pertaining to similarity.

[3.4] But yet the similarity of the two forms consists in their agreement in some respect. Therefore, the similarity of the two forms will only be perceived through a comparison of one to the other and from a perception of what it is in virtue of which they are similar. And since sight perceives similarity, but there is no third form in it by which it perceives similarity, sight cannot perceive the similarity of the two forms unless it compares one to the other.

[3.5] Likewise, sight perceives the difference between two different forms by a comparison of one to the other.³⁶

[3.7] And since that is the case, the visual sense does not perceive similarity and difference among forms through brute sensation but through a comparison of forms among each other.

[3.8] In addition, when sight perceives two colors of the same kind, but one of them is more vivid³⁷ than the other, e.g., myrtle-green and pistachio-green, it will perceive that they are green, but it will also perceive that one of them is of a more vivid green. So it will differentiate between two greens, and it will perceive their similarity in greenness as well as their difference in vividness or dullness.

[3.9] Nonetheless, differentiation between two greens is not the actual sensation of green, for the sensation of green arises from the [general] "greening" of sight as well as from the [specific] "greening" of sight by both greens, so it will perceive that they are of the same kind.³⁸ Therefore, the perception by sight that one green is more vivid than the other and [yet] that the two are of the same genus represents a differentiation of the coloring that occurs in sight, not the actual sensation of color.

[3.10] The same also holds when two colors are similar in vividness and are of the same kind, for sight perceives the two colors, and it perceives that they are of the same kind and that they are similar in vividness.

[3.11] And the same holds for the effect of light on sight, for sight perceives the light and differentiates between strong and weak light.

[3.12] Thus, the perception by sight of similarity and difference among colors, of similarity and difference in light, and of similarity in the outlines, shapes, and spatial dispositions of the forms of visible objects, as well as of differences among them, arises only from comparing them to one another, not from brute sensation.

[3.13] In addition, the sense of sight perceives the transparency of [completely] transparent bodies as well as the transparency of bodies that are not absolutely transparent, but it does not perceive such transparency through any other procedure than comparison. For transparent stones of

slight transparency are not perceived by sight to be transparent until after they are placed against the light; then the light will be perceived behind them, and it will [thereby] be perceived that they are transparent. Likewise, the transparency of no transparent body will be perceived by sight until after a body or light that lies behind it is perceived, and along with that it will be perceived through differentiation that what appears from behind is different from the transparent body [through which it appears].

[3.14] However, the perception that what lies behind the transparent body is different from that [transparent] body is not [arrived at] by brute sensation; rather, it is a perception [arrived at] by judgment.³⁹ And since transparency will only be perceived [indirectly], by implication, it will be perceived only through differentiation⁴⁰ and judgment.

[3.15] Writing, as well, will be deciphered only by [the reader's] discerning the forms of the letters, along with their combinations, and by comparing them to similar ones already known to the writer.⁴¹ And by the same token, when the way many visible characteristics are perceived is examined, it will be found that they are not perceived through brute sensation, but through judgment and differentiation.

[3.16] And since this is the case, not everything that is perceived by sight is perceived through brute sensation; instead, many visible characteristics will be perceived through judgment and differentiation in conjunction with the sensation of the form that is seen.

[3.17] However, sight does not possess the power to differentiate; the faculty of discrimination⁴² differentiates these properties. Nonetheless, the differentiation of these visible characteristics that is carried out by the faculty of discrimination cannot take place without the mediation of sight.

[3.18] Sight also perceives many things by means of recognition, so it recognizes that a human is a human, that a horse is a horse, and that Socrates is Socrates when it has seen the same thing before. And it recognizes familiar animals, trees, shrubs, and stones when it has seen them or their like before. Moreover, it recognizes all familiar characteristics⁴³ that are in visible objects.

[3.19] Sight perceives what kind of thing⁴⁴ a visible object is through recognition exclusively. But recognition is not perception by brute sensation, for sight does not recognize everything it has seen before. And when sight perceives some particular individual and is later removed from it for a long time, then sees that individual again but does not remember it, it does not recognize that individual, for it does not recognize what it knew before unless it remembers. Therefore, if recognition were perception by brute sensation, it would follow that, when sight saw some individual that it had seen before, it would immediately recognize it on seeing it again under all conditions, but such is not the case.

[3.20] And since recognition occurs only through remembering, recognition is not perception by brute sensation. Perception through recognition does, however, entail perceiving by some means of judgment, for recognition is the perception of similarity between two forms—i.e., of the form sight perceives at the moment of recognition and the form of that visible object, or its like, that it has perceived one or more times before. Accordingly, there will be no recognition without remembering, for if the original form is not present in memory, sight will not perceive the similarity of the two forms, and so it will not recognize the visible object.⁴⁵

[3.21] Recognition, moreover, entails recognition of the form of some individual object or of the form of its kind. Therefore, the recognition of an individual arises from the assimilation of the form of an individual at the time sight perceives that individual to another form that it has perceived before. Recognition of kind arises from an assimilation of the form of a visible object to other forms resembling it among individuals of its kind that it has perceived earlier.

[3.22] But perception of similarity entails judgment, for it only occurs by means of comparing one form to another. Therefore, recognition is merely a form of judgment; yet this form of judgment is distinct from other [forms of] judging, because, rather than involving an evaluation of all the characteristics of a form, recognition will occur through defining features.⁴⁶ Thus, when sight perceives a certain characteristic in a form and remembers an earlier form [with that characteristic], it will immediately recognize the form. But this is not the case with everything that is perceived through judgment, for various things that are perceived through judgment are perceived only after a scrutiny of all the characteristics they possess.

[3.23] For instance, at the very moment a writer sees the combination "ABCD," he will immediately grasp that it is "ABCD". Therefore, from his perception that "A" comes first and that "D" comes last, he will grasp that it is "ABCD". Likewise, if he sees "DOMINUS" written, he will immediately grasp it through recognition and habit. And the same holds for all words familiar to him; when the writer sees them, he will immediately grasp them without having to differentiate one from the other. But such is not the case when the writer sees an unfamiliar written word that he has not seen before, for the writer will not recognize this word until after he has differentiated its letters, and [only] afterwards will he recognize the word. Thus, when any form, or its like, that has not been seen before is perceived by sight, sight will not perceive what that form represents until after it has differentiated all or several of the characteristics of that form.

[3.24] On the other hand, a familiar form will be perceived immedi-

ately by sight through a perception of certain of the characteristics possessed by that form. Therefore, whatever is perceived through recognition will be perceived by means of a defining feature, but not everything that is perceived through judgment will be perceived by means of a defining feature. Still, several characteristics of visible objects are perceived only through recognition, and the perception of what kind of thing a given visible object is, or what kind of thing a given object perceived by another sense is, will occur only through recognition. And the faculty of recognition is allied with the faculty of sensation, so the perception of sensible characteristics is fully achieved only through recognition.

[3.25] However, recognition does not occur through brute sensation. Therefore, of [all] the characteristics that are perceived by visual sensation, some are perceived through brute sensation, some through recognition, and some through judgment and differentiation.

[3.26] Also, several of the visible characteristics that are perceived through judgment and differentiation are perceived in an extraordinarily short time, and it is not apparent that their perception involves judgment and differentiation because of the speed of the inferential process through which these characteristics are perceived. For shape, size, transparency, and similar characteristics that are possessed by visible objects are generally perceived by means of an extremely quick perception. But there is no perception at that time that their perception involves judgment. Since the perception of these characteristics does involve judgment, however, it is only because of the obviousness of their interrelationships and the faculty of discrimination's familiarity with such characteristics [that the process of judgment goes unnoticed by the perceiver]. Accordingly, as soon as this form reaches [the eye], sight perceives all the characteristics it possesses, and so they will be differentiated by it at the moment of perception.

[3.27] And the same applies to logical argument and all forms of reasoning when the premises are evident and general; the faculty of discrimination does not require much time to reach the conclusions entailed by them but, instead, will understand the conclusion immediately after grasping the premises.

[3.28] The reason is that the faculty of discrimination does not proceed by juxtaposing and ordering premises in the way that an argument based on terms does, for its conclusions will not be based on words or on the arrangement of premises.⁴⁷ The procedure followed by the faculty of discrimination is not like this, because the faculty of discrimination grasps the conclusion without needing words and without needing an arrangement of premises or an arrangement of words.

[3.29] For the arrangement of words in an argument is only one way

in which the faculty of discrimination reaches a conclusion, but to reach a perceptual conclusion the faculty of discrimination does not need [this particular] mode of reasoning or [this particular] arrangement of [premises leading to] a perceptual conclusion.

[3.30] Therefore, the visible properties that are perceived through judgment are generally perceived very quickly, and for the most part it does not seem as if their perception is arrived at through judgment. Even in the case of visible properties that are perceived through judgment and differentiation, since they are frequently perceived through judgment, and since the faculty of discrimination [already] knows these characteristics if it sees them later, it will perceive them through recognition without having to differentiate all the properties in objects seen later, and it will do so through defining features alone. Moreover, it will reach its conclusion by means of recognition without having to go through the steps of argumentation, as happens, for example, with the writer who sees an unfamiliar word for the first time.

[3.31] And the same holds for all deductions that are made through judgment when their premises are evident and their conclusions true; for when the soul⁴⁸ realizes that the conclusion is true and reaches that conclusion frequently afterward, the conclusion will be transformed into an evident premise. Thus, when the soul sees the premise, it will immediately reach the conclusion without having to go through the steps of argumentation.

[3.32] Moreover, several deductions whose truth the faculty of discrimination knows only through judgment are deemed to be first principles and are thought to be grasped naturally through pure understanding alone, not by means of judgment. For example, it is assumed that [the proposition] "the whole is greater than the part" will be judged naturally by the understanding to be true and that the perception of its truth does not involve judgment. But the fact that the whole is greater than the part will only be understood through judgment, for there is no way for the differentiating [faculty] to grasp that the whole is greater than its part without first knowing the meaning of "whole" and "part" and the meaning of "greater." For if it does not know the meaning of "parts," it will not know the meaning of "whole." But the meaning of "whole" is simply "totality," whereas to be a "part" means simply to be "something," and "greatness" is a relation [of something] to something else, so to be "greater" than something else means to be more than equal to it. So the test of whether every whole is greater than its part is whether the former is somehow equal to the latter yet exceeds it by some amount. From the conjunction of the meaning of "greater" with the meaning of "whole" in [terms of] additional amount, it becomes apparent that the whole is greater than

the part. And since the conclusion that the whole is greater than the part is reached only in this way, its realization occurs by judgment alone, not by natural understanding. So what occurs by nature in the understanding is merely the perception of the conjunction of the meaning of "whole" and the meaning of "greater" in [terms of] additional amount.⁴⁹

[3.33] Now the arrangement of this syllogism is as follows: (1) Every whole exceeds the part. (2) Everything that exceeds something else is greater than it. (3) Therefore, every whole is greater than its part. But the speed with which the faculty of discrimination reaches the conclusion is due only to the fact that the major premise is evident.⁵⁰ Nonetheless, the realization by the faculty of discrimination that the whole is greater than its part occurs through judgment, and since the major premise is obvious to it, it will realize the conclusion as soon as the specific minor premise occurs to it, and that specific premise involves the meaning of "whole" as exceeding the part. And since the truth of the conclusion of this syllogism is absolutely certain in the soul and exists in memory, when the proposition occurs to it, the understanding accepts it without having to go through the steps of argumentation, so it realizes it by means of recognition alone.

[3.34] Everything of this kind is called a "first principle" by mankind. And it is supposed that such will be grasped by pure understanding so that there is no need of anything but pure understanding to realize its truth.⁵¹ And the reason for this is that such propositions are grasped immediately.

[3.35] Therefore, syllogisms whose premises are universal and obvious are grasped in an imperceptible amount of time. Then, if the syllogism is frequently reiterated, the intellect will grasp it in such a way that the truth of its conclusion will be assimilated or certified in the soul, at which time the conclusion will become an evident premise.⁵² In this way the faculty of discrimination will grasp numerous deductions that are reached by means of judgment in an imperceptible amount of time without having to go through the steps of argumentation.

[3.36] Furthermore, how visible characteristics will be perceived by judgment and recognition is often not apparent, for their perception will occur very quickly, and the perception of how they are perceived will occur only through a second deductive process that follows the initial deductive process through which the visual perception was realized. However, the faculty of discrimination does not use this second deductive process at the time it perceives a given visible characteristic, nor does it discern how it perceives that characteristic, nor can it because of the speed with which it perceives characteristics by means of recognition and by deduction whose premises are evident and indubitable to the soul. For this reason it does not notice how it grasps the truth of various true

propositions that are perceived by means of recognition, and their truth is affirmed on the basis of a judgment made when they are realized. For when these propositions occur to the faculty of discrimination, it immediately judges that they are true by means of recognition, but at the point of recognition it does not investigate how that truth was verified before, nor does it investigate how it perceives that the propositions are true when they occur to it.

[3.37] Furthermore, the second deductive process through which the faculty of discrimination perceives how it perceives what it perceives is not a process that occurs terribly quickly; instead, it requires deliberation. For perceptions differ; some occur naturally to the understanding,⁵³ some occur through recognition, and some occur through deliberation and discernment. Therefore, the perception of how the perception occurs and that it is of such-and-such a kind is reached only through a deductive procedure and a differentiation that is not swift. Accordingly, at the instant of perception, how the visible properties perceived through judgment are [themselves] perceived is usually not evident.

[3.38] Moreover, man is inherently apt to differentiate and deduce without difficulty or effort, and he does not perceive that he is deducing unless he deduces with difficulty. For when he does not exert effort and thought, he does not perceive that he is engaged in deduction. Therefore, customary deductions whose premises are evident and that do not demand effort are natural to man, and because of this he does not perceive that, when he is grasping such conclusions, he is grasping them through deduction. Evidence that man is inherently apt to deduce and that he engages in deduction without perceiving that he is deducing is found in children at an early stage in their growth. For a child grasps many things that a grown man discerns, and he uses many procedures for differentiation. For instance, when two things of the same kind, such as two fruits, are shown to a child, and when one is more attractive than the other, he will accept the more attractive one and reject the other. But the choice of the more attractive object is based exclusively upon a comparison of one to the other. So the child's perception that the attractive one is attractive and that the ugly one is ugly—and, likewise, his choosing the more attractive over the less attractive one—indicates that he chooses it only after comparing one to the other, perceiving the form of each of them, and perceiving by deduction the attractiveness of the more over the less attractive one. But the choice of the more attractive is based entirely upon a major premise that asserts that what is more attractive is better, and what is better is more worthy of being chosen. The child therefore uses this premise, but he does not perceive that he is using it.

[3.39] And since this is the case, the child deduces and differentiates.

But there is no doubt that the child does not know what a deduction is and does not perceive whether he is deducing or not when he does. Moreover, if one were to try to teach him what deduction is, he would not understand. Yet, since the child does deduce yet has no idea what a deduction is, it follows that the human soul is inherently apt to engage in deduction without difficulty or effort, yet when a man perceives that something is of such-and-such a kind, he does not perceive that he achieves this perception through deduction. It is only obvious conclusions whose premises are exceedingly obvious that are drawn through judgment, though; when conclusions whose premises are not particularly obvious and which entail difficulty are drawn by a man, he may well perceive that he makes them through judgment when they really are a matter of differentiation.

[3.40] From everything we have said, then, it has been shown that some characteristics that are perceived by sight are perceived through brute sensation, others through recognition, and others yet through differentiation, deduction, judgment, and syllogism; and [it has also been shown] that the manner in which particular characteristics are perceived by sight is usually not evident because of the speed with which it perceives through recognition, and because of the speed with which it grasps visible properties through deduction, and also because the faculty of discrimination is inherently apt to deduce without effort or difficulty, doing so instead naturally and customarily.

[3.41] Furthermore, that faculty does not need to go through the deductive steps to perceive any of the particular characteristics that are frequently seen.

[3.42] Moreover, characteristics that are frequently seen and are perceived through judgment and differentiation exist in the soul in such a way that mankind does not perceive that they are ensconced there;⁵⁴ nor does their being ensconced there have a perceptible beginning, for it is from childhood that man perceives visible objects, and it is from childhood that some differentiation occurs in him, especially the differentiation through which sensible distinctions are perceived. Thus, he perceives sensible characteristics by judgment and differentiation and gains a knowledge of sensible characteristics, and these sensible characteristics are continually presented to him until they are ensconced in his soul in such a way that he does not even perceive their being ensconced. Hence, when a particular characteristic that is [already] ensconced in his soul is presented to him, he will perceive it through recognition the moment it is presented. But in the process he does not perceive how he perceives it, or how he recognizes it, or how the knowledge of that characteristic has come to be ensconced in his soul. Accordingly, all of the particular characteris-

tics that are perceived through judgment and differentiation and that are frequently re-presented [to him] have already been grasped by man at an earlier time and have become ensconced in the soul so that a universal form of some particular property is created and ensconced in the soul.⁵⁵ As a result, such properties are perceived without [the soul's] having to go through the deductive steps it went through initially, and without having to undergo the process of judging through which the veracity of that characteristic is grasped,⁵⁶ and without perceiving how the perception of that property arises when it arises, and without perceiving how recognition occurs at the moment of perception. So there is no lingering need to retrace the steps of deduction except in the case of particular characteristics possessed by particular individuals, such as the shape of a particular thing (i.e., in an individuated object), or the spatial disposition of an individual visible object, or the size of an individual visible object, or a comparison of the color of one individual visible object with the color of another visible object, and the like. In these ways the perception of all particular properties of visible objects will take place.

[3.43] And now that all of these points have been explained, we shall begin to explain how each of the particular visible properties is perceived by sight and the kinds of deductive processes the faculty of discrimination employs in grasping the properties perceived by the sense of sight.

[3.44] The particular properties that are perceived by sight are numerous, but they are generally reduced to twenty-two, namely: *light, color, distance,*⁵⁷ *spatial disposition,*⁵⁸ *corporeity,*⁵⁹ *shape, size, continuity, discontinuity* or *separation, number, motion, rest, roughness, smoothness, transparency;* likewise: *opacity, shadow, darkness, beauty, ugliness, similarity, and difference* among all particular characteristics as well as among all the forms composed of particular characteristics. These, then, are all of the things that are perceived by the sense of sight. If there is any visible characteristic besides these, it will be subsumed under one of them: e.g., arrangement, which will be subsumed under spatial disposition; writing and drawing, which are subsumed under shape and arrangement; straightness, curvature, concavity, and convexity, which are subsumed under shape; multitude and dearth, which are subsumed under number; equality and excess, which are subsumed under similarity and difference; joy, laughter, and sadness, which are included in the shape of the face (and are therefore subsumed under shape); weeping, which is included in the shape of the face along with the streaming of tears (so it is subsumed under shape and motion); moistness and dryness, which are subsumed under motion and rest, for moistness is perceived by the sense of sight only from the fluidity of the moist body and from the motion of one of its parts with respect to another, whereas dryness is perceived by sight only through

the rigidity of the parts of the dry body as well as through the lack of motion in fluidity. And likewise, every particular property perceived by sight is subsumed under the headings that we described earlier, and all of the visible properties are as we have claimed above.⁶⁰

[3.45] This being the case, moreover, the differentiation and deduction carried out by the faculty of discrimination, as well as the recognition of forms and their defining features, will occur only through the faculty of discrimination's differentiation of the forms reaching into the hollow of the common nerve when the final sensor perceives them and through recognition of the defining features of those forms.

[3.46] Furthermore, the sensitive body reaching from the surface of the sensitive organ to the hollow of the common nerve—i.e., the visual spirit—is sensitive throughout, for the sensitive power extends through the whole of this body. Therefore, when the form reaches from the surface of the sensitive organ to the hollow of the common nerve, every part of the sensitive body will sense the form. And when the form arrives at the hollow of the common nerve, it will be perceived by the final sensor, and at that time differentiation and deduction will take place. Thus, the sensitive power senses the form of the visible object throughout the entire sensitive body that extends from the surface of the sensitive organ to the hollow of the common nerve, and the faculty of discrimination discerns the properties that the form possesses at the moment the final sensor perceives the form. This, then, is the way in which the forms of visible objects will be perceived by the sensitive power, as well as by the final sensor and the faculty of discrimination.⁶¹ On this basis, moreover, it will be shown that the sensitive power senses the place on the sensitive organ where the form reaches, for it only senses the form according to the place where the form arrives.

[3.47] It has also been shown in the preceding chapter that a form extends from any given point on the surface of the *glacialis* along a single, continuous line, following whatever bends or curves are in it, until it reaches a single point at the place where the form enters the hollow of the common nerve.⁶² And since that is the case, the form arriving at an area on the surface of the *glacialis* extends from there to another area in the hollow of the common nerve. Moreover, the form of each of the different visible objects that are perceived together at the same time extends to a specific place in the hollow of the common nerve, and the forms of all of those visible objects reach the hollow of the common nerve, and the relative arrangement of those forms in the hollow of the common nerve will be the same as the relative arrangement of the visible objects themselves.⁶³ Thus, when the eye faces some visible object, the form of the light and color on that visible object reaches the surface of the eye and the surface

of the *glacialis*, and it extends along the determinate paths that we described [earlier], preserving its proper arrangement, shape, and structure until it reaches the hollow of the common nerve. And it will be perceived by the sensitive power when it arrives at the body of the *glacialis* to pass through the whole of the sensitive body. Then, when it reaches the hollow of the common nerve, it is perceived by the final sensor, and the faculty of discrimination differentiates all the [visible] properties it possesses. But the form of color and the form of light reach the hollow of the nerve only because the sensitive body that pervades the hollow of the nerve is colored by the form of light and color and is illuminated by the form of light. So the form reaches the hollow of the common nerve, and the portion of the sensitive body that is in the hollow of the common nerve where the form of the visible object extends will be colored by the color of that visible object and illuminated by the light that is in that visible object. And if the visible object possesses one color, that portion of the sensitive body will be of one color, whereas if the parts of the visible object are of different colors, the parts of that portion of the sensitive body in the hollow of the common nerve will be of different colors. The final sensor, moreover, perceives the color of the visible object from the coloring that it encounters in that portion [of the sensitive body], and it perceives the light of the visible object from the illumination it encounters in that [same] portion. Meanwhile, the faculty of discrimination perceives various particular properties that are in the visible object by discerning the properties that are in that form at that spot—i.e., from the arrangement of the parts of the form, from the configuration of what surrounds that form, from the configuration of that form's parts, from the different colors, spatial dispositions, and arrangements of the parts of that form, and from their similarity and difference.⁶⁴

[3.48] Furthermore, the light reaching from the colored visible object to the eye does not arrive on its own without color, nor does the form of the color reaching from the colored visible object to the eye arrive on its own without light, so the form of the light and color in the visible object arrives only as a mixture, and the final sensor perceives such forms only as mixtures. Notwithstanding this fact, the [final] sensor perceives the illuminated visible object and perceives that the light appearing in the visible object is distinct from the color, and this perception constitutes differentiation. [The capacity of] differentiation, however, belongs to the faculty of discrimination alone, not to the sensitive faculty. Yet when it is perceived by the discriminative faculty, this property becomes ensconced in the soul, so there is no need for repeating the deductive steps when every [such form] reaches it [afterward]; instead it remains ensconced in the soul. The faculty of discrimination's perception that the light in the

object is distinct from the color in it, as well as its perception that the accidental light in the colored visible object is distinct from the color in it, is due to the fact that the light shining on any given visible object can vary, sometimes increasing and sometimes decreasing. Yet, despite these variations, its color remains the same; even though the brightness of the color may vary according to the variation in light, the color does not vary in kind. Moreover, accidental light may shine on a visible object through an aperture, but when that aperture is blocked, that visible object will be darkened. Hence, from the faculty of discrimination's perception of the variation in light shining on visible objects, and from its perception of the visible object's being illuminated at times and lacking light at others, it perceives that the colors possessed by visible objects are distinct from the light that shines on them. Therefore, the form of the colored visible object that the sensitive faculty perceives is a form mixed from the form of the light and color that are in the visible object, and the faculty of discrimination perceives that the color that is in it is distinct from the light that is in it. But this perception takes place according to recognition at the moment the form reaches the [final] sensor, for already ensconced in the soul is the notion that the light in every form that is a mixture of light and color is distinct from the color in that form.⁶⁵

[Perception of Light and Color]

[3.49] Among the properties belonging to the form, the first one that the faculty of discrimination perceives is the kind of color [it possesses]. But what kind of color [the form possesses] will be perceived by the faculty of discrimination only through recognition, if the color of the visible object is among those colors familiar to it, so the faculty of discrimination's perception of what kind of color [the form possesses], which occurs through recognition, arises exclusively from a comparison of the form of its color to forms that it has perceived before, that is, from forms resembling [the form of] that color.⁶⁶ For, when it perceives a red color and perceives that it is red, sight will not perceive that it is red unless it recognizes it, and this recognition is due only to an assimilation⁶⁷ of it to things it has perceived before. If, however, sight had never perceived a red color until this time, it would not know that the red it perceives is red. Thus, when the color is one of the familiar colors, it will be known to sight through recognition, but if it is among colors that are unfamiliar to it, such that sight has never perceived such a color before, it will not be perceived by sight so as to be recognized by it; rather sight will assimilate it to colors that are near it, ones that it has already apprehended. Thus, brute sensation provides the basis for perceiving a color; then, when [that

color] is transmitted to the eye over and over again, it will be perceived through recognition, specifically, of what kind of color it is.

[3.50] What kind of light [is being seen] will also be perceived by sight through recognition alone, for sight recognizes sunlight and differentiates it from moonlight and firelight, and thus it recognizes moonlight and firelight. Therefore, the perception by sight of what kind of light each of these is occurs only through recognition.

[3.52] Everything perceived by the sense of sight after light and color will therefore not be perceived through brute sensation but will be perceived through differentiation and deduction along with sensation. For everything that is perceived through differentiation and deduction will be perceived only by distinguishing the properties possessed by the sensible form, and likewise, everything that is perceived through recognition is perceived solely through a perception of the defining features conveyed by the sensible form. But the properties perceived through differentiation, deduction, and recognition are only perceived with the sensation of the form. The light in an intrinsically luminous body, however, is perceived by sight on its own, as it actually exists, on the basis of the sensation itself; and the light and color in a colored body illuminated by accidental light are perceived by sight mixed together, and [they are thus perceived] through brute sensation. Therefore, essential light is perceived by the sensitive faculty from the illumination of the sensitive body, and color is perceived by the sensitive faculty from an alteration and a coloring that occurs in the sensitive body. And along with this sort of perception of light by the sensitive body on the basis of accidental light mixed with that color, the sensitive faculty thus perceives the colored light of the body when the form of color reaches it, but it only perceives its light when the form of essential light reaches it.⁶⁸ So these are the only two visible properties that are perceived by sight through brute sensation.

[3.53] We shall say, further, that the perception of color, insofar as it is color, precedes the perception of what kind of color it is: that is, sight perceives color and senses that it is color before it senses what kind of color it is. For as soon as the form reaches the eye, the eye is colored, and when the eye is colored, it senses that it is colored, and thus it senses the color [itself]. Then, by differentiating the color and comparing it to colors already known to sight, it perceives what kind of color it is. Therefore, the perception of color, insofar as it is color, will occur before the perception of what kind of color it is, and the perception of what kind of color it is will occur through recognition. Evidence that sight perceives color, insofar as it is color, before it perceives what kind of color it is [can be found] in the fact that, when visible objects whose colors are strong—e.g., deep green, brown, and the like—are in a location that is not too dark,

those colors are only perceived by sight in that location as color [in the generic sense].⁶⁹ Still, it senses that they are colors, but it does not discern what kind of colors they are at the beginning of perception. When the location is not too dark, however, and when sight scrutinizes [the colors] closely, it will perceive what kind of colors they are, or [it will do so] if the light increases and intensifies in that location. From this experiment it will therefore be clear that sight perceives color, insofar as it is color, before it perceives what kind of color it is.

[3.54] What sight perceives about color at the very moment it reaches the eye is its coloring-effect, and coloring is a sort of darkening or shading when the color is subtle. And if the visible object is of various colors, sight will first perceive the gradations in darkness of the various parts of the form of that visible object, or [it will perceive them] as various gradations of shadow. So the first thing that sight perceives from the form of color is a change in the sensitive organ and a coloring in it that consists of darkness or something resembling darkness. Then the sensitive faculty will differentiate that coloring. And if the visible object is illuminated, that color will be differentiated by sight, and what kind of color it is will be perceived when it belongs to the set of colors that sight has frequently perceived. Moreover, if it is one of the colors that sight has almost constantly perceived, [what kind of color it is] will be perceived in minimal time, so that there is no perceptible time between the instant when the color is recognized and the instant when it was first perceived as mere color. However, if it belongs to the set of colors that are not clear and that have only been perceived rarely by sight, or if the color lies in a dark, dimly lit place, what kind of color it is will be perceived by sight only after a perceptible interval of time. Furthermore, if the visible object is dark, so that there is only a little illumination in it, as is the case with what is perceived at night or in places that are extremely dark, only its darkness will be discerned by the sensitive faculty. From the perception of colors in dark places, therefore, it is clear that the perception of color, insofar as it is color, precedes the perception of what kind of color it is.

[3.55] A further indication that sight perceives color, insofar as it is color, before it perceives what kind of color it is can be found in the fact that, when sight perceives an unfamiliar color that it has never seen before, it will perceive that it is a color, yet it will nonetheless have no idea of what kind of color it is. But when it scrutinizes that color closely, sight will assimilate it to the nearest color resembling it.

[3.56] From these experiments, then, it is eminently clear that the perception of color, insofar as it is color, will precede the perception of what kind of color it is. And it has also been shown on the basis of these experiments that the perception of what kind of color it is will be based only on

differentiation. Hence, what sight perceives through brute sensation is only [the fact of] color, insofar as it is color, as well as [the fact of] light, insofar as it is light, but other than this brute sensation perceives nothing without differentiation, deduction, and recognition.

[3.57] We should also point out that the perception of what kind of color it is invariably takes time, for the perception of what kind of color it is occurs only through differentiation and assimilation. But differentiation can only occur over time; therefore, the perception of what kind of color it is invariably takes time. There is clear evidence, moreover, that the perception of what kind of color it is invariably takes time in what is seen to happen in the motion of a top,⁷⁰ for if lines of various colors are painted on the outer surface of that top so as to extend from its center, on the side of its axle, to its outer edge, then, when the top is spun vigorously while one looks at it, he will perceive all of its colors as a single color different from all the colors on it, that color appearing to be composed of all the colors of those lines. So he will not perceive the lines or the differences among the colors.⁷¹ Moreover, while this is going on, he will perceive the top to be still when its spin is extremely swift, for none of its points remains fixed in the same spot for any perceptible time, but instead every point spins through the entire circumference along which it revolves in minimal time. Accordingly, the form of the point radiates to the eye to [delineate] the circumference of a circle on [the surface of] the eye, so, in the minimal time [of the top's rotation] sight only perceives the color of that point according to the entire circumference of the circle as it is configured in the eye. Hence, in [this] minimal time, sight perceives the color of that point according to its entire path of revolution. And the same holds for all of the points on the surface of the top; sight perceives the color of each of them according to the entire circumference of the circle along which that point moves in minimal time, and every point lying the same distance from the center moves along the same circular circumference as the top spins. On this account, then, it happens that the color of every point among those that are equidistant from the center will appear on the circumference of the same circle during the minimal time that one revolution takes, so the colors of all the points on the entire circumference of that circle will appear mixed. Accordingly, the color of the surface of the top is perceived as a single color mixed from all of the colors that are on its surface.

[3.58] Thus, if sight were to perceive what kind of color it is in an instant, and if it needed no time to arrive at the perception of what kind of color it is, then at any given instant of the top's rotation it would perceive individually what kind of color all of the colors on the top are while it was moving. For if it needs no time to perceive what kinds of colors they are,

then, in a portion of the time of revolution and at any instant during the time of revolution as the top spins, sight will perceive those colors in the same way that it will perceive what kinds of colors they are when they are motionless, for all the colors of familiar visible objects remain the same in kind whether they are in motion or at rest. At any instant, therefore, that the visible object moves, its color does not change. But since sight does not perceive what kinds of colors are on the surface of the top when the top spins vigorously, and since it does perceive what kind of colors they are when the top is immobile or spins slowly, then, that being the case, sight does not perceive what hue a given color is unless it remains fixed in the same spot for a perceptible amount of time, or unless it takes a perceptible amount of time to move a distance that is not so untoward as to distort the spatial relationship between that [spot of] color and the eye.⁷²

[3.59] It will therefore be obvious from this case that the perception of what kind of color it is will invariably take time, and it will be obvious from this case that the perception of what kinds of things all visible objects are will invariably take time. For, since sight requires time to perceive what kind of color it is that it perceives through brute sensation, it requires all the more time to perceive the visible properties that are grasped through differentiation and deduction.⁷³ Therefore, the perception of what kinds of things visible objects are, as well as perception through recognition and perception through differentiation and deduction, will invariably take time, but more often than not it will take minimal time.

[3.60] We shall also point out that color, insofar as it is color, and light, insofar as it is light, will invariably take time to be perceived, i.e., that the instant when color will be perceived as color, insofar as it is color, and when light will be perceived as light, insofar as it is light, is different from the instant when the air transmitting the form makes initial contact with the surface of the eye. For color, insofar as it is color, and light, insofar as it is light, are only perceived by the sensitive faculty after the form arrives in the sensitive body, and they are not perceived by the final sensor until after the form reaches the hollow of the common nerve. But the way the form reaches the hollow of the common nerve is just the same as the way light extends from apertures through which it passes to bodies facing those apertures,⁷⁴ and light invariably takes time to pass from an aperture to a body facing the aperture, even though the time-interval is imperceptible. For there is only one of two ways in which light can extend from an aperture to a body facing the aperture: either the light will reach a portion of the air abutting on the aperture before it reaches a subsequent portion, after which it will pass to that portion, then on to another until it reaches the body that faces the aperture; or else the light will reach through the whole of the air between the aperture and the body facing the aperture,

and it will reach that same body facing the aperture, all at the same instant. If the air receives the light in successive intervals, then light can only reach the body facing the aperture by moving, but motion will only occur in time. On the other hand, if the air as a whole receives the light all at once, the light's reaching the air after it was not there will happen only in time, even though it may be imperceptible. For when the aperture through which the light enters is blocked, and then the obstruction is removed, the instant when the obstruction is removed from the first portion of the aperture and when the air in the aperture on the side of the light is exposed is different from the instant when the light reaches the air contiguous with that portion inside the aperture and continuous with that air at all times. For light does not reach any portion of the air inside the aperture when it is blocked from light until after some portion of the aperture is exposed to the light, but no portion of the aperture is exposed in less than an instant. An instant is indivisible, though. Hence, no light reaches the inside of the aperture at the instant when that portion of the aperture is exposed, for the portion of the aperture that is exposed in an instant is not exposed in successive intervals, nor is that portion of the aperture that is exposed in a single instant a quantifiable portion. For only a point, which lacks dimension, or a line, which lacks breadth, is exposed in an instant, because it is only by being uncovered in successive intervals—and therefore by being moved—that an obstruction possessing length and breadth will be removed. Motion, however, will only occur in time, and the portion of the aperture that is exposed in a single instant lacks breadth.

[3.61] Thus, it consists of a point or a line, but neither a point, which lacks dimension, nor a line, which lacks breadth, constitutes a [quantifiable] portion of air. Therefore, a point, which lacks dimension, or a line, which lacks breadth, constitutes the point of the aperture that is exposed in an instant, and it represents nothing but the limit of some portion of the air inside the aperture, not an [actual] portion of the air. So a point, which lacks dimension, does not receive light, nor does a line, which lacks breadth, for only a body receives light. And since this is the case, none of the light reaches the air inside the aperture at the very instant the initial portion of the aperture is opened. Thus, the instant, or point in time, at which the light reaches the air inside the aperture, or a portion of that air, is different from the instant at which the initial portion of the aperture is opened. And between each of these two instants there is [an interval of] time. Therefore, light passes from the air outside the aperture to the air inside the aperture only over time, but this time is absolutely imperceptible because of the speed with which air receives the forms of light.⁷⁵

[3.62] Likewise, when the eye faces a visible object after having not

faced it, and when the air transmitting the form of the visible object makes contact with the surface of the eye after not having touched it, the form will pass from the air transmitting the form to the interior of the hollow of the common nerve only over time.⁷⁶ But the sense lacks a means of perceiving this time because it is so short and because the sense lacks adequate precision, being too weak to perceive whatever is exceptionally small. Thus, with respect to the sense, this time-interval amounts to an instant.

[3.63] In addition, the sensitive organ does not sense the forms reaching it until it undergoes their effect. Therefore, it does not sense color, insofar as it is color, or light, insofar as it is light, until after it has undergone the effect of the form of light and color. But the effect of the form of color and the form of light on the sensitive organ constitutes something of an alteration, and alteration only occurs over time. Therefore, sight does not perceive color, insofar as it is color, or light, insofar as it is light, except over time. Moreover, during the time that the form reaches from the surface of the sensitive organ to the hollow of the common nerve, the sensitive power that pervades the entire sensitive body will perceive the color, insofar as it is color, and the light, insofar as it is light, and when the form reaches the hollow of the common nerve, the final sensor will perceive the color, insofar as it is color, and the light, insofar as it is light. Hence, the perception of color, insofar as it is color, and light, insofar as it is light, occurs at a time following the time when the form reaches from the surface of the sensitive organ to the hollow of the common nerve.⁷⁷

[3.64] Furthermore, the first instant at which the form reaches the surface of the eye is different from the first instant at which the air transmitting the form makes contact with the first point on the surface of the eye when the eye faces a visible object after having not faced it or after the eyelids are opened after having been closed. For when this happens, the first point on the surface of the eye touched by the air transmitting the form of that visible object forms a single point or a line, which lacks breadth; then [it continues] bit-by-bit until the air transmitting the form touches the [whole] area on the surface of the eye where the form reaches. But when a point, which lacks dimension, or a line, which lacks breadth, makes contact on the surface of the eye with a point, which lacks dimension, or a line, which lacks breadth, on the surface of the air transmitting the form, none of the form of light and color reaches the surface of the eye, because the smallest portion of the surface to which light or the form of color can reach will be nothing but a surface [itself]. Therefore, at the instant the first point of the air transmitting the form makes contact with a point on the surface of the eye, none of the form reaches the surface of the eye. Therefore, when the eye faces the visible object or the eyelids are opened

after having been closed, the first instant at which the form reaches the surface of the eye is different from the first instant at which the air transmitting the form makes contact with the surface of the eye.

[3.65] Since this is the case, the form of light or color does not reach any portion of the sensitive organ or of the surface of the eye except over time. Therefore, the sensitive faculty does not perceive color, insofar as it is color, or light, insofar as it is light, except over time; that is, the instant at which the sensation of color, insofar as it is color, and light, insofar as it is light, occurs is different from the first instant at which the air transmitting the form makes contact with the surface of the eye.

[3.66] From everything we have said, then, it is evident how sight perceives light, insofar as it is light, how it perceives color, insofar as it is color, how it perceives what kind of color or light it is, and how it perceives the quality of light.⁷⁸

[Perception of Distance]

[3.67] Now the distance of a visible object from the eye will not be perceived by sight through brute sensation, nor is the perception of the distance of the visible object a perception of the object's location, nor is the perception of the visible object in its location due solely to the perception of its distance, nor is the perception of the visible object's location due solely to a perception of its distance. For the location of the visible object depends upon three things, namely, distance, direction, and the magnitude of the distance.

[3.68] Hence, the magnitude of the distance is different from the fact of distance, insofar as it is distance, because distance [*per se*] means an absence of contact between two bodies, and an absence of contact means that there is some space between those two bodies. The magnitude of the distance, on the other hand, is the extent of that space. The fact of distance, insofar as it is distance, is thus a matter of spatial disposition; so it is not the magnitude of the distance. Accordingly, perception of the fact of distance [*per se*], which is an absence of contact, is different from perception of the extent of the spatial separation, which is the measure of the distance.⁷⁹

[3.69] Now the perception of the magnitude of a distance follows from the perception of magnitude, whereas the perception of the visible object's distance and the perception of its direction both follow from a perception of the spatial disposition of its location. Furthermore, the way in which either of these is perceived is different from the way in which the other is perceived, for the absence of contact is different from direction. Thus, the perception of a visible object's location is not [the same as] the perception

of a visible object's distance.

[3.70] The perception of a visible object in its place consists in the perception of five things: namely, perception of the light that is in it, perception of its color, perception of its distance, perception of its direction, and perception of the magnitude of its distance. None of these, moreover, is perceived by itself, nor is any one of them perceived after another; instead, all of them are perceived together, because they are perceived through recognition rather than through a process of deduction.

[3.71] On the basis of the perception of a visible object in its place, the proponents of [visual] rays have supposed that vision will take place through rays that are emitted from the eye and extend out to the visible object, so that vision will occur at the endpoint of the ray. And they have argued against the natural philosophers⁸⁰ by asking [the following question]: If vision occurs by means of a form reaching from the visible object to the eye, and if that form arrives inside the eye, then how is the visible object perceived in its place outside the eye when its form is now extended into the eye? But these theorists have failed to realize that vision is not achieved through brute sensation alone, but that vision is only fully realized through differentiation or previous knowledge, so, if there were no previous knowledge or differentiation, vision would not be realized in the eye, nor would sight perceive what the visible object is when it is seen. For what a visible object is is perceived not through brute sensation but through differentiation, recognition, or a process of deduction that occurs when seeing takes place. Therefore, if vision were a matter of brute sensation alone, and if all the properties of visible objects that are perceived [by sight] were perceived through brute sensation alone, the visible object would not be perceived in its place until after something extended out to it to make contact with it and feel it. However, since vision is not achieved through brute sensation, but through differentiation, deduction, and recognition, there is no need for the sensitive agent to reach out to the visible object in order to perceive it in its place.⁸¹

[3.72] So let us return to our discussion of how visual perception occurs, and let us say that the distance of a visible object is perceived, as such, only through differentiation. In addition, the [resulting] notion is one of those notions that becomes ensconced in the soul over time in such a way that the fact that it is ensconced there is not perceived by the soul because of the extraordinary frequency with which it recurs to the faculty of discrimination; thus, there is no need for that faculty to repeat the process of perceptual deduction when it perceives each visible object. Nor at the moment of perceiving each visible object does the faculty of discrimination analyze how the notion of a visible object's distance has come to be ensconced in it, for it does not discern how it perceives each visible object

when it perceives it. But it perceives distance only in conjunction with other properties possessed by the visible object, and, when it perceives the visible object, it perceives that property by means of previous knowledge.

[3.73] How the faculty of discrimination perceives distance through differentiation is as follows. When the eye faces a visible object after having not faced it, it perceives the visible object, but when it is removed from its facing position, the perception will disappear. Likewise, when the eyelids are opened after having been closed, and when the eye faces some visible object, it will perceive that visible object, but when the eyelids are closed, the perception will disappear. Now it is intuitively obvious that what affects the eye in a given situation but disappears when it is removed is not fixed in the eye, nor is what creates the effect in the eye. It is also intuitively obvious that what appears when the eyelids are opened and disappears when they are closed is not fixed in the eye, nor does the thing creating this effect lie within the eye. Now when the faculty of discrimination perceives that the effect occurring in the eye, which provides the basis for its perception of the visible object, is not something fixed within the eye, nor is the thing creating that effect within the eye, then it immediately perceives that what occurs in the eye comes from outside, so the thing creating the effect lies outside the eye. Moreover, since vision ceases as soon as the eyelids are closed or as soon as the eye is removed from a facing position yet returns as soon as the eyelids are opened or the eye is restored to a facing position, the faculty of discrimination perceives that what is seen in the eye is not placed directly upon the eye. And when the faculty of discrimination perceives that what is seen neither lies within the eye nor is placed directly upon the eye, it immediately perceives that there is distance between that thing and the eye. For it is intuitively obvious, or at least nearly so, to the faculty of discrimination, that, if something is not actually in a body or placed directly upon it, there must be distance between them, and this is how the distance of a visible object, insofar as it is distance, is perceived.

[3.74] However, in perceiving the distance of a visible object, the faculty of discrimination does not need to go through the analytic procedure we detailed, for we have done this only for the sake of illustration. Rather, the faculty of discrimination reaches its perceptual conclusion as soon as sight occurs without relying on such an analytic procedure. Therefore, from the perception of the visible object when the eye faces it or when the eyelids are opened, and from its disappearance when the facing position is changed or when the eyelids are closed, the faculty of discrimination perceives that the visible object lies outside the eye rather than being placed directly upon it. And this is how the faculty of discrimination perceives

that there is distance between the eye and the visible object. Then, given the frequent recurrence of this notion, i.e., that all visible objects lie outside the eye and that there is distance between every visible object and the eye, it becomes ensconced in the soul in such a way that the soul does not perceive that it has become ensconced there or how it has become ensconced there. Thus, to perceive the distance of a visible object from the eye requires some differentiation, namely, for the faculty of discrimination to perceive that vision is due to something that operates from outside the eye. And, in addition, when this notion becomes ensconced in the soul, the faculty of discrimination will realize that every visible object that is perceived by sight lies outside the eye and that there is some distance between that object and the eye.⁸²

[3.75] As we claimed above, moreover, distance is only perceived in conjunction with other properties. But how distance will be perceived in conjunction with spatial disposition and how the visible object will be perceived in its place will be explained in our discussion of how spatial disposition is perceived.⁸³

[3.76] The perception of the magnitude of a distance from the eye varies, for some distances are perceived by the sense of sight, and their magnitudes are accurately determined, but others are perceived without having their magnitudes accurately determined.⁸⁴ That a visible object is distant from the eye is perceived for every visible object, and it is grasped with certainty for every visible object. However, the magnitude of the distance is not accurately determined by sight for every visible object, for between some visible objects and the eye there are objects arranged in successive, continuous order, whereas between other visible objects and the eye there are no objects arranged in successive, continuous order, so their distances are not spanned by a continuous, ordered range of bodies. Thus, when sight perceives a continuous, ordered range of bodies, i.e., of visible objects, that spans a given distance, it will perceive the sizes of those bodies. And when it perceives the sizes of those bodies, it will perceive the sizes of the spaces that lie between their extremities. Now the space that lies between the two extremities of a visible body that spans the distance between the eye and a visible object, one of those extremities lying on the side of the visible object, the other on the side of the viewer, represents the distance of the visible object from the eye, for it corresponds to the space between the eye and the visible object.⁸⁵ Thus, when sight perceives the measure of this space, it will perceive the measure of the visible object's distance. Therefore, sight perceives the magnitude of the distances of visible objects whose distance is spanned by a continuous, ordered range of bodies by perceiving the measures of the bodies ranged in order along those distances.

[3.77] Now the distance of some of these visible objects is moderate, whereas the distance of others is inordinate.⁸⁶ Therefore, the distance of visible objects that lie at a moderate distance is perceived by sight according to a correct and definite perception, because, when visible objects lie at a moderate distance, and there is a continuous, ordered range of bodies between them and the eye, these objects are perceived by sight correctly. And if sight perceives these visible objects correctly, it will correctly perceive the bodies ranged in order between itself and them. Moreover, if sight perceives these bodies correctly, it will perceive the spaces between their extremities correctly. Finally, if it perceives those spaces correctly, it will perceive correctly and with precision the measures of the distances of the visible bodies ranged along those spaces. Therefore, when the distance of visible objects from the eye is spanned by a continuous, ordered range of bodies, and when that distance is moderate, sight perceives the measure of their distances correctly and precisely—which is to say with as much precision as sense can achieve in perception.⁸⁷

[3.78] On the other hand, when visible objects lie at inordinate distances and those distances are spanned by a continuous, ordered range of bodies, even though the bodies along that range are perceived by sight, the measures of the distances of the visible objects will not be perceived correctly and precisely by sight, because visible objects whose distance is untoward are not correctly perceived by sight.⁸⁸ And when there are bodies arranged in continuous, successive order between the eye and those visible objects, not all of those [intervening] visible bodies will be correctly perceived by sight because of the excessive distance between their extremities and because they lie beyond the threshold at which sight perceives visible objects with accuracy. And if sight will not perceive those bodies correctly, it will not perceive the spaces between their extremities correctly. Therefore, it will not correctly perceive the distances between itself and the visible objects that lie at the extremities of those bodies. When the distances of visible objects are untoward, then, and when there are bodies in continuous, successive order between them and the eye, the magnitudes of their distances are not correctly perceived by sight.

[3.79] Furthermore, the distances of visible objects whose distance is not spanned by a continuous, ordered range of bodies are certainly not perceived correctly by sight; accordingly, when it perceives clouds over a plain or in places without mountains, sight will conclude that they lie far away [at a distance] comparable to [that of] celestial objects.⁸⁹ If, moreover, the clouds lie among mountains but are continuous, the peaks of the mountains may be hidden by the clouds, whereas if the clouds are separated, the peaks of the mountains may appear above them, and sight may perceive portions of the clouds lying against the shoulder of those moun-

tains, and this may happen in the case of mountains that are not very high. From this [sort of] experience, then, it seems that the distance of the clouds is not inordinate, and the majority of them lie closer to the ground than mountain peaks, so the conclusion that they lie exceedingly far away is erroneous. Hence, it will be evident that sight does not [correctly] perceive the measure of the distance of clouds when they lie above a plain, but the measure of the distance of clouds will be [correctly] perceived by sight when they lie among mountains, and the peaks of those mountains appear above them.

[3.80] This phenomenon is also encountered in various visible objects that are situated at ground-level; that is, the measure of their distances, when they are not spanned by a continuous, ordered range of bodies, will not be [correctly] perceived by sight. From such examples, then, it is evident that sight does not perceive the magnitude of the distance of a visible object unless its distance is spanned by a continuous, ordered range of bodies, and unless sight perceives those bodies and determines their measures accurately. For instance, let anyone who wants to conduct the experiment set up a room that he will not enter before the time of the experiment. And let there be a narrow aperture in any of the walls of that room, and let there be a space behind this aperture that has not been seen before that time. Then, within that space let two walls be set up, one nearer the aperture than the other, and let there be some determinate distance between those two walls. Then, let the nearer wall block a portion of the farther wall, but let some portion of that farther wall show. Let the aperture be high enough above the ground that, when the viewer looks through it, he cannot see the ground behind the wall with the aperture in it.⁹⁰ When the experimenter enters this place and looks through the aperture, he will definitely see the two walls together, but he will not perceive the distance between them. Indeed, if the first wall lies an inordinate distance from the aperture, he will perceive the two walls as contiguous, and he will perhaps conclude that they are continuous, forming a single wall, when their color is the same.⁹¹ If, however, the first wall lies a moderate distance from the aperture, and if it is perceived that there are two walls, it will be judged that the two are near to, or contiguous with, one another; so the distance between them will not be accurately determined. Furthermore, when it perceives the first wall, given that its distance is moderate, sight [will judge its distance] as if it were near, and it will not determine its distance accurately. So the distance between two bodies of this sort will not be accurately determined by the sense of sight when the experimenter has not seen that location or those two walls before.⁹² And sight might perceive those two walls as contiguous, even when it has already determined the distance between them.

[3.81] Since sight does not perceive the distance between two bodies of this sort, it will not perceive the magnitude of the distance of the farther body, even though it perceives its form. And if it does not perceive the magnitude of the distance of this body, even though it perceives the body [itself], then sight will not perceive a continuous range of bodies spanning that distance, so, on the basis of its perception of the form of the visible object, sight will not perceive the magnitude of the distance of that visible object properly. Now sight perceives the magnitude of the distance of a visible object only through deduction. And sight deduces any measure only by comparing that measure to another measure already known to sight or to some measure perceived at the same time; but without an ordered range of bodies spanning the distance of a visible object, sight has no means of measuring the distance of the visible object or of subjecting it to comparison in order to perceive its measure correctly. Moreover, if sight measures the distance by anything other than those bodies, the measure will be arbitrary rather than accurate. Therefore, the magnitude of the distance of a visible object is not perceived by the sense of sight unless its distance is spanned by a continuous, ordered range of bodies, and sight perceives those bodies as well as their measures.

[3.82] The experiment that we have described provides the same results for a variety of visible objects, such as two trees standing in the relationship described for the walls, or a stick placed crosswise to the aperture in the same position as we described for the first wall.

[3.85] Furthermore, the distances of visible objects that stand apart from one other are perceived by sight through a perception of the separation between the visible objects.⁹³ Moreover, the magnitude of the distances between visible objects is handled by sight in the same way as the [magnitude of the] distances of visible objects from the eye. For, when there is a continuous, ordered range of bodies between two separate visible objects, and when sight perceives those bodies and their measures, it will [correctly] perceive the magnitude of the distance between those two visible objects; if [there is] not [such a range of bodies], however, sight will not correctly perceive the magnitude of the distance between them. Likewise, if there is a continuous, ordered range of bodies between the two visible objects, but if those bodies lie at such a remote distance that sight cannot determine their measures accurately, the measure [of the distance] between those two objects will not be determined accurately.

[3.86] Therefore the distances of visible objects from the eye are perceived only through a perception carried out by the faculty of discrimination, for what occurs in the eye at the time of sight occurs only through something outside [the eye]. Moreover, the magnitude of the distance of visible objects is not correctly perceived by the sense of sight unless the

distances of the visible objects are spanned by a continuous, ordered range of bodies, provided that [any such] distance is moderate and, in addition to this, that sight also perceives those bodies ranged in continuous order and accurately determines their measures according to their succession. The measures of distances that do not meet these requirements are not accurately determined by sight. Moreover, of visible objects whose distances are not accurately determined by sight, some lie at distances that are spanned by a range of continuous, ordered bodies, so that, although sight perceives those bodies, their extremities lie an inordinate distance away. Others lie at distances that are spanned by a continuous, ordered range of bodies, but sight does not [correctly] perceive those bodies, whether their distances are inordinate or moderate. Others still lie at distances that are not spanned by a continuous, ordered range of bodies, and these include visible objects that are so high above the earth that they lie an inordinate distance away and have no other [comparable] distance near them or a wall spanning their distance.⁹⁴ All visible objects fall under these categories.

[3.87] When sight perceives visible objects the magnitudes of whose distances are not accurately determined by sight, the faculty of discrimination immediately apprehends the measures of their distance according to estimation rather than true reckoning. And it compares their distance to the distance of similar visible objects that have been perceived before by sight, and it depends upon the form of the visible object in making its judgment, and it compares the form of the visible object to the form of similar visible objects that sight has perceived before, the magnitude of their distances having already been accurately determined by the faculty of discrimination. And thus it compares the distance of a visible object the magnitude of whose distance it cannot accurately determine with the distance of similar visible objects that have been perceived by sight before, the measure of their distances having already been accurately determined by the faculty of discrimination. Thus, if the faculty of discrimination cannot accurately determine the lineaments of the form of the visible object, it will compare the magnitude of its entire form to the magnitudes of forms of visible objects that are equal in size, the magnitudes of their distances having already been accurately determined, and it will assimilate the distance of a visible object whose distance it cannot accurately determine to the distance of visible objects that are the same size whose distances have already been accurately determined.⁹⁵

[3.88] And this is the best that the faculty of discrimination can do in perceiving the measures of the distances of visible objects. Thus, in perceiving the distance of an object of this sort, it may reach an accurate determination by following such a deductive process, or it may err. But in

those instances in which it does reach an accurate determination, it cannot be sure whether it has reached an accurate determination or not. Moreover, this deductive process will be carried out extremely quickly because the faculty of discrimination is accustomed to perceiving the distance of visible objects through deduction or accurate determination.

[3.89] Furthermore, the faculty of discrimination may estimate the measure of the distance of a visible object if it is spanned by an ordered range of bodies and is moderate, [and it will do so] because the faculty of discrimination is accustomed to estimating or deducing the distances of visible objects and because of the speed with which it arrives at its estimate. And if the distance of the visible object is moderate, there will not be much discrepancy between the estimate of the distances and the true distance.

[3.90] Therefore, when sight perceives any visible object, the faculty of discrimination will immediately perceive its distance, as well as the measure of its distance, to the best of its ability—i.e., through accurate determination or through estimation—and its distance will immediately have an imagined measure in the soul. Thus, given a visible object perceived by sight and having its form imagined in the soul, when its distance is spanned by a continuous, ordered range of objects, that distance being moderate, and when sight perceives those bodies ranged in continuous order over its distance, and when the faculty of discrimination has already apprehended these bodies and accurately determined their measures, then the measure of the distance [of that visible object] is accurately determined.

[3.91] On the other hand, if the distance is not spanned by a continuous, ordered range of bodies, or if it is spanned by a continuous, ordered range of bodies that are perceived by sight but whose distances are so inordinate that sight cannot accurately determine the sizes of those bodies, or if the eye faces a continuous, ordered range of bodies but sight does not [correctly] perceive those bodies or does not accurately determine their sizes, or if the eye could perceive those bodies but does not notice them and therefore does not determine their sizes, whether those bodies lie at an inordinate or at a moderate distance, then the measure of that distance imagined in the soul will not be accurately determined or verified.

[3.92] Now the distances between disjoined visible objects are perceived only through the perception of the separation that exists between them, and some of the magnitudes of the distances between disjoined visible objects are correctly perceived, whereas others are perceived through estimation. Thus, the measure of the distance between two visible objects that have a continuous, ordered range of bodies between them is accurately determined as long as sight perceives those bodies and de-

termines their sizes. On the other hand, if two visible objects do not have a continuous, ordered range of bodies between them, or if they have a continuous, ordered range of bodies between them but sight does not accurately determine the sizes of those bodies or will not perceive those bodies, then the measure of the distance between the two visible objects is not accurately determined. It is therefore in these ways that the sense of sight will perceive the distances of visible objects.

[3.93] Furthermore, when bodies span the distances of familiar objects lying at familiar distances, which sight is used to perceiving, those bodies are perceived by sight and their sizes are accurately determined because they recur to sight so often that sight perceives the measures of their distances through recognition. For, when it perceives any familiar visible object that lies at a familiar distance, sight will recognize it and will recognize its distance, so it will estimate the magnitude of its distance. Therefore, when it estimates the magnitude of the distance of such bodies, the estimate of their distance will be almost exact, so there will not be much discrepancy between the estimated and actual distance. The magnitudes of the distances of familiar objects that lie at familiar distances are therefore perceived by sight through recognition and through an estimate of their sizes. The majority of the distances of visible objects, moreover, are perceived in this manner.

[Perception of Spatial Disposition]

[3.94] Now spatial disposition, which sight perceives among visible objects, can be subdivided into three kinds, the first of which involves the spatial disposition of the entire visible object vis-à-vis the eye or the spatial disposition of any of the visible object's parts vis-à-vis the eye. This kind of spatial disposition is [called] "opposition."⁹⁶ The second kind involves the spatial disposition of the surface of a facing visible object vis-à-vis the eye; this includes the spatial disposition of the surfaces of a visible object facing the eye when it has several surfaces and many of those surfaces are exposed to view; it also includes the spatial disposition of the boundaries of the surfaces of the visible objects vis-à-vis the eye, as well as the spatial disposition vis-à-vis the eye of the lines or the spaces between any two points or between any two visible objects that are perceived at the same time by sight.⁹⁷ The third kind involves the spatial disposition of the parts of the visible object in relation each another; it also involves the spatial disposition of the boundaries of the surface of the visible object in relation to each other, as well as the spatial disposition of the parts of the boundaries of the surface of the visible object with respect to each other. This kind of spatial disposition is [called] "arrange-

ment." Likewise, the spatial disposition of various visible objects in relation to one another is a subtype of this. Therefore, all spatial dispositions perceived by sight can be subdivided into these three kinds.

[3.95] The spatial disposition of one thing with respect to another is a function of the distance of one of the things from the other and the spatial orientation of the one with respect to the other. Therefore, the opposition of a visible object vis-à-vis the eye depends on the distance of the visible object from the eye and the direction of the visible object vis-à-vis the eye. Now it has already been shown that the perceptual notion of a visible object's distance is ensconced in the soul.⁹⁸ The true location of the visible object, however, is perceived from the spatial disposition of the visible object vis-à-vis the eye, for the eye only perceives a visible object from a facing position. Furthermore, the locations perceived by sense are perceived by differentiation, so both sense and [the faculty of] discrimination distinguish among locations, even when there are no visible objects filling them. But [the faculty of] discrimination makes the distinction between a location right in front of the eye and a location near it, and the faculty of discrimination perceives all locations through imagination. Therefore, when the eye faces some location and perceives a visible object [in it], if the eye then shifts its focus from that location to face another location, the original visible object will disappear from view. But when the eye returns its focus to face that [original] location, the original visible object will come back into view.

[3.96] Now if sight perceives the visible object facing it in the location where the visible object is, and if the faculty of discrimination perceives the location facing the eye when that visible object is perceived, and if, when the eye shifts its focus so that it no longer faces that place, the object disappears from view, then the faculty of discrimination will perceive that the visible object only exists in the direction that the eye faces when that visible object is seen.

[3.97] It has also been shown that sight receives forms properly along radial lines and that it is affected by forms only along such lines.⁹⁹ It has also been shown that the form extends through the body of the eye along straight, radial lines.¹⁰⁰ Therefore, when the form of the visible object reaches the eye, the sensitive faculty will immediately sense the form, and it will sense the area on the eye where the form reaches, and it will sense the direction [of the radial line]¹⁰¹ along which the form will extend through the body of the sensitive organ. Therefore, when sight perceives the location of the form on the eye and also perceives the direction [of the radial line] along which the form has extended [to the eye], the faculty of discrimination will immediately perceive the location to which, from which, and along which that [radial] line has extended. But the location

along which and from which that [radial] line extends is where the visible object is situated. Therefore, it is on the basis of the perception of the area on the eye where the form reaches, along with the perception of the direction [of the radial line] along which the form has extended and according to which sight is affected by the form, that the faculty of discrimination perceives the actual direction from which the form of the visible object has reached [the eye]. This is how the locations of visible objects are differentiated, for visible objects that are separated from one another are discerned by sight [as separated] only through a differentiation of the distinct places on the surface of the sensitive organ where the forms of the individual visible objects reach.¹⁰²

[3.98] Perceiving the location of a visible object in this manner has a parallel in hearing, for the sensitive faculty perceives sound through the sense of hearing, and it also perceives the place from which the sound comes, so it differentiates between a sound coming from the right and a sound coming from the left, as well as [one coming] from in front and [one coming] from behind. Indeed, it differentiates the locations of sounds even more subtly than this, so it distinguishes the location of a sound reaching it from straight ahead more easily than it does the location of a sound reaching it from a location off to the side. But the places from which sounds originate are distinguished by the sensitive faculty by means exclusively of the direction from which the sounds come to the hearing. Thus, the sense of hearing perceives sounds, and it also perceives the direction from which the sounds come, and it is from perceiving the direction from which the sounds reach the hearing, that [direction] being according to the straight lines along which the sound strikes the hearing, that the faculty of discrimination perceives the location from which the sound comes. Consequently, just as the locations of sounds are perceived by the sense of hearing and subsequently by the faculty of discrimination through hearing, so are the locations of visible objects perceived by the faculty of discrimination through visual sensation.

[3.99] Furthermore, among those things demonstrating that the sensitive faculty perceives the direction [of the radial line] along which sight is affected by the form of a visible object, what is perceived in mirrors according to reflection provides support, for the visible object that sight perceives through reflection can only be perceived by sight directly opposite, as if [the object were actually] facing it. And its form reaches the eye along the straight lines that constitute radial lines extended directly outward from the eye. Thus, since sight senses the form along radial lines, it will judge the visible object to lie at the endpoints of those lines, for it will perceive no familiar object that it regularly perceives except at the endpoints of the lines that are imagined [to extend] between the center of the

eye and the visible object, and these are radial lines. Hence, from the fact that sight perceives the visible object, after reflection, as if it faced the eye directly along the straight [radial] lines according to which the reflected forms reach the eye [from the mirror], it will be apparent that the sensitive faculty senses the direction [of the radial line] along which the form arrives and along which sight is affected by the form. And when the sensitive faculty senses the direction from which it is affected by the form, the faculty of discrimination perceives the location from which that line extends, so it will perceive the location of the visible object. Thus, the location of a visible object is perceived *grosso modo* by the sensitive faculty from a perception of its spatial disposition at the moment it is seen, so it will be perceived *grosso modo* by the faculty of discrimination from a perception of the spatial disposition of the visible object at the moment it is seen, but it is correctly perceived and accurately determined on the basis of a perception of the direction from which sight is affected by the form of the visible object. However, the notion of the distance of the visible object has already become ensconced in the soul. Thus, as soon as the [form of] the visible object reaches the eye, the faculty of discrimination perceives the location of the visible object along with the ensconced notion of its distance. But the combination of distance and location yields opposition. Therefore, when the faculty of discrimination perceives the location and distance of the visible object together, it will perceive its opposition. Perception of opposition thus arises from a perception of the visible object's location together with a perception of the visible object's distance, and perception of location will be according to the manner we described. Therefore, when the form of the visible object reaches the eye, the sensitive faculty will sense the location on the sensitive organ where the form arrives, and the faculty of discrimination perceives the location of the visible object from the direction [of the radial line] along which the form extends. Moreover, the notion of distance is already established for it. So it perceives location and distance together at the time the form is perceived by the sensitive faculty. Therefore, as soon as the sensitive faculty perceives the form, the faculty of discrimination will perceive the [visible object's] opposition. So the perception of opposition will occur in the way just described.

[3.100] Now it has already been shown how sight perceives the form of a visible object by brute sensation. Accordingly, when the form of the visible object reaches the eye, the sensitive faculty will perceive the color of the visible object, and its light, and the location on the eye that has been colored and illuminated by that form. Meanwhile, the faculty of discrimination will perceive both its location and its distance when its light and color are perceived by the sensitive faculty. Hence, light and color, as

well as location and distance, are perceived at the same time, i.e., in minimal time. But location and distance yield opposition, and light and color yield the form of the visible object, so it is on the basis of the perception of the form along with the perception of opposition that the visible object is perceived to be in opposition to the eye. Thus, the perception that the visible object faces the eye results solely from the fact that the form and [the fact of] opposition are perceived together. Then, given the frequent recurrence of this perception, the form is transformed into a sign¹⁰³ for the sense and for the faculty of discrimination. Thus, when the form reaches the eye, it is perceived by the sensitive faculty, and the faculty of discrimination perceives its opposition, and from this the sensitive faculty forms the perception of the visible object in its [true] location. In this way, therefore, the perception of the visible object in its [true] location will ensue, and the same holds for any of the parts of the visible object.

[3.101] When, therefore, the distance of the visible object is moderate and is accurately determined in magnitude, the location where the visible object is perceived by sight will be the true location.¹⁰⁴ And [even] if the distance of the visible object is not accurately determined in magnitude, the perception of the visible object's being in opposition will be accurately determined, because opposition, as such, consists of place and distance, in the generic sense. But the location where the visible object is perceived by sight is estimated, not precisely determined, because a determinate location is perceived on the basis, solely, of an accurate determination of the magnitude of the distance.

[3.102] Now the spatial disposition of the surfaces of visible objects vis-à-vis the eye is subdivided into two: directly facing and obliquely facing. A surface [is said] to face the eye directly when it is perceived by sight straight ahead and when the visual axis touches some point on it so as to form equal [i.e., right] angles with it. A surface [is said] to face the eye obliquely when it is perceived by sight at a slant and when the visual axis touches every point on it at an inclination so as to form unequal angles with it, striking that surface everywhere at different inclinations.

[3.103] Now the boundaries of the surfaces of visible objects, as well as the lines in objects and the gaps between visible objects and between the parts of visible objects fall into two categories: first, lines and gaps¹⁰⁵ intersecting the radial lines, and second, lines and gaps parallel to the radial lines they correspond to. As far as spatial disposition is concerned, lines and gaps that intersect the radial lines are subdivided into oblique and directly facing according to the twofold division of spatial dispositions and surfaces. A directly facing line is one to which the visual axis will fall orthogonally at some point, whereas an oblique line is one to which the visual axis, will [invariably] fall obliquely rather than orthogo-

nally, no matter where it is dropped.

[3.104] Now sight perceives the fact that surfaces and lines are oblique, or that they are directly facing, by perceiving difference or equality among the distances of the extremities of the surfaces or lines [from the center of sight¹⁰⁶]. For when it perceives the surface of a visible object and perceives the distances of its edges, if it senses the equality of the distances of the edges of the surface from the center of sight, or if it senses the equality of the distances [from the center of sight] of two locations lying equidistant from the spot on the surface where the viewer is directing his focus, sight will perceive that the surface is directly facing, and the faculty of discrimination will judge it to be directly facing. On the other hand, when it perceives the surface of the visible object, but perceives that the distances of its extremities [from the center of sight] are different and does not find two locations on that surface that are the same distance [from the center of sight] and equidistant from the spot on the surface to which the viewer directs his focus, sight will perceive that the surface is oblique with respect to itself, and the faculty of discrimination will judge it to be oblique.¹⁰⁷

[3.105] And the same holds for the spatial dispositions of lines and gaps that are directly facing or oblique; when it perceives that the distances of the two endpoints of the line or gap [from the center of sight] are equal, or when it perceives that two points on the line or surface that are equidistant from the point to which the viewer directs his focus (a point, that is, on the line or gap) are also equidistant from the center of sight, sight perceives that the line or gap is directly facing. On the other hand, sight perceives the line or gap as oblique when it senses that the distances of the two endpoints of the line or gap from the center of sight are different, or when it senses that the distances [from the center of sight] of the two points equidistant from the point to which the viewer is directing his focus are different. And this equality or difference is often perceived by the sensitive faculty by means of estimation and signs. It is therefore in this way that oblique and directly facing [dispositions] will be perceived by sight.

[3.106] Moreover, if the entire surface or entire line faces the eye directly, then no part of it will face the eye directly on its own. Or, rather, no part of it faces the eye directly on its own except for the part directly opposite the [visual] axis. Therefore, when the visual axis scans a surface or line that faces [the eye] directly, the axis will fall obliquely to any part, other than the original point to which the visual axis fell orthogonally. Hence, aside from the aforementioned part, any part on a surface or line that faces [the eye] directly will be oblique, when taken by itself. Yet when the surface or line is taken as a whole, it will be directly facing as a whole.

Furthermore, when the point on the surface or line to which the [visual] axis will be perpendicular is the midpoint of that surface or line, the surface or line will be [in a] perfectly facing [disposition] vis-à-vis the eye. On the other hand, if that point is not the midpoint, then the surface or line will be [in a] directly facing [disposition], but not a perfectly facing one; and the closer the point on the surface or line to which the [visual] axis falls orthogonally is to the midpoint of the surface or line, the closer that surface or line will be to a perfectly facing disposition.

[3.107] Now the spatial dispositions of lines and gaps that are parallel to the radial lines are perceived by sight on the basis of the perception of opposition. For when sight perceives the endpoints of the lines or gaps that are right next to or near visible objects that face it with their own near extremities right next to the eye, it will perceive their spatial disposition, and it will perceive their extension in the line of opposition.¹⁰⁸

[3.108] It is therefore in these ways that the perception of the spatial dispositions of surfaces, lines, and gaps with respect to the eye will occur to sight.

[3.109] Now some surfaces, lines, and gaps that intersect radial lines are extremely oblique with respect to those radial lines, some are slightly oblique, and some are perpendicular to the radial lines, these latter surfaces, lines, and gaps facing the eye directly. Moreover, for surfaces, lines, and gaps that are extremely oblique with respect to the radial lines, the farther extremity of any of them lies away from the eye, i.e., at the [farther] extremities of the radial lines. The nearer extremity, for its part, lies toward the eye, i.e., near the center of sight. So when sight perceives any line or any gap, it will immediately perceive the two places occupied by the endpoints of that line or that gap. Similarly, when sight perceives any surface, it will perceive where the edges of that surface are by perceiving the extension of that surface according to length and breadth. Thus, when it perceives a surface that is not only oblique, but extremely oblique to the radial lines, sight will perceive where the farther edge is when it perceives the surface, and it will perceive that it lies at the [farther] extremities of the radial lines; it will also perceive where the nearer edge is, and it will perceive that it lies near the center of sight; and the same holds for a line or gap that is extremely oblique. Furthermore, when sight perceives that one of the two extremities of the surface, line, or gap lies away from the eye, and when it also perceives that the other extremity lies toward the eye, it will immediately perceive the remoteness of one of the extremities of that surface, line, or gap and the nearness of the other. Moreover, when it perceives the remoteness of one of the two extremities of the line, gap, or surface and the nearness of the other, it will immediately perceive the oblique disposition of that surface, line, or gap. Therefore, in the case of

surfaces, lines, and gaps that are exceedingly oblique with respect to the radial lines, sight perceives their obliquity by perceiving where their two extremities are.

[3.110] Neither the slant of slightly inclined surfaces, lines, or gaps, nor the directly facing [disposition] of surfaces, lines, or gaps that face the eye directly is correctly perceived or accurately determined by sight unless they lie at a moderate distance spanned by an ordered range of bodies that are perceived by sight. From the measures of these bodies it perceives the measures of the distances of the extremities of those surfaces, lines, and gaps, and it [thereby] perceives the equality or inequality of the distances of the two extremities of the surface, line, or gap. For none of the places occupied by the extremities of surfaces, lines, or gaps that face [the eye] directly or that are slightly inclined [to it] lie toward the center of sight [in any discernible way]; instead, their opposite extremities occupy places that are [perceived according to] right and left, or up and down. Therefore, since sight does not perceive the measures of the [appropriate] distances for objects disposed toward the eye in this manner, it will not perceive the difference or inequality, or the equality of the distances of their opposite extremities. And since it does not perceive this, it will perceive neither their obliquity nor their directly facing [disposition]. Thus, if the surfaces, lines, or gaps lie exceedingly far away, and if their obliquity is slight, sight will not be able to perceive their obliquity, nor will it be able to differentiate between oblique and directly facing [dispositions], for the magnitudes of the distances of surfaces, lines, and gaps that lie exceedingly far away are estimated rather than accurately determined by sight. Furthermore, when they lie extremely far away, and when their obliquity is slight, the difference between the distances of their opposite extremities will be [so] tiny [as to] dwindle to nothing compared to the [overall] distances of the extremities [from the eye]. And since sight cannot accurately determine the magnitude of the distances of their extremities, it will not perceive the difference in the distances of their surfaces, lines, or gaps [from the center of sight]. And since it cannot perceive the difference in the distances of the extremities of the surface, line, or gap, it will judge those distances to be the same, and it will not perceive the obliquity of that surface, line, or gap. And since it cannot perceive the obliquity of that surface, line, or gap, it will judge it to face [the eye] directly. So the obliquity of surfaces, lines, or gaps that lie extremely far away will not be perceived by sight when it is slight. Therefore, sight perceives all surfaces, lines, or gaps that lie extremely far away and that are barely inclined as if they were directly facing, so it neither determines their spatial disposition accurately nor differentiates between oblique and directly facing [dispositions] but, rather, perceives oblique and directly facing [dis-

positions] in the same way.

[3.111] Likewise, when the distance of surfaces, lines, or gaps is moderate but is not spanned by a range of ordered bodies, or if sight does not perceive the bodies spanning their distances or does not determine the magnitudes of their distances accurately, then the spatial disposition of those surfaces, lines, or gaps is not accurately determined by sight. So sight does not discern whether they are oblique or directly facing but determines their spatial disposition through estimation, and sight may well judge something of this sort to be directly facing when, in fact, it is oblique. On the other hand, if the surfaces, lines, or gaps lie at a moderate distance that is spanned by an ordered range of bodies, and if sight perceives those bodies and their magnitudes, it will perceive the magnitudes of the distances of the extremities of those surfaces, lines, or gaps [from the center of sight]. It will also perceive the equality of the distances of their opposite extremities [from the center of sight], if those extremities are equidistant [from the center of sight], or their inequality, if they are not equidistant [from the center of sight]. And when it perceives the equality of the distances of the extremities of the surface, line, or gap [from the center of sight], or when it perceives their inequality, it will perceive the directly facing [disposition] or the obliquity of that surface, line, or gap with accuracy.

[3.112] In the same vein, the obliquity of lines, surfaces, or gaps that are exceedingly oblique are perceived by sight only when their distance is moderate in comparison to their size. For sight does not perceive where the extremities of the surface, line, or gap are unless it perceives how that surface, line, or gap extends. But sight does not perceive how the surface, line, or gap extends unless it lies at a moderate distance in comparison to the size of that surface, line, or gap. Thus, the slant of a surface, line, or gap that cuts the radial lines at an extreme angle will be perceived by sight according to a perception of where its extremities are. And if the slant is slight, or if the [surface, line, or gap] faces [the eye] directly, it will be perceived by sight as oblique or directly facing on the basis of the perception of the magnitudes of the distances of its opposite extremities [from the center of sight]. But sight does not accurately determine the spatial disposition of extremely oblique surfaces, lines, or gaps unless it accurately determines how they are extended, and it does not accurately determine the spatial disposition of surfaces, lines, or gaps that are slightly oblique or directly facing unless it accurately determines the magnitudes of the distances of their extremities and perceives the inequality or equality of the distances of their opposite extremities [from the center of sight]. But sight rarely determines the spatial disposition of visible objects with accuracy. The majority of spatial dispositions that sight perceives among

visible objects are perceived by sight only through estimation. Hence, estimation provides the only basis for visual perception of the spatial dispositions of visible objects. Accordingly, when a viewer wishes to determine accurately the spatial disposition of some surface, or of one of the lines on visible objects, or of one of the gaps on the surfaces of visible objects, he will inspect the form of that visible object and examine how its surface, or the line [on its surface], or the gap [on its surface] extends. Hence, if the form of that visible object on which that surface, line, or gap lies is accurately determined, and if the slant of that surface, line, or gap is extreme, sight will perceive its obliquity correctly by perceiving how it extends and by perceiving where its two opposite extremities are. Moreover, if the form of that visible object is clear[ly perceived], if its obliquity is not extreme, and if its distance is spanned by an ordered range of bodies, sight will see the bodies spanning the distances of its extremities and will scrutinize their magnitudes, and then, on the basis of the perception of the magnitudes of the distances of its extremities [from the center of sight], it will perceive the distance of that surface, line, or gap, as well as the degree of its obliquity or the fact that it faces [the eye] directly.

[3.113] If, however, the form of the visible object is not clear[ly perceived], or if it is clear[ly perceived] and its obliquity is not extreme, but its distance is not spanned by an ordered range of bodies, sight will not accurately perceive the spatial disposition of a surface, line, or gap of this kind. In addition, when sight does not perceive a form clearly and does not find its distance spanned by an ordered range of bodies, it will immediately perceive that the spatial disposition of that surface, line, or space is not accurately determined.

[3.114] It is therefore in these ways that sight perceives the spatial disposition of the surfaces of visible objects, or the spatial disposition of lines or gaps in the surfaces of visible objects, assuming that they all intersect the radial lines.

[3.115] When the gap between two disjoined visible objects is extremely far away—i.e., when each of the visible objects at the extremities of the gap lies an inordinate distance [from the center of sight]—that gap will then be perceived by sight as directly facing, even if it is oblique, because it does not perceive the difference in distance [from the center of sight] of [the visible objects forming] its extremities. Yet if one of the two visible objects forming the two extremities of the gap is nearer than the other, and if sight perceives the fact that it is nearer, it perceives the gap between them as oblique insofar as it perceives the nearness of the nearer of the two visible objects and the remoteness of the farther of the two. On the other hand, if one of the two visible objects is nearer, but sight does not perceive its nearness, then it will not sense the obliquity of the gap be-

tween them. Thus, the spatial disposition of surfaces, lines, and gaps that intersect the radial lines is not accurately determined by sight unless they lie at a moderate distance and, in addition, unless sight accurately determines the inequality or equality of the distances of their extremities [from the center of sight]. If sight does not accurately determine the equality or inequality of the distance of their extremities [from the center of sight], though, it will be unable to determine their spatial disposition accurately.

[3.116] Furthermore, the majority of the spatial dispositions of visible objects that are perceived by sight are perceived only through estimation. Therefore, if they lie at a moderate distance, there will not be much discrepancy between the spatial disposition perceived by sight through estimation and the true spatial disposition, whereas if they lie extremely far away, sight will not differentiate between oblique and directly facing [disposition]. For, if sight does not perceive the inequality of the distances of the two extremities of the visible object [from the center of sight], it will perceive them to be equal, and so it will judge the visible object itself to be directly facing.

[3.117] It is therefore in these ways that the sense of sight will perceive the spatial dispositions of surfaces, lines, and gaps.

[3.118] The spatial disposition of the parts of the visible object with respect to one another, the spatial disposition of the edges of the surface or surfaces of the visible object with respect to one another, and the spatial disposition of separate visible objects with respect to one another (all of these cases falling under the head of arrangement) are perceived by sight through the perception of the locations on the eye to which the forms of the parts extend and through the perception by the faculty of discrimination of the arrangement of the parts of the form that extend to the eye. For the form of each of the parts of the surface of the visible object reaches a particular spot on the area of the surface of the sensitive organ to which the form of the whole object extends. And if the surface of the visible object is of various colors, and if there are differences among the parts of the visible object according to which those parts are differentiated from one another, the form reaching the eye will consist of different colors, and its parts will be differentiated according to the way the parts of the visible object's surface are differentiated. So the sensitive faculty senses the form while sensing each of the parts of the form by means of a sensation of the colors of those parts, as well as of the light in them, and it senses the locations of the forms of the parts in the eye by sensing the colors and light of those parts, and the faculty of discrimination perceives the arrangement of those locations by perceiving the difference among the colors of the parts of the form and by perceiving the distinctions among the

parts. And so it perceives right and left, as well as above or below, by comparing those parts to one another, and it also perceives contiguity and separation.

[3.119] Now, along the line-of-sight—i.e., according to outward or inward projection [vis-à-vis the center of sight]—the relative spatial dispositions of the parts of a visible object are perceived by sight through perception of the magnitude of the distances of the parts from the center of sight and through perception of the difference among the distances of the parts [from the center of sight] according to relative extent. Indeed, when the visible object lies at a moderate distance, the relative spatial dispositions of its parts along the line-of-sight are perceived by sight, but only if it perceives the magnitude of the visible object's [overall] distance [from the center of sight] while perceiving the magnitudes of the distances of its parts [from the center of sight] and while perceiving the inequality or equality among the distances of the parts from the center of sight. However, if sight does not accurately determine the magnitudes of its distance and the magnitude of the distances of its parts [from the center of sight], it will not perceive the arrangement of its parts along the line-of-sight. On the other hand, if the visible object is one of those that are routinely perceived by sight, it will perceive the arrangement of its parts, as well as the shape of its surface, according to outward or inward projection, but [it will do so] through recognition rather than through vision per se. If the visible object is among unfamiliar objects that sight does not recognize, though, it will perceive its surface as flat when it cannot accurately determine the magnitudes of the distances of its parts [from the center of sight]. And this perception arises when sight looks at any convex or concave body that lies extremely far away, for in that case sight will not perceive its concavity or convexity but will perceive the object as flat.¹⁰⁹

[3.120] As far as differences in location, discontinuity, and continuity are concerned, the relative spatial disposition of the parts of a visible object's surface are not perceived by sight except through a perception of the parts of the form that reach the eye, as well as through a perception of the various colors and differences that distinguish the parts from one another and a perception of the arrangement of the parts of the form by the faculty of discrimination. Neither the relative spatial dispositions nor the relative distances from the eye of the parts of the visible object's surface are perceived by sight along the line-of-sight except through a perception of the magnitude of the distance of the parts and through a perception of the inequality or equality of the magnitudes of their distances. Therefore, the arrangement of the parts along the line-of-sight is [properly] perceived by sight when the magnitudes of their distances [from the center of sight] are accurately determined. On the other hand, the arrangement of the

parts is not [properly] perceived when the magnitudes of the distances of its parts are not accurately determined by sight. Furthermore, the arrangement of the individual parts of a visible object is perceived by sight through a perception of the locations on the eye where the forms of those parts extend, as well as through a perception of [their] distinct interpositions on the eye by the faculty of discrimination; and the same holds for individual visible objects. The boundaries of the surface or surfaces of the visible object are perceived by the eye, along with their arrangement, through a perception of the spot on its surface where the color and light of that surface reach the eye and through a perception of the boundaries of that part and the arrangement of the circumference of that part by the faculty of discrimination. In these ways, then, sight perceives the spatial dispositions of the parts of visible objects, the relative spatial dispositions of the surfaces of visible objects, the spatial dispositions of the boundaries of their surfaces, the relative spatial dispositions of the individual parts of visible objects, and the relative spatial dispositions of individual visible objects.

[Perception of Corporeity]

[3.121] Now corporeity, which consists in the extension of a body in three dimensions, is perceived by sight in some bodies and not in others. Still, according to human judgment, it is an absolute given that only a body can be perceived by sense, and so, when someone perceives a visible object, he will immediately realize that it is a body, even though he may not perceive its extension according to three dimensions. But sight perceives the extension of all bodies according to length and breadth on the basis of the perception of the surfaces of bodies that face it. Therefore, when it perceives the surface of a body, thereby realizing that this visible object is a body, it will immediately perceive the extension of that body according to length and breadth. So only the third dimension is left. Now some bodies are enveloped by plane surfaces that intersect each other to form corners, some are enveloped by concave or convex surfaces, some are enveloped by surfaces of various shapes that intersect one another to form corners, and some are enveloped by one [continuous] curved surface. Therefore, if one of the intersecting surfaces that envelop a body is plane, and if that surface faces the eye directly, and if the remaining surfaces that intersect this plane surface that faces the eye directly are perpendicular to that surface or are oblique to it so as to converge on one another behind it, then, when sight perceives that body, only the surface that faces the eye directly will be seen by it. Of such bodies, then, sight perceives only the length and breadth, so it does not sense the corporeity

of such bodies. On the other hand, if one of the intersecting surfaces that envelopes the body faces the eye but not directly, and if the intersection of this surface with another surface on that body is perceived by sight so that it can perceive both surfaces at once, then the corporeity of that body will be perceived by sight. For it will perceive the slope of the surface of the body in terms of its depth, whereby it will perceive the extension of the body according to depth. But it will also perceive the extension of that sloping surface in length and breadth, and so it will perceive the corporeity of such a body.

[3.122] And the same holds if one of the surfaces of the body faces the eye directly, and one or more of the surfaces intersect that surface obliquely so as to diverge outward behind the surface that faces the eye, for in such a body sight will perceive both the surface that faces the eye directly and the surface that intersects it obliquely. And it will also perceive the intersection of these surfaces, and thus, as we said, it will perceive the corporeity of that body. And I say that, in general, whenever sight can perceive two surfaces intersecting one another in a given body, it will perceive its corporeity.

[3.123] In the case of bodies with a convex surface that is perceived by sight, whether those bodies consist of one or more surfaces, sight will be able to perceive their corporeity through a perception of their actual [shape], for when a convex surface faces the eye directly, the distances of its parts from the eye will be unequal, and its midpoint will lie nearer the eye than its outer edge.¹¹⁰ So when sight perceives its convexity, it will perceive that its midpoint is nearer to it than its extremities. And when it senses that the object's midpoint lies nearer to it, whereas the object's outer edge lies farther away, it will immediately sense that the surface curves away from it toward the back, and so it will sense the extension of the body in depth with respect to the surface directly facing it. But it will also perceive the extension of that body according to length and breadth through the perception of the extension of the convex surface according to length and breadth. And the same holds if, in addition to the surface that faces the eye directly, the other surfaces of the body are convex, and if sight perceives their convexity, for sight will also perceive their extension according to three dimensions.

[3.124] In the case of a body containing a concave surface that is perceived by sight, if sight senses another surface on that body and senses the intersection of that surface with the concave one, it will then sense the slope of the [other surface] of that body, and when it senses the slope of that surface, it will immediately sense the body's corporeity. On the other hand, if its concave surface is perceived by sight, but none of the remaining surfaces is exposed to view, sight will not perceive the corporeity of

such a body, nor will sight perceive anything about such bodies beyond their extension in two physical dimensions.¹¹¹ Moreover, sight will sense the corporeity of such bodies only through previous knowledge, not through a sensation of the three dimensions of the body. But a concave surface also extends in depth according to the propinquity of its outer edge and the remoteness of its midpoint with respect to the eye, but, as far as perception of depth is concerned, only the extension of the [side's] hollow is perceived, not the extension of the body [itself] that contains that concave surface.

[3.125] Thus, the perception of corporeity by sight depends exclusively on a perception of the way the surfaces of bodies slope [toward one another]. But the slopes of the surfaces of bodies according to which sight is alerted to the fact that bodies are bodies are perceived by sight only in the case of bodies that lie at a moderate distance. In the case of bodies that lie extremely far away, however, when their distance is not accurately determined by sight, sight does not perceive the slopes of the surfaces. And thus it does not perceive its corporeity by the sense of sight, for in such bodies sight does not perceive the relative spatial disposition of the parts of their surfaces, so it only perceives them as flat. It does not, therefore, perceive the slopes of the surfaces, and so it does not perceive the body's corporeity. Thus, sight does not perceive the corporeity of a body that lies extremely far away and whose distance is not accurately determined by it.

[3.126] But sight perceives the corporeity of bodies by perceiving the slopes of the surfaces of [those] bodies, and the slopes of the surfaces of [those] bodies are only perceived by sight in the case of visible objects that lie at a moderate distance when the relative spatial disposition of the parts of their surfaces are perceived by sight. And, except for these visible objects, sight does not perceive the corporeity of bodies, or else it perceives their corporeity through previous knowledge alone.¹¹²

[Perception of Shape]

[3.127] The shape of a visible object is subdivided into two kinds, the first being the shape of the circumference of the surface of the visible object or the [shape of the] circumference of some part of the visible object.¹¹³ The second kind is the shape of the body of the visible object, or the shape of the body of some part of the visible body—which is to say the form of the surface of the visible object whose corporeity is perceived by the sense of sight or the form of a part of the surface of the visible object whose corporeity is perceived [by the sense of sight].¹¹⁴ Everything that sight perceives in the way of the shapes of visible objects falls under these heads.

[3.128] The shape of the circumference of a visible object's surface is perceived by the sensitive faculty through the perception of the circumference of the form that reaches the hollow of the common nerve and through the perception of the circumference of the area on the surface of the sensitive organ where the form of the visible object reaches, for the circumference of the surface of the visible object is delineated in both of these places. Therefore, whichever of these places the sensitive faculty examines, it will be able to perceive the shape of the circumference of the visible object [delineated] in it. Likewise, the shape of the circumference of any part of the surface of the visible object is perceived by the sensitive faculty through its sensation of the arrangement of the parts of the boundaries of the form of the part. And if the sensitive faculty wants to accurately determine the shape of the circumference of the surface of the visible object or the shape of the circumference of some part of the visible object, it will move the visual axis over the circumference of the visible object. Through [such] a scanning-process, then, it will accurately determine the spatial disposition of the parts of the boundaries of the form of the surface or the part of the surface that lies on the surface of the sensitive organ as well as in the hollow of the common nerve, so it will perceive the shape of the circumference of the surface on the basis of its accurate determination of the spatial dispositions of the boundaries of the form. It is in this way, then, that the shape of the circumference of the visible object, or the shape of the circumference of some part of the surface of the visible object, will be perceived by the sense of sight.

[3.129] Now the form of the surface of a visible object is not perceived by sight except through the perception of the spatial dispositions of the parts of the visible object's surface and through the dissimilarity or similarity of the spatial dispositions of the parts of the surface of the visible object.¹¹⁵ And the form of the surface is accurately determined through the perception of the inequality or equality of the distances of the parts of the surface of the visible object [with respect to the eye] or [through the perception] of the inequality or equality of the heights of the parts of the surface. For the convexity of the surface is only perceived by sight through the perception of the nearness of the central parts on the surface and the remoteness of the parts at the extremity, or else through the inequality of the heights of its parts when the upper surface of the body is convex. By the same token, the convexity of the outer edge of the surface is only perceived by sight through the perception of the nearness of the midpoint and the remoteness of the outer edge when its convexity faces the eye, or through the inequality of the heights of its parts when its bulge points down or up, or else through the inequality of its right-hand or left-hand parts when its bulge points toward the right or left.

[3.130] When a concave surface faces the eye, however, its concavity is perceived by sight through the perception of the remoteness of the central parts and the proximity of the outer edges. And the same holds for the concavity of the outer edges of the surface when it faces the eye. But sight does not perceive the concavity of the surface when the concavity faces upward or downward, or toward the side, unless the concave surface is cut in such a way that the curvature of its edge facing the eye is apparent.

[3.131] A surface is perceived by sight as flat through the perception of the equality of the distance of its parts and its uniform arrangement throughout, and the same holds for the straightness of the edge of a surface when that edge faces the eye. However, when a surface faces the eye and several edges enclose that surface, the straightness, bend, or curvature of [any] edge of the surface will be perceived by sight through the arrangement of its parts among one another.

[3.132] The convexity, concavity, or flatness of the surface of a visible object facing the eye is perceived by sight through the perception of the difference in, or the equality of, the distances, or heights, or breadths of the parts of the surface [from the center of sight], as well as through the [perception of] how much the distances, or heights, or breadths of the parts exceed one another. Likewise, the convexity, concavity, or flatness of any part of the visible object is perceived by sight through a perception that the distances, or heights, or breadths of the parts of that part vary in magnitude or are equal among one another. It is for this reason that sight will not perceive concavity or convexity except in visible objects that lie at a moderate distance. Sight, moreover, perceives the nearness of certain parts of the surface and the remoteness of others by means of bodies that lie between it and the surface or by means of bodies spanning the distances of the parts, when the nearness or remoteness of those bodies are accurately determined by sight. And if some parts of the surface protrude, and others are indented, then sight perceives their protrusion and indentation through the slopes of the surfaces of the parts, and the intersections of the parts, and their curvatures at the points of indentation, and [it also perceives them] through the relative spatial disposition of the surfaces of the parts. This will be the case when sight has not perceived that surface, or anything like it, before. If, however, that visible object is familiar, sight will perceive its form as well as the form of its surface through previous acquaintance.¹¹⁶ The form of a visible object that is enveloped by surfaces that intersect one another and that have various spatial dispositions is perceived by sight from the perception of the intersection of its surfaces, and from the perception of the spatial disposition of each of its surfaces, and from the perception of the shape of each of its surfaces.

[3.133] Hence, the forms of the shapes of visible objects whose corporeity is perceived by sight are perceived through the perception of the forms of their surfaces and through the perception of the relative spatial dispositions of their surfaces. Moreover, the forms of visible surfaces whose parts have various spatial dispositions are perceived by sight through the perception of the convexity, concavity, or flatness of the parts of their visible surfaces, or from the height or depth of the parts of the surface. This, therefore, is how the forms and shapes¹¹⁷ of visible surfaces will be perceived. Moreover, when the sensitive faculty wants to accurately determine the form of a visible object's surface, or the form of any part of the visible object, it will shift its focus straight ahead and will make the visual axis scan all the parts of that object until it will sense the distances of its parts, the spatial dispositions of each of its parts vis-à-vis the eye, and the spatial disposition of all of the parts with respect to one another. And when the sensitive faculty perceives the distances and spatial dispositions of the parts of the surface, and when it perceives the height and depth of those parts, it will perceive the form of that surface of the visible object, and it will accurately determine its shape. But sight frequently errs in its perception of the forms of the surfaces of visible objects and the forms of the shapes of visible objects, but it does not perceive its error. For a slight convexity, or a slight concavity, or a slight protrusion or indentation is poorly perceived by sight along the line-of-sight, even when its distance is moderate, unless it lies very near the eye.

[3.134] Hence, sight perceives the forms of visible objects when the sizes of the parts of their surfaces are perceived by sight and when the inequality or equality of the distances of their parts [from the center of sight] are perceived by sight, whereas sight accurately determines the forms of visible objects when the magnitudes of the distances of their parts [from the center of sight] and the amounts by which the distances of the parts [from the center of sight] differ among each other are accurately determined by sight. Likewise, the shapes of the circumferences of the surfaces of visible objects and the shapes of the circumferences of the parts of the surfaces of visible objects are not accurately determined by sight unless they lie at a moderate distance, and unless sight accurately determines the arrangement of their extremities and the relative spatial dispositions of their parts, and unless it accurately determines their angles of juncture. If neither the spatial disposition of their extremities nor their angles of juncture, assuming they have such, are accurately determined by sight, sight will not accurately determine their shapes. Therefore, all the shapes of visible objects are perceived by sight in the ways that we have described.

[Perception of Size]

[3.135] The magnitude or size of a visible object is perceived by sight, but the way it is perceived is a matter of debate as far as the perception of magnitude is concerned. Several of those [authorities who have tried to explain this] believe that a visible object's size is perceived by sight only through the size of the angle formed at the center of sight, that angle also containing the surface of the visual cone whose base encompasses the visible object, [and they further believe] that sight correlates the sizes of visible objects to the sizes of the angles formed by the rays that comprehend the visible objects at the center of sight. So the perception of magnitude depends solely upon those angles.¹¹⁸ Certain other [authorities] believe that the perception of size is not achieved through a correlation of the angles alone, but also through an evaluation of the distance and spatial disposition of the visible object along with a correlation of the angles.¹¹⁹

[3.136] Actually, it is not possible for the perception of the sizes of visible objects by sight to depend solely upon a correlation of angles subtended by visible objects at the center of sight, for, as far as sight is concerned, the same visible object may not differ in size, even though it lies at distances that vary to a moderate extent.¹²⁰ For when a visible object is near the eye so that sight perceives its size, and then it is moved some distance away from the eye, its size will not diminish much as far as sight is concerned, provided that the second distance is moderate. Moreover, as far as sight is concerned, the size of no familiar visible object will ever change as its distances change, assuming that those distances are moderate.

[3.137] Likewise, when bodies of equal size lie at different distances, and the farther distance is moderate, they will be perceived as equal in size by sight. Nevertheless, the angles subtended by the same visible object at various moderate distances differ by some amount. For when a visible object lies one cubit from the eye and is then moved farther away from the eye until it lies two cubits from it, there will be a significant difference in the two angles subtended by that object at the center of sight. Still, sight does not perceive the object lying two cubits away as any smaller than the object lying one cubit away. By the same token, if it is moved three or four cubits away from the eye, it will not appear smaller, even though the angles formed at the center of sight will differ by a considerable amount.¹²¹

[3.138] So too, if a square is drawn on the surface of some body, and if that body is raised until the surface on which the square is drawn is almost parallel to the line-of-sight so that the eye can still make out the

square, sight will perceive the square as having equal sides, although the angles subtended by the sides of the square at the center of sight will be unequal when the center of sight lies near the surface on which the square is drawn. Nevertheless, sight will perceive the sides of the square as equal.

[3.139] Likewise, when diameters are drawn in a circle at various angles to one another, and the surface on which the circle is drawn is raised until it is nearly parallel to the line-of-sight, the angles subtended by the circle's diameters at the center of sight will vary significantly according to the orientation of the diameters. Nevertheless, sight invariably perceives the diameters of the circle to be equal, as long as they lie at a moderate distance.¹²²

[3.140] If the perception of [the size of] visible objects depended solely on a correlation of the angles subtended by visible objects at the center of sight, then, the sides of the square would not be perceived as equal, nor would the diameters of the circle be perceived as equal, nor would the circle be perceived as circular, nor would any single visible object be perceived to be of the same size at various distances. Therefore, on the basis of such experiments, it is clear that the perception of the sizes of visible objects does not depend solely on a correlation of angles.

[3.141] Now that this has been shown, let us determine precisely how magnitude is perceived. It has already been shown that the perception of various sensible properties depends entirely upon deduction and differentiation.¹²³ Magnitude is one of those properties that is perceived through judgment and deduction, and the basis upon which the faculty of discrimination determines the size of the visible object is the size of the area on the eye upon which the form of the visible object is projected. And the area upon which the form of the visible object is projected is determined and measured by the angle at the center of sight that contains the visual cone, which encompasses [both] the visible object and the area on the eye upon which the form of the visible object is projected. Therefore, the area on the eye upon which the form of the visible object is projected and the angle containing the visual cone that encompasses that area are factors that the sensitive faculty and faculty of discrimination cannot do without in perceiving the magnitude of the visible object.

[3.142] Still and yet, neither an evaluation of the angle by itself, nor an evaluation of the area on the eye subtending that angle, suffices on its own for the faculty of discrimination to perceive size, for, when a single visible object lying near the eye is perceived by sight, the sensitive faculty will perceive the location on the eye upon which the visible object's form is projected, and it will perceive the size of that location. Then, if that visible object is drawn farther away from the eye, it will still be perceived by sight, and the sensitive faculty will perceive the location on the eye

upon which the form is projected the second time, and it will perceive the size of that location. And it is clear that the location of the eye upon which the form is projected in the first place and the location of the eye upon which the form is projected afterward differ in size, for the [size of the] location of the form on the eye will depend upon the sizes of the angles encompassing the visible object at the center of sight. The farther away the visible object gets, the narrower the [visual] cone encompassing it will get, and [the narrower that cone gets, the narrower] its angle [will get], and [the narrower that angle gets, the narrower] the location on the eye upon which the form is projected [will get]. So when the sensitive faculty perceives the location upon which the form of the visible object is projected, and when it perceives the size of that location, it will perceive the decrease in size of that location according to the distance of the visible object from the eye.

[3.143] This situation occurs over and over again for sight; that is, visible objects continually recede from the eye, or the eye recedes from them, or they continually approach the eye, or the eye approaches them, and sight perceives them, and it perceives the decrease in the size of the locations of their forms on the eye with the increase in distance, and it also perceives the increase in the size of the locations of their forms on the eye with the decrease in distance. On the basis, therefore, of such repeated experience, it becomes ensconced in the soul that, as far as the faculty of discrimination is concerned, the farther the visible object recedes from the eye, the smaller the location of its form on the eye becomes, and [the smaller that location becomes, the smaller] the angle at the center of sight encompassing the visible object [becomes]. When this happens, it is established in the faculty of discrimination that [the size of] the area upon which the visible object's form is projected, as well as the angle at the center of sight encompassing the visible object, depends entirely on the distance of the visible object from the eye. And when this fact is ensconced in the soul, then, if the faculty of discrimination determines the size of a visible object, it will not evaluate the angle alone but will evaluate the angle and the distance together, for it has been established for it that the angle will depend entirely upon the distance. Thus, the sizes of visible objects will be perceived only through differentiation and correlation. But the correlation through which the size of the visible object is perceived involves a correlation of the base of the visual cone, which is the surface of the visible object, to the angle of the cone as well as to the magnitude of the length of the cone, which is the distance of the visible object from the eye. Furthermore, the evaluation [carried out] by the faculty of discrimination invariably includes [an evaluation of] the area on the surface of the sensitive organ upon which the form of the visible object is projected along

with an evaluation of the distance of the visible object from the surface of the eye, for the size of the area upon which the form is projected will invariably depend on the size of the angle encompassing that area at the center of sight. For the most part, moreover, the difference between the distance of the visible object from the surface of the eye and its distance from the center of sight has no effect [on the perception of] distance.

[3.144] It has also been shown that the sensitive faculty perceives the lines extending between the center of sight and the visible object, these lines representing radial lines, and it perceives the arrangement of these lines, as well as the arrangement of visible objects and the arrangement of the parts of any visible object.¹²⁴ When the sensitive faculty perceives this [set of arrangements], the faculty of discrimination perceives that the farther these [radial] lines extend from the center of sight, the larger the intervals between their extremities will get. But this fact is already ensconced in the soul, and along with it there is also ensconced in the soul the fact that, the farther the radial lines get from the center of sight, the larger the visible object at their extremities will be. Thus, when sight perceives a visible object and perceives its boundaries, it will perceive the [radial] lines along which it perceives the boundaries of that visible object. But the [radial] lines along which it perceives the boundaries of the visible object form the angle at the center of sight that encompasses that visible object, and they are also the [radial] lines encompassing the location on the eye upon which the form of the visible object is projected. Thus, when sight perceives those [radial] lines, the faculty of discrimination will imagine the extension of those [radial] lines from the center of sight to the boundaries of the visible object. And when, on that basis, it perceives the magnitude of the visible object's distance, it will imagine the magnitude of the length of those lines, as well as the extent of the interval between their endpoints, but the intervals between the endpoints of these lines form cross-sections of the visible object. So when the faculty of discrimination imagines the size of the angle, the magnitude of the lengths of the radial lines, and the extent of the intervals between their endpoints, it will perceive the actual size of the visible object.

[3.145] Now the [radial] lines that extend between the center of sight and the boundaries of any visible object perceived by sight are perceived by the sensitive faculty and the faculty of discrimination, and the sensitive faculty and the faculty of discrimination perceive the size of the area on the eye upon which the form of that visible object is projected. And when the faculty of discrimination perceives the radial lines, it will perceive their relative spatial disposition, and it will perceive their convergence or divergence, and it will perceive how they extend. To complete the perception of the visible object's size, then, nothing remains but [to

determine] the magnitude of the visible object's distance.

[3.146] It has already been shown in [the discussion of] how the distance of a visible object is perceived that the distance of any visible object is perceived by sight either precisely or by estimation.¹²⁵ So when the faculty of discrimination perceives the spatial disposition of the radial lines encompassing the boundaries of the visible object, and when it perceives the size of the area they demarcate on the surface of the sensitive organ, which is [a function of] the size of the angle, and when it also imagines the magnitude of the visible object's distance, then it will immediately imagine the size of the angle and that of the distance together. And when it imagines the size of the angle and the magnitude of the distance together, it will perceive the size of the visible object according to the size of the angle and the magnitude of the distance together. So the faculty of discrimination imagines the magnitude of the distance of any visible object perceived by sight, and it imagines the [radial] lines encompassing its boundaries, and by means of this conceptual process, the form of the visual cone that encompasses the visible object will occur to it along with the size of the cone's base, which is formed by the visible object.¹²⁶ And so the size of the visible object will occur to it.

[3.147] Evidence that the perception of a visible object's size will occur through a correlation of the object's [apparent] size to its distance is found in the fact that, when sight perceives two visible objects that lie at different distances but subtend the same angle at the center of sight—i.e., such that the rays passing through the endpoints of the first of those objects extend to the endpoints of the second—and if the first of those objects does not block the second one entirely, and if sight accurately perceives the distance of each of them, the farther visible object will always appear larger to sight than the nearer one. Moreover, the greater the distance of the farther visible object becomes, the larger it will be perceived to be, as long as sight accurately determines the magnitude of its distance. For instance, if an observer looks at a wall that lies at a moderate distance from the eye, and if he accurately determines the distance and size of that wall, and if he accurately determines the magnitude of its breadth, then, if the observer places his hand in front of one of his eyes between the center of sight and the wall and closes the other eye, he will find that his hand will cover a considerable portion of that wall. Yet he will perceive the size of his hand in that situation, and he will perceive that the size [of the portion] of the wall covered by his hand is much larger than the size of his hand, and sight will perceive the radial lines and will perceive the angle formed by these radial lines. In this case, then, sight perceives that the angle subtended by the hand and by the wall is the same angle, and it also perceives that the portion covered by the hand is

much larger than the hand. And since this is so, the faculty of discrimination, in arriving at this perception, perceives that the farther of the two visible objects lying at different distances and subtending the same angle is larger.

[3.148] Afterward, if the eye is shifted in this situation, and the observer looks at another wall farther away than that [first] wall, and if he places his hand between the eye and that [second] wall, he will find that the portion of the second wall covered [by his hand] is larger than the portion of the first wall covered [by his hand]. And if he then looks at the sky, he will find that his hand will cover half of what appears of it, or at least a large portion of it. Nonetheless, the observer will not doubt that, as far as sensation is concerned, his hand is nothing in comparison to the portion of the sky that is covered by it. It has therefore been shown on the basis of this experiment that sight does not perceive a visible object's size through a correlation of angles alone, but through a correlation of the visible object's [apparent] size to the magnitude of its distance, as well as through a correlation of angles. Moreover, if perception of the size of a magnitude were determined by angle alone, two visible objects lying at different distances and subtending the same angle at the center of sight would have to appear equal, but such is not the case. Therefore, the size of a visible object is perceived by [the faculty of discrimination] only through its imagining the cone that encompasses the visible object, while imagining the size of the angle of the cone and the length of the cone, and then correlating the [size of the] base of the cone to the size of its angle and its length, all at the same time. This is how size is perceived.

[3.149] Sight is so accustomed to determining the distances of visible objects that, when it senses both the form and the distance of the visible object, it will immediately imagine the size of the location of the form and the magnitude of [the object's] distance, and, by combining these two notions, it will perceive the size of the visible object. Nevertheless, the magnitudes of the distances of visible objects form part of the set of magnitudes that are perceived by sight. And it has already been pointed out that the magnitudes of some distances of visible objects are perceived accurately, whereas others are perceived through estimation,¹²⁷ and [it has been pointed out] that those magnitudes that are perceived through estimation are perceived by assimilating the distance of the visible object to distances like it among visible objects whose distances are accurately determined,¹²⁸ and [it has also been pointed out] that distances that are precisely determined are ones that are spanned by a continuous, ordered range of bodies.¹²⁹ So it is through perception by sight of the continuous, ordered bodies spanning their distances, as well as from the accurate determination of the sizes of those bodies, that the magnitudes of the dis-

tances of the visible objects flanking those bodies will be perceived. It remains, therefore, to explain how sight will perceive the magnitudes of the distances of visible objects that are spanned by a continuous and ordered range of bodies and how it accurately determines the sizes of the continuous and ordered bodies that span the distances of visible objects.

[3.150] For the most part, the bodies that are ranged in continuous order over the distances of visible objects consist of portions of the ground. And the familiar visible objects that are continually perceived by sight stand on the earth's surface, and the ground lies between them and the body of the person who is observing. And the magnitudes of the portions of the ground that lie between the viewer and visible objects standing on the face of the earth and that span the distances between those visible objects and the eye are continually perceived by sight. Moreover, the magnitudes of the portions of the ground that lie between the viewer and visible objects standing on the face of the earth are perceived only if sight measures them against one another and measures the portions of the ground far away from the center of sight against portions of the ground that are near it and have had their magnitudes accurately determined. Then, given how often sight perceives [such] portions of ground and how often it measures them, it will perceive the magnitudes of the portions of the ground that are at [the viewer's] feet by recognizing them and by assimilating them to ones like them that have already been perceived. Thus, when sight looks at the portion of the ground lying between it and a visible object, it will realize its magnitude because of how often it perceives portions of ground similar to that one. And this perception is among those that the sensitive faculty acquires from the very beginning of [a person's] development. And so [notions of] the magnitudes of the distances of familiar objects will become impressed in the imagination and ensconced in the soul so that a person does not notice how they have become ensconced there.

[3.151] Now the way in which the portions of the ground between the viewer and visible objects are initially perceived is as follows: the very first portion to have had its magnitude accurately determined by sight is the one at the [viewer's] feet, for the magnitude of the portion at the [viewer's] feet is perceived by sight and by the faculty of discrimination. But that faculty determines [its size] on the basis of the measure of the human body, for what lies at the feet is always measured unconsciously by a person according to his feet when he paces over it, or according to his arm, when he extends his hand to it. So everything on earth that is near a person is invariably measured unconsciously in terms of the human body, and sight perceives this measure and senses it. The faculty of discrimination, meanwhile, perceives this measure and understands it, and on that

basis it accurately determines the magnitudes of the portions of the ground immediately surrounding the human body. Thus, the magnitudes of the portions of ground near any person have already been grasped by the sensitive faculty as well as by the faculty of discrimination, and their forms have already been imagined by the faculty of discrimination and ensconced in the soul. But sight perceives these portions of ground continually, and the sensitive faculty senses the [radial] lines that extend from the eye to the extremities of these portions when sight perceives them and when it examines the whole of the ground [before it]; it also perceives the areas on the surface of the sensitive organ where the forms of those portions of ground are projected, and it perceives the magnitudes of those areas on the eye as well as the size of the angles subtended by those areas on the eye. Thus, the angles subtended by the portions of the ground near any person are realized by the sensitive faculty over the course of time, and their forms are imagined in the soul. Also, the lengths of the radial lines extending from the center of sight to the extremities of the portions of the ground near any person are perceived by the sensitive faculty and by the faculty of discrimination, and they are accurately determined by them, for the lengths of those [radial] lines are always measured unconsciously in terms of the human body. Therefore, when a person stands upright and looks toward the ground at his feet, the lengths of the radial lines will depend on the height of the standing person, and the faculty of discrimination will realize with certainty that the distance between the eye and that portion of the ground is the height of the standing person.

[3.152] So the extent of the areas on the ground immediately surrounding the human body is realized and perceived by the faculty of discrimination, and their forms are ensconced in the soul. When sight looks at a portion [of the ground] at the [viewer's] feet, then, the sensitive faculty will immediately perceive the [radial] lines extending out to the extremities of that part, and the faculty of discrimination will imagine the lengths of the [radial] lines extending out to its extremities as well as the sizes of the angles formed by those [radial] lines. And when the faculty of discrimination imagines the lengths of those [radial] lines and the sizes of the angles formed by those [radial] lines, it will accurately perceive the magnitude of the space between the endpoints of those [radial] lines. It is in this way, then, that the magnitudes of the parts of earth encompassing some portion of the ground¹³⁰ are accurately determined by the sense of sight.

[3.153] Subsequently, the magnitudes of the portions of ground at the next remove from these portions are perceived by sight through a comparison of the lengths of the radial line-segments that extend to their extremities to the lengths of the rays that extend to the initial portions [of

ground] immediately surrounding the person. And thus the faculty of discrimination compares the radial lines reaching a third location to the second rays that mark the dividing-line between the first and second portions [of ground], and it perceives the increase in length of the third ray over that of the second one. And when it senses this, it will sense the length of the third ray, and it will accurately perceive the length of the second ray. The length of the two rays comprehending the second portion of ground will thus have been accurately determined by the faculty of discrimination, and their spatial disposition will have also been accurately determined by it. And when it perceives the length and spatial disposition of the two rays, it will accurately perceive the [magnitude of the] interval between their endpoints.¹³¹ It is in this way, therefore, that the faculty of discrimination will also perceive the extent of the portions of ground at the next remove from those at the [viewer's] feet.

[3.154] Moreover, the portions of ground at the next remove from those at the [viewer's] feet are invariably measured in terms of the human body. For when a person paces over the ground, he will measure the ground over which he paces according to [the measure of] his feet and his pace, and the faculty of discrimination will perceive its extent. And when a person traverses the location where he was and continues to pace over successive portions [of ground] with his feet, when he comes to those successive portions of ground, he will measure them in the same way he measured the previous ones, and he will perceive those successive portions of grounds in the same way he did the previous ones. And this perception will be absolutely determinate, and so his first perceptual determination will be corroborated by this second perceptual determination. Hence, if its extent was not accurately determined by the first perceptual pass, it will be accurately determined by the second. And this comparative measurement is invariably perceived by the sensitive faculty, and it avails itself of such measurement without any conscious effort, and when some portion of ground is scanned by sight, the sensitive faculty and the faculty of discrimination perceive its measure automatically rather than through conscious effort. Then, because of the continual recurrence of this process, the extent of the portions of ground passed over by the feet is accurately determined, as is the extent of the portions next in order. In this way, then, the sensitive faculty and the faculty of discrimination grasp the magnitudes of the portions of ground immediately surrounding a person and lying between his eye and visible objects, and this grasp occurs at the very beginning of a person's development. Subsequently, through their sensitive and discriminative faculties, people grasp the magnitudes of the distances of familiar visible objects standing on the face of the earth. Thus, the perception of the distances of familiar

visible objects standing on the face of the earth will be due to recognition and the assimilation of those distances to one another.¹³²

[3.155] Now this is not to say that the perception of the magnitudes of the distances of visible objects, which is carried out by the sensitive faculty and the faculty of discrimination, is a matter of perceiving the number of cubits that a given distance is; rather, the viewer derives a determinate, imagined magnitude from some given distance and some given portion of ground, and he compares such determinate magnitudes to the magnitudes of the distances he perceives later. Likewise, it is from the cubit, or the palm's-breadth, or some other measured magnitude that he derives a determinate magnitude. Thus, when a viewer perceives some space and wants to know how many cubits it spans, he will compare the form of that space that has been derived by the imagination to the form of a cubit that has been acquired by the imagination, and, on the basis of this comparison, he will perceive the magnitude of the space in terms of cubits.¹³³

[3.156] It is also normal for a person, when he wants to determine some property accurately, to look at it repeatedly, to differentiate its particular characteristics, and to take his time examining it, and thus he will perceive that property as it actually exists. Therefore, when the viewer perceives any visible object on the ground and wants to determine its distance accurately, he will scrutinize the portion of ground lying directly between him and the visible object, and he will move his line-of-sight along it. And so he will move his visual axis over that portion of ground, and he will measure it, and he will perceive it according to its individual parts, and he will sense its small parts when the distance of the outer limit of this space is moderate. And when sight perceives the portions of the ground and perceives their small parts, the faculty of discrimination will perceive the magnitude of the entire space, for, by passing the visual axis over that space, the faculty of discrimination will accurately determine the size of the area on the eye upon which the form of that space is projected, the size of the angle subtended by that area,¹³⁴ and the length of the ray that extends to the outer limit of that space. When these last two characteristics are accurately determined by the faculty of discrimination, it will accurately determine the magnitude of the portion of ground that is seen. So too, the distances of objects, such as walls and mountains, that stand above the earth's surface and lie far away [from the viewer] are perceived by sight in the same way as the magnitudes of the portions of the earth are, and sight will perceive the distances of visible objects ranged along them by perceiving the magnitudes of their lengths. This, then, is how sight accurately determines the magnitudes of the distances of visible objects that lie at moderate distances, those distances being spanned

by a range of continuous, ordered bodies.

[3.157] Now some visible objects that stand on the ground lie at moderate distances, and the portions of ground lying between them and the center of sight are of moderate extent. But some lie at extreme and inordinate distances, and the portions of ground lying between them and the center of sight are of inordinate extent. But the extent of portions of ground is perceived by sight in the ways we have described. Accordingly, the extent of any of them that lies near [the viewer] and is of moderate size is perceived and accurately determined by sight, whereas the extent of any of them that lies at an inordinate distance is not accurately determined by sight. For when it examines intervals, sight perceives their extent as long as it senses the increase in the length of the rays, and as long as it senses the angles subtended by the small parts of the portions of space as the visual axis scans the space. And it will accurately determine the extent of the space as long as it senses a slight increase in the length of the ray and a slight increase in the angle subtended by the given space. But when the distance is extreme, sight will not sense the slight increase in the length of the ray, nor will it sense the motion of the ray over a small portion of a space that lies extremely far away, nor will it sense the angle subtended by a small portion [of ground] that lies extremely far away, nor will it accurately determine the length of the ray extending to the outer limit of the space, nor will it accurately determine the size of the angle subtended by that space. And since it does not accurately determine the length of the ray extending to the outer limit of that space, and since it has not accurately determined the size of the angle subtended by the space, it will not accurately determine the extent of the space.

[3.158] In addition, when the distance is extreme, the small portions [of ground] that lie at the outer limit of the space are not perceived or distinguished by sight, for a small magnitude disappears from sight at an extreme distance. Thus, when the visual axis is moved over a space that is inordinately far away, and when it reaches the outer limit of that space, it will pass over a small portion of the space, so the sensitive faculty will not sense its motion, because a small portion [of ground] at an extreme distance does not subtend a perceptible angle at the center of sight. So if the visual axis moves over a distant space, and if sight senses that it has just passed over some portion of that space, then the extent of the portion it has passed over will not be the extent perceived through sense; rather, it will be larger.¹³⁵ And as the space extends out farther, the portions [of ground] toward the outer limit of the space that disappear from sight will become larger, as will the portions over which the motion of the rays is not sensed. Thus, the extent of extreme distances on the ground are not accurately determined by sight, because it cannot accurately determine

the length of the ray[s] extending to their outer limit, nor can it accurately determine the size of the angle subtended by that space.

[3.159] Furthermore, the sensitive faculty senses the fact that the magnitude of the space has been determined, for a visible object that lies near the eye at a moderate distance is seen more clearly [than one lying farther away] precisely because the forms of such [objects] are clearer and are more clearly perceived by sight. Moreover, their color and illumination are clearer to sight, as are the spatial dispositions of their surfaces and the spatial dispositions of their parts, and the form of their parts and the parts of their surfaces are clearer to sight.¹³⁶ Also, if there is some design or picture [in them], or [if they have] small subdivisions, those designs or subdivisions will appear more clearly to sight. But such is not the case for visible objects lying extremely far away. For when a visible object lies extremely far away, sight will not determine its form as it actually is but will be uncertain about its color, its luminosity, and the form of its surfaces, and none of the subtle characteristics or small subdivisions in it will appear. And this fact is evident to sense. Therefore, when sight perceives some space on the ground and immediately afterward sees its outer limit along with some visible objects at its outer limit, it will sense that the space lies at a moderate distance or lies inordinately far away. On the one hand, if it accurately determines the form of its outer limit or the form of a visible object at its outer limit with perfect clarity, and if, in addition, it distinguishes the extent of that space in the way previously described, then on that basis the faculty of discrimination will perceive that the extent of that space is accurately determined by perceiving the clarity of the form of its outer limit or the form of the visible object at its outer limit. On the other hand, if it does not accurately determine the form of its outer limit or the form of a visible object at its outer limit [with clarity], then it will not accurately determine the extent of that space. In addition to this, after having examined this space, the faculty of discrimination perceives that the extent of this space is not accurately determined because of the indefiniteness of the form of its outer limit or the form of the visible object at its outer limit.

[3.160] Therefore, the magnitudes of the distances of visible objects will be distinguished by sight while the way in which their magnitudes are perceived is accurately determined at the moment of perception, and if the viewer wants to accurately determine the size of a visible object or to accurately determine the magnitude of the distance of a visible object, he will scrutinize the distance and define it, and thus a determinate distance will be distinguished by him from an indeterminate one. Thus, the only distances of visible objects that are of a determinate size are those distances that are spanned by a continuous, ordered range of bodies and,

moreover, that are moderate. The magnitudes of these sorts of distances are therefore perceived by sight in the way we have shown, and no others are accurately determined by sight; instead they are estimated and assimilated—i.e., sight assimilates the distance of a visible object to ones similar to it among familiar visible objects whose distances have already been accurately determined by it. But the moment sight senses the indefiniteness of the form of a visible object that is due to [extreme] distance, it will be uncertain about how far away it is. Now a distance whose magnitude is accurately determined by sight is [considered] moderate when a portion of it that is of a perceptible size in relation to the whole and that lies at its outer limit does not disappear from sight. Moreover, with regard to a visible object whose size is [correctly] perceived by sight, a distance is [considered] moderate when, at its outer limit, a portion of that object that is of a perceptible size in relation to the whole does not disappear from sight if sight focuses on that part by itself. Thus, any space is [considered to be] of moderate extent if, in forming part of a length, it has a perceptible size in relation to the length as a whole, and if it is perceived by sight, so that no portion of the space, except one that has no perceptible size in relation to the length of that space, disappears from sight. A distance that is of inordinate extent, however, is one in which a [quantifiable] portion at its outer limit lacks perceptible size in relation to the length as a whole. And a distance that is inordinate with respect to sight is one in which any magnitude contained by it that has a perceptible size in relation to the whole disappears from sight, or when some characteristic of the visible object [at that distance] is invisible, that invisibility preventing the visual perception of precisely what that visible object is.

[3.161] The sensitive faculty will also perceive the magnitude of a visible object's distance according to the size of the [visual] angle subtended by the visible object. For, when it perceives familiar objects that lie at familiar distances, sight will immediately recognize them at the moment of perception, and when sight recognizes them, it will recognize their sizes, for their sizes will already have been accurately determined on account of the frequency with which any of the familiar visible objects has been perceived, so they [will] have become ensconced in the imagination. Moreover, as soon as it perceives a familiar visible object, sight perceives the area on the eye upon which the form of that visible object is projected and which corresponds to that form. Then, when the sensitive faculty perceives the size of the visible object through recognition, and when it perceives the angle subtended by that visible object at this time, it will perceive the magnitude of the distance of the visible object in that situation, for the angle subtended by that visible object will depend entirely on the magnitude of the distance.¹³⁷ And just as the sensitive faculty gets an

indication of the size and distance [of the object] from that angle, so too it gets an indication of the magnitude of its distance from the size that is recognized by it along with the angle. For that magnitude subtends that angle at that particular distance alone, or at one equal to it, not at every distance. And since the sensitive faculty perceives the magnitude of the distance of that familiar visible object with great frequency, during which times that visible object subtends a similar angle at the center of sight, and since it will have gotten continual indications of the size of that visible object from the magnitude of the distance of that visible object along with the size of an angle equal to that [currently perceived] angle, the faculty of discrimination will apprehend the magnitude of the distance at which it perceives the size of that visible object in relation to that angle. And when the faculty of discrimination apprehends the magnitude of the distance of that visible object in relation to that angle, and when at that distance it perceives the size of that visible object with respect to that same angle at the time the faculty of discrimination recognizes that visible object, and when it recognizes its size, having perceived it before, and when it immediately perceives the size of that angle subtended by that visible object at this time, it will perceive the magnitude of the distance according to which that particular distance corresponds to that particular angle. Thus, the sensitive faculty perceives the magnitude of the distances of familiar visible objects by correlating the angle to the size of the visible object. Then, from continual reiteration, the sensitive faculty will perceive the distance of a familiar visible object through recognition. At the time the angle is perceived and the familiar visible object is recognized, the size of the angle subtended by the visible object will serve as an indication of the magnitude of the distance of that visible object, and the majority of the distances of familiar visible objects are perceived in this way. But this perception is not particularly accurate, although there is no significant discrepancy between the distance [derived in this way] and the correctly determined distance, so it is from this [type of] perceptual process that the mathematicians have supposed that the size of any visible object is perceived through the angle.¹³⁸ Thus, when sight perceives familiar visible objects that lie at familiar distances, and when it recognizes the magnitudes of their distances in this way, it will, for the most part, arrive at the truth of the matter in regard to the magnitudes of their distances, or there will be no significant discrepancy between the magnitudes of their distances as perceived by it and the true magnitudes of their distances.

[3.162] In the case, however, of the magnitudes of the distances of unfamiliar visible objects that it does not perceive with frequency, sight generally errs, although sometimes it may find itself reckoning their sizes

[correctly] in this way. According to the ways we have described, then, the magnitudes of the distances of visible objects are perceived by the sense of sight.

[3.163] Having shown how the magnitudes of the distances of visible objects are perceived, and having analyzed the distances of visible objects, we shall now analyze the [kinds of] magnitudes of visible objects that are perceived by sight as well as analyzing their perception by sight. Accordingly, we should say that the [kinds of] magnitudes that sight perceives from a facing position are the magnitudes of visible surface, the magnitudes of the parts of visible surfaces, the magnitudes of the boundaries of visible surface, the magnitudes of the boundaries of the parts of visible surfaces, the magnitudes of the intervals between the boundaries of the parts of visible surfaces, and the magnitudes of the intervals between individual visible objects. These are the only kinds of magnitudes that sight perceives from a facing position. Now the size of the body of a visible object is not perceived by sight from a facing position, for sight does not perceive the entire surface of a body from a facing position; it perceives only that portion of its surface that faces it, even if the body is small. And if sight does perceive the mass of the body, it will perceive not the size of its body but, rather, the shape of its mass. Thus, if the body is moved, or if the eye moves so that sight perceives the body's entire surface [directly] by sensation or through defining features, then the faculty of discrimination will perceive the sizes of its mass by means of a secondary deduction beyond the deduction that is used during the visual process itself. Likewise, when it perceives the size of the mass of any part of the body, the faculty of discrimination will only perceive it by means of a secondary deduction beyond the deduction that is used during the visual process itself. Thus, the magnitudes that sight perceives from a facing position are only the sizes of the surfaces or lines that we have specified.

[3.164] It has already been shown that the perception of size is due only to a correlation of the base of the visual cone encompassing the size to the angle of the cone at the center of sight and to the length of the cone, which represents the magnitude of the distance of the visible object.¹³⁹ It has also been shown that certain distances of visible objects are accurately determined, and certain of them are estimated.¹⁴⁰ The sizes of visible objects whose distance is accurately determined are perceived by sight through a correlation of their sizes to the angles subtended by those magnitudes at the center of sight, as well as to their determinate distances. Thus, the perception of the magnitudes of the distances of such visible objects will be a determinate perception. The magnitudes of the distances of visible objects whose distance is estimated, not determinate, however, are perceived by sight through a correlation of their size to the angles

subtended by those magnitudes at the center of sight, as well as to their estimated, not determinate, distances. Accordingly, the perception of the magnitudes of the distances of such visible objects will not be accurately determined. When the sensitive faculty wants to determine the size of any visible object with accuracy, then, it will move the line-of-sight over its cross-sections, and so it will move the visual axis over all portions of the visible object. Hence, if the distance of the visible object is extreme, the indefiniteness of its form will be immediately revealed to the sense, and it will be obvious to the sensitive faculty that its size is not accurately determined. But if the distance of the visible object is moderate, then the determinate nature of its visual perception will be immediately revealed to the sense. Accordingly, if the visual axis is moved over a visible object of this sort, sight will measure it correctly, and it will perceive its parts, and it will accurately determine the sizes of its parts. And through [such] motion sight will accurately determine the sizes of the areas on the surface of the sensitive organ upon which the form of the visible object is projected as well as the size of the angle of the visual cone subtended by that part. Then, if it wishes to accurately determine the distance of that object on the basis of some intervening entity, sight will accurately determine the extent of that entity by the [axial] motion [just described], the [overall] extent [of that entity] being virtually equal to the lengths of the radial lines.¹⁴¹ So when the sensitive faculty accurately determines the magnitude of the visible object's distance and the size of the angle forming the cone that encompasses the visible object, it will accurately determine the size of that visible object.

[3.165] Now the motion of the [visual] axis over the parts of the visible object will not be due to a rotation of the axis from the center of the eye, or through its independent motion over the parts of the visible object, for it has already been shown that this line always extends directly to the place where the nerve to which the eye is attached flexes.¹⁴² And since its situation does not change with respect to the [center of] the eye, but, rather, the entire eye moves in opposition to the visible object while the central location, which is the center of the sense of sight, faces any part of the visible object, and since the entire eye will move in opposition to the visible object, the [visual] axis will pass over every part of the visible object. And so the form of any part of the visible object extends to the eye straight along the [visual] axis when the axis reaches it. Still, the [visual] axis will remain fixed in its situation, so it will not change its situation with respect to any part of the eye as a whole. And, under this condition, its rotation will be due solely to the motion of the entire eye at the place in the eyesocket where the nerve [flexes].

[3.166] So when sight wishes to inspect a visible object and begins to

examine it at the extremity of the visible object, the endpoint of the [visual] axis will then lie upon the outer edge of the visible object. In that case, then, the majority of the [form representing the] whole visible object will lie on an area of the surface of the eye that is inclined to, or to the side of, the [visual] axis away from where the axis lies, for the form of the object's edge will be in the middle of the eye where the [visual] axis lies, so the rest of the form will be inclined to, or to the side of, the [visual] axis. Afterward, as sight moves beyond this position over [one or] another cross-section of the visible object, the [visual] axis will be shifted to a part next to that [original] part of the visible object, and the form of the first part will be inclined to the [new] place to which the [visual] axis is moved. Nor at any time after will that form stop inclining away as long as the [visual] axis moves along that cross-section until the axis reaches the endpoint of that cross-section of the visible object and to the opposite side of the visible object from the first part. In this case, then, the form of the entire visible object will be inclined [to the visual axis] on the opposite side of where it was originally inclined, except for the final part at the extremity which [originally] lay on the [visual] axis at the center of the eye['s surface]. But, throughout this motion the [visual] axis will remain fixed in its situation [relative to the eye as a whole], and this motion will be extraordinarily swift, so it is generally imperceptible on account of its swiftness. Furthermore, during its motion, the [visual] axis does not coincide with the endpoints of the angle subtended by the visible object at the center of sight, nor does it mark out a slice corresponding to the angle subtended by any of the cross-sections of the visible object, for this would only occur if the [visual] axis moved on its own account while the rest of the eye remained immobile, which is impossible.¹⁴³ Instead, the entire eye moves during inspection, and the axis moves along with its motion. However, the sensitive faculty only perceives the size of the angle subtended by the visible object at the center of sight by perceiving the size of the part of the surface of the eye in which the form of the visible object is delineated and by imagining the angle subtended by that part at the center of sight.

[3.167] Now the sense of sight perceives the sizes of the areas of the eye on which the forms are delineated naturally, and it imagines the angles subtended by those areas naturally.¹⁴⁴ But the sensitive faculty does not accurately determine the form of the visible object or the object's size by the motion of the eye unless, according to that motion, it perceives every portion of the parts¹⁴⁵ of the visible object through its midpoint or the point on the eye where the axis lies. Through this motion the form of the visible object moves over the surface of the eye, and so the area on the eye's surface where the form lies will change, because, as the motion con-

tinues, the form of the visible object will shift area-by-area on the eye's surface. Yet every time the sensitive faculty perceives the part of the visible object at the end of the visual axis, it will also perceive the entire visible object, and it will perceive the entire area on the eye's surface upon which the form of the entire visible object is projected, and it will perceive the size of that area, and it will perceive the size of the angle subtended by that area at the center of sight. And so the sensitive faculty will repeatedly perceive the size of the angle subtended by that visible object. As a result, this angle will be accurately determined by the sensitive faculty, while the faculty of discrimination will apprehend the size of the angle as well as the magnitude of the distance, and from these it will perceive the visible object's actual size. This, then, is how the visual inspection of visible objects is carried out by sight and how the size of visible objects is accurately determined through visual inspection.

[3.168] In addition, when sight perceives the lengths of the radial lines extending between the center of sight and the extremities of the visible object or the areas on the surface of the visible object, it will sense the equality or inequality of their lengths. If, on the one hand, the surface of the visible object that sight perceives is oblique, it will sense its obliquity by sensing the inequality of the magnitudes of the distances of its extremities [from the center of sight]. But if the surface faces the eye directly, sight will sense its facing disposition by sensing the equality of the distances [of its extremities from the center of sight]. Accordingly, the size [of the object] does not escape the faculty of discrimination, because it is from the inequality of the distances of the endpoints of the cross-sections of an oblique magnitude [from the center of sight] that the faculty of discrimination perceives the obliquity of the cone that encompasses the object, and from that it will sense the change in the size of its base that is due to obliquity.¹⁴⁶ Moreover, it will not confuse the size of an oblique magnitude with the size of a directly facing magnitude through assimilation unless the correlation is based on angle alone. But if the correlation is based on angle as well as on the lengths of the radial lines extending between the center of sight and the extremity of the visible object, it will be certain about the size of the magnitude.

[3.169] The magnitudes of lines and intervals are perceived by sight through the perception of the magnitudes of the distances of their extremities and through the perception of the inequality or equality of those distances. But the farther, or the farthest, moderate distance with respect to a visible object when that object is oblique is less than the farthest moderate distance with respect to that same visible object when it faces the eye directly. For a moderate distance for a visible object is one at which a part of the visible object that has a perceptible size with respect to the

whole does not disappear from sight. But when a visible object is oblique, the angles formed by the two rays extending¹⁴⁷ from the center of sight to any part on the oblique visible object will be smaller than the angle formed by the two rays extending from the center of sight to that same part, at the same distance, when the visible object faces the eye directly. So, when the visible object is oblique, a part that has a perceptible size with respect to the whole disappears from sight at a shorter distance than that same part does when the visible object faces the eye directly. Thus, the farthest moderate distance with respect to an oblique visible object is smaller than the farthest moderate distance with respect to that same visible object when that visible object faces the eye directly. Furthermore, when it is oblique, the entire visible object disappears from sight at a shorter distance than it does when it faces the eye directly, and its size decreases [more quickly] at a shorter distance than it does when it faces the eye directly.

[3.170] Therefore, visible objects have their sizes accurately determined by sight when they lie at a moderate distance and when that distance is spanned by a continuous, ordered range of bodies, and sight perceives their sizes by correlating them to the angles of the cones of rays that encompass them and to the lengths of the radial lines. But [what are considered] moderate distances for any given object depend on the spatial disposition of that object in terms of an oblique or a directly facing orientation. The angles are accurately determined only if sight scans the cross-sections of the surface of the visible object or those of whatever magnitude it wishes to determine, and distance is accurately determined through the motion of the visual axis over the body spanning the distances of the extremities of that surface or that interval. On the whole, the form of the distance, as well as the form of the visible object lying at a moderate distance (provided that this distance is spanned by a continuous, ordered range of bodies), occur simultaneously in the imagination at the moment the visible object is visually inspected, which is when sight perceives the body spanning the distance of the visible object as the visible object is perceived. Accordingly, the faculty of discrimination will perceive the size of the visible object according to the magnitude of the form of its determinate distance along with the visible object's own form. Hence, the sizes of such visible objects alone are correctly perceived by sight. According to the way we have described, then, the sizes of visible objects are perceived by the sense of sight.

[3.171] We shall explain later, in our discussion of visual deceptions, why a visible object is perceived to be smaller than it actually is at an extreme distance, and why a visible object is perceived to be bigger than it actually is from very near, and we shall discuss the causes of these decep-

tions [at that time].¹⁴⁸

[Perception of Separation]

[3.172] Separation between visible objects is perceived by sight from the separation of the forms of two bodies or of two distinct visible objects that reach the eye. But in the gap that separates any two distinct bodies there will be light or a colored and illuminated body, or there will be darkness. Therefore, when sight perceives two separated bodies, the form of the light, or the form of a body's color, or the form of the darkness that exists in the gap [between the bodies] reaches an area on the eye that lies between the forms of the two separated bodies that reach the eye. Moreover, there may be light, or color, or darkness in a body that lies between the two bodies and is contiguous with both of them. Therefore, if sight does not sense that whatever light or darkness exists in the gap [between the two bodies] does not exist in a body that is contiguous with the two bodies that flank it, it will not sense the separation of the two bodies. Furthermore, the surface of either of those two bodies slopes toward the area where the separation occurs. Therefore, the sloping of the two surfaces of the two bodies or of the surface of either of the two bodies may be obvious to sight, or it may not be.¹⁴⁹ Accordingly, if the sloping of the two surfaces of the two bodies or of the surface of either of the two bodies is evident to sight, then sight will sense the separation of the two bodies. Hence, sight perceives the separation of the bodies by perceiving any of the things we discussed: either by perceiving light where the separation occurs and sensing that this light lies behind the surfaces of the two separated bodies; or by perceiving a colored body where the separation occurs and sensing that it is different from both of the separated bodies; or by perceiving darkness where the separation occurs and realizing that it is darkness rather than a body contiguous with the two bodies; or by perceiving the slope of both of the surfaces of the two bodies where the separation occurs or the slope of the surface of either of the two bodies. Therefore, no separation between bodies is perceived by sight unless it is done so according to one of these conditions.

[3.173] A separation may exist between two distinct bodies, or it may exist between two bodies that are not [entirely] distinct—e.g., when two bodies, such as the fingers and members of an animal, or the branches of trees, are continuous according to certain parts and separated from one another according to other parts. In either case, though, sight only perceives the separation in the ways that we have described. Now it may happen that the separation of the bodies is [perceived] by recognition or by previous acquaintance, but that perception does not arise from visual

sensation.

[3.174] Some separations between bodies are wide, and some are narrow. A wide separation does not generally escape sight because of the appearance of a body spanning the distance of separation, according to which that body appears distinct from both of the separated bodies, or because of [sight's] perception of light or of an illuminated gap in the distance [of separation]. A moderate or narrow separation is only perceived by sight at a distance in which a body the same size as the breadth of the distance [of separation] does not disappear from sight. If, however, the distance between the two bodies is [so] narrow [as to be] invisible, and if its distance from the eye is the same as that at which bodies of the same size as the breadth of the distance [of separation] disappear from sight, sight will not perceive that distance, even if the two bodies lie at a moderate distance from the eye, and sight perceives the two bodies correctly. For a moderate distance is one in which a magnitude that has a perceptible size with respect to the magnitude of the whole distance does not in any way disappear from sight, whereas a correct perception is one in which there is no sensible discrepancy at all between the perception and the reality of the visible object in respect to the visible object as a whole. The extent of the distance, however, may be of such a magnitude that it lacks perceptible size in comparison to the distance of the visible object, or it may lack perceptible size with respect to either of the two separated bodies, for a separation may be the size of a hair; nonetheless, this is not [necessarily] so tiny as to make the distance [represented by it] vanish. Thus, the separation between visible objects is perceived by sight in ways like those we have discussed.

[Perception of Continuity]

[3.175] Continuity, for its part, is perceived by sight from the absence of a distance [of separation]. Thus, if sight does not sense some distance [of separation] in a body, it will perceive the body as continuous, or if there is a hidden distance [of separation] in the body that is not perceived by sight, sight will perceive that body as continuous, even though there is separation in it.

[3.176] Moreover, sight perceives continuity and also differentiates between continuity and contiguity by perceiving the joining of two edges of two bodies. But sight does not judge that there is contiguity unless it has realized that each of the two contiguous bodies is different from the other, for the difference between two contiguous bodies can at times be found in two continuous bodies. Thus, if the sensitive faculty does not sense that each of the two contiguous bodies is different from the other

and separate from it, it will not sense contiguity but will judge that there is continuity [between them].

[Perception of Number]

[3.177] Number, as well as what is numbered, is perceived by sight, for at any given time sight perceives many individual visible objects at once, and when sight perceives that they are separate, it will perceive that each of them is different from the other, and so it will perceive a multitude. But the faculty of discrimination will perceive number on the basis of multitude. Thus, number will be perceived by the sense of sight through the perception of many individual visible objects when sight perceives them at the same time, and it perceives their individuality as well as perceiving that each of them is different from the other. This, then, is how number is perceived by the sense of sight.

[Perception of Motion]

[3.178] Motion is perceived by sight through a correlation of the moving object to another visible object, for when sight perceives a moving visible object while it perceives another visible object, it will perceive its spatial disposition with respect to that moving visible object.¹⁵⁰ So when the visible object is moving and the other visible object is stationary, at the time of motion the spatial disposition of the moving visible object will change with respect to [the spatial disposition] of the stationary visible object because of the moving visible object's motion. When sight perceives the moving object and at the same time perceives the other object [that is stationary], and when it also perceives the former's spatial disposition with respect to [that of] the latter, it will perceive its motion. Thus, motion is perceived by sight through the perception of a change in the moving object's spatial disposition with respect to that of the other [stationary] object.¹⁵¹

[3.179] Furthermore, motion is perceived by sight in one of three ways: from the relationship of the moving visible object to several [other] visible objects, from the relationship of the moving visible object to one visible object, or from the relationship of the moving visible object to the center of sight itself. In the first case, when sight perceives a visible object and its motion, and when it perceives that object in line with any [other] visible object, then perceives it in line with another visible object different from the first, while the center of sight remains fixed, it will sense the motion of that visible object. Moreover, when a visible object moves with respect to a single visible object, sight perceives the moving visible object,

as well as its spatial disposition with respect to the other visible object, and then perceives that its spatial disposition has changed with respect to that other visible object, [sensing] either that it has drawn farther away, or that it has drawn nearer, or that it has moved to the side, while the center of sight remains fixed; or else it perceives a change in the spatial disposition of any of the parts of the moving visible object with respect to that stationary visible object or a change in the spatial disposition of all of its parts with respect to the [stationary] visible object. It is in this last way that sight perceives the motion of a rotating visible object when someone compares it to another [stationary] visible object. Therefore, when sight perceives the [changing] spatial disposition of a moving visible object, or the [changing] spatial disposition of [all of] its parts, or the [changing] spatial disposition of any of its parts,¹⁵² it will perceive the motion of the moving visible object.

[3.180] Finally, when a visible object moves with respect to the center of sight, sight perceives the moving visible object while perceiving its place and its distance [from the eye]. So when the center of sight is fixed, but the visible object moves, the spatial disposition of the moving visible object will change with respect to the center of sight. Thus, if the visible object moves in the plane facing the eye, its place will change, and sight will sense its change of place, and when sight senses its change in place, it will perceive its motion, provided that the center of sight stays fixed.¹⁵³ If, on the other hand, the motion of the visible object is along the line-of-sight extending between the object and the center of sight, the visible object will either recede from or approach the center of sight by its motion. Then, when sight senses its receding or its approach, it will sense its motion, provided the center of sight remains stationary.¹⁵⁴ Finally, if the motion of the visible object is rotary, then it necessarily follows that the part of it directly facing the eye will change [place], and when that part of the visible object changes [place], and sight senses its change [of place], it will sense the motion of the visible object, provided the center of sight remains stationary. These, then, are the ways in which sight will perceive motion when the center of sight remains fixed in place.

[3.181] Sight will also perceive motion in one of these ways, even when the center of sight is moving. This will happen when sight senses a change in the spatial disposition of the moving visible object while sensing that this change is not due to the motion of the center of sight and while differentiating between the change in spatial disposition occurring in the visible object that is due to its own motion and the change in spatial disposition occurring in the eye that is due to the motion of the eye. Hence, when sight senses the change in the spatial disposition of the visible object and also senses that its change in spatial disposition is not due to the

motion of the center of sight, it will sense the motion of the visible object. Now the form of the moving visible object moves on the eye[*'s surface*] according to the object's motion. But sight does not perceive the motion of the visible object from the motion of its form on the eye alone; on the contrary, sight perceives the motion of a visible object only by comparing the visible object to another according to the ways we described.¹⁵⁵ For the form of a stationary visible object sometimes moves on the eye[*'s surface*] while that visible object remains immobile, and therefore sight does not perceive that it moves, because when sight moves with respect to facing visible objects, the form of each visible object facing the eye will move on the eye's surface according to its motion, whether the object is moving or is stationary.¹⁵⁶ But since sight is accustomed to the motion of the forms of visible objects on its surface [even] when those visible objects are stationary, it will not judge the object to be in motion from the motion of its form unless the form of another visible object reaches the eye, and unless sight perceives the change in spatial disposition of the [form of the] moving visible object with respect to the form of the other visible object, or unless [it perceives] a change of forms at the same place on the [surface of the] eye, which will happen in the case of rotation. Thus, motion is perceived by sight only in the ways we have listed.

[3.182] What kind of motion it is is perceived through the perception of the space over which the visible object moves when it moves as a whole, and sight determines the kind of motion it is when it determines the shape of the space over which the moving visible object moves. So when the visible object rotates, sight will perceive its motion as rotary by perceiving the sequential change of its parts on the eye with respect to some other visible object, or the change of any of its parts in consecutive order with respect to various visible objects, or the change of the parts of one visible object in consecutive order while the visible object, as a whole, remains fixed in place.

[3.183] Moreover, if the motion of the visible object is composed of rotary motion and locomotion,¹⁵⁷ sight will perceive that motion as composite by perceiving the change of the parts of the moving visible object with respect to the eye, or with respect to another visible object, while perceiving the motion of the visible object as a whole from its [original] location. It is therefore in these ways that sight perceives how visible objects move.

[3.184] Furthermore, sight does not perceive motion except over time, for motion occurs only over time, and every part of a motion occurs only over time. Now sight perceives the motion of a visible object only by perceiving the visible object in two different locations or according to two different spatial dispositions. But the location or spatial disposition of a

visible object changes only over time. Thus, when sight perceives a visible object in two different places or according to two different spatial dispositions, this will occur only at two different instants. But between any two different instants there is some time-interval. Thus, sight only perceives motion over time.

[3.185] We shall also point out that the time in which sight perceives motion must be perceptible, for sight perceives motion only by perceiving the visible object in two different locations, one after another, or according to two different spatial dispositions, one after another. Therefore, if sight perceives a moving visible object in a second location and does not at the same time perceive it in a first location where it perceived it before, the sensitive faculty will immediately sense that the instant at which it perceives the object in the second place is different from the instant at which it perceived it in the first place, whence it will sense the difference in the two instants. The same applies when sight perceives motion on the basis of the moving object's change in spatial disposition, for when it perceives the moving object according to a second spatial disposition and does not at the same time perceive it according to the first spatial disposition that it perceived before, it will immediately sense the difference in the two instants, whence it will perceive the time-interval between them. Therefore, the time in which sight perceives motion is necessarily perceptible.

[3.186] And since these points have been explained, we shall now recount what can be summarized from them. Accordingly, we shall observe that sight perceives motion by perceiving the moving visible object according to two different spatial dispositions at two different instants between which there is a perceptible amount of time, and this how motion is perceived by sight.

[3.187] Sight perceives variations in swiftness or slowness among motions, as well as equality among motions, by perceiving the spaces over which moving visible objects pass. Thus, when sight perceives two moving visible objects, and when it perceives the two spaces over which those two visible objects move, and when it senses that one of the two spaces passed over by the two moving visible objects in the same time is longer than the other, it will sense the [greater] swiftness of the visible object passing over the longer space. Furthermore, when the two spaces over which the two visible objects pass in the same time, or in two equal amounts of time, are equal, and when sight senses the equality of those spaces, it will sense the equality of the motion of the two moving objects. So too, when sight senses the equality of the two spaces along with the inequality of the two times over which the two motions take place, it will sense the [greater] swiftness of the moving object passing over the space

in less time; and, by the same token, when two moving objects pass over equal spaces in equal times, and when sight senses the equality of times and the equality of spaces, it will sense the equality of the two motions. We have now explained how sight perceives motion and how it differentiates motions, as well as kinds of motions and their equality or inequality.

[Perception of Rest]

[3.188] Rest is perceived by sight through perception that the visible object remains at the same location or in the same spatial disposition over a perceptible amount of time. Therefore, when sight perceives a visible object at the same location or according to the same spatial disposition at two different instants between which there is a perceptible time-interval, it will perceive that the visible object is immobile during that time. Moreover, sight perceives the spatial disposition of an immobile visible object with respect to another visible object or with respect to the center of sight itself. This, then is how the perception of the immobility of visible objects will be carried out by sight.

[Perception of Roughness]

[3.189] Roughness is generally perceived by sight from the form of light appearing on the surface of a rough body, for roughness consists of a variation in spatial disposition of the parts of the surface of a body, so, when light shines on the surface of that body, the raised portions will generally cast shadows. Meanwhile, when light reaches the depressed portions, it will also create shadows, so the raised portions will be exposed to light and revealed. If shadows are formed in the depressed portions, but no shadows exist on the raised portions, the form of light will vary on the surface of that body. On a smooth surface,¹⁵⁸ however, such is not the case, for the portions of a smooth surface are uniform in spatial disposition, so when light shines on them, the form of light will be uniform throughout the surface. Thus, the form of light on a rough surface is different from the form of light on a smooth surface. Sight, moreover, recognizes the form of light on rough surfaces and the form of light on smooth surfaces from the frequency with which it sees rough and smooth surfaces. Thus, when sight senses the light on the surfaces of bodies in the way it usually does for rough surfaces, it will impute roughness to that body. But when it senses light on the surface of a body in the way it usually does for smooth surfaces, it will impute smoothness to the surfaces of that body.

[3.190] Yet when the roughness is inordinate, the raised portions [of the surface] will be of a substantial size, and thus sight will perceive the elevation of those parts, and it will perceive the spatial disposition of the surface of the body by perceiving the distance between parts. So when sight perceives the variations in spatial disposition of the parts of the body's surface, it will perceive its roughness without having to evaluate the light.

[3.191] In addition, when the roughness of the body is inordinate, and light shines upon it, the form of light on its surface will vary to an inordinate extent as well. From the variation in the form of light, then, the distance between the parts, as well as the variation in their spatial dispositions, will be seen, and on this basis the roughness of the body will be apparent. Thus, if the light shining on a rough body comes from a location directly opposite the rough surface, and if the light is intense, sight will not perceive the roughness of this body unless it perceives the prominence of some portions [of its surface] and the depression of others.¹⁵⁹ So if the roughness of this body is inordinate, i.e., as great as possible, sight will perceive the separation between parts and the variation in their spatial dispositions, and it will generally perceive the roughness of the body. On the other hand, if the roughness is slight, and the depressed or hollow portions of that body are exceptionally small, the roughness will generally go unseen, and sight will never perceive the roughness of this body unless it carefully scans [all] portions of the body's surface from up close. Thus, when sight discerns the separation between parts of such a body,¹⁶⁰ as well as their elevation or depression, it will perceive its roughness. If, however, sight does not discern the separation between its parts, or the elevation and depression of its parts, it will not perceive its roughness. Roughness is therefore perceived by sight through the perception of variation in the spatial dispositions of the parts of a body's surface or from the form of light that sight is accustomed to seeing on the surfaces of rough bodies. In addition, sight recognizes roughness from an absence of uniformity. Therefore, if sight senses no uniformity in the body['s surface], it will judge it to be rough, but sight frequently errs in [judging] roughness when it tries to recognize it in this way. For a surface may be polished, but its polish may not be apparent because polished objects do not appear polished unless they are placed in a particular way [with respect to the eye].¹⁶¹

[Perception of Smoothness]

[3.192] Smoothness,¹⁶² which consists of uniformity in the surface of a body, is generally perceived by sight through the form of light that appears on the surface of a smooth body, sight being used to seeing that

[kind of] light on smooth surfaces. So when the light on the surfaces of the body is uniform, sight will recognize the smoothness of the surface through it. Sometimes, too, sight perceives smoothness through close scrutiny. Accordingly, when sight scrutinizes the surface of a smooth body, it will perceive the uniformity of its parts, and so it will perceive its smoothness.

[3.193] Polish, which constitutes extreme smoothness, is perceived by sight through the dazzling light on the surface of a polished body. Thus, smoothness is perceived by sight through the perception of the uniformity of the surface. The uniformity of the surface, for its part, is generally perceived by sight through the uniformity of the light on the surface of the body, whereas polish is perceived by sight from the dazzling light on the surface of the body and from the spatial disposition [of the body] according to which the light is reflected.

[3.194] But sometimes roughness and smoothness coexist in the same surface, insofar as some bodies have surfaces with portions that are raised or depressed according to various spatial dispositions, or some portions of the portions are raised or depressed according to various spatial dispositions whereas others are uniform in spatial disposition, the result being that the surface as a whole is rough, whereas some of its portions are smooth. So the roughness of such a surface is perceived by sight from the perception of variations in spatial disposition among the prominent and depressed portions, whereas the smoothness of the [smooth] portions is perceived through the form of light that is perceived by sight on the surfaces of [those] portions. Sometimes, though, sight perceives the smoothness of such portions through close scrutiny and the [resulting] perception of the uniformity of each of them on the surface. It is in these ways, then, that sight perceives smoothness, polish, and roughness.

[Perception of Transparency]

[3.195] Transparency is perceived by sight through a deduction based on the perception of what lies behind a transparent body. But the transparency of a transparent body is not perceived by sight unless there is some opacity in it, and unless its transparency is less absolute than that of the air intervening between the eye and the transparent body. Indeed, if its transparency is absolute, sight will not perceive its transparency, so it will not perceive anything except what lies behind it.¹⁶³ If, however, there is some transparency in it, it will be perceived by sight according to the opacity it possesses. And its transparency is perceived through the perception of what lies behind it, for when there is light or an illuminated, colored body behind a transparent body, it will be seen behind the trans-

parent body. But sight does not sense the transparency of the body when it senses what lies behind it unless it senses that the color and light that are perceived behind the transparent body are light and color [that actually lie] behind the transparent body, not light and color belonging to the transparent body itself. If not, it will not sense the transparency of the transparent body. So if there is neither light nor an illuminated body behind the transparent body, or in its vicinity, and if no light or color appears behind it or anywhere in its vicinity, then the transparency of that body is not perceived. This will be the case when a transparent body is placed against some opaque body that encompasses it or that coincides with it, and the transparent body is of a dark color.¹⁶⁴ For in that case sight will not sense the transparency of this body.

[3.196] The same applies if the region behind the transparent body is dark, and no light appears behind it.¹⁶⁵ Thus, when sight senses that the color it perceives behind the transparent body belongs to a body behind the transparent body, it will sense the transparency of the transparent body. Likewise, when the transparent body is only slightly transparent, and the body that lies behind it is feebly lit, as are the bodies in its vicinity, then its transparency is not perceived by sight unless the form of light is directly behind the transparent body. For if sight apprehends light behind it, it will perceive its transparency. These, then, are the ways in which sight perceives the transparency of transparent bodies.

[Perception of Opacity]

[3.197] Opacity is perceived by sight through the absence of transparency. So when sight perceives a body but senses no transparency in it, it will deduce its opacity.

[Perception of Shadow]

[3.198] Shadow is perceived by sight in relation to the light of an object that casts light or a portion of light, for shadow is the absence of some light in the shaded area, which is illuminated by light other than the light blocked from that shaded area.¹⁶⁶ And when sight senses some object next to that shaded area, and the light on that neighboring object is more intense than the light in the shaded area, it will sense the darkening of that area and the absence in it of the light shining upon the body in its vicinity. For when sight senses any light in any given place, but that place is not exposed to sunlight or some other intense light, it will sense the darkness of the place and the absence of sunlight or any intense light in that place. Moreover, sight may sense the body that casts the shadow, or

it may not immediately discern the body casting the shadow. Eventually, though, when sight perceives the area that is feebly lit while it perceives that the bodies abutting on the area of faint light are more intensely lit than that feebly lit area, it will immediately sense the shadow in that area. This, then, is how sight perceives shadow.

[Perception of Darkness]

[3.199] Darkness, however, is perceived by sight through deduction on the basis of the absence of light. Thus, when sight perceives some location and does not perceive any light [whatever] in it, it will sense its darkness.¹⁶⁷

[Perception of Beauty]

[3.200] Beauty is perceived by sight from the perception of particular characteristics, the means of their perception having already been explained. For each of the aforesaid particular characteristics will create some form of beauty on its own, whereas in conjunction they create other forms of beauty. But sight only perceives beauty in the forms of visible objects that are perceived by the sense of sight, and the forms of visible objects consist of particular characteristics that have already been discussed. So sight perceives forms by perceiving these characteristics; hence, it perceives beauty by perceiving these characteristics.¹⁶⁸

[3.201] There are many kinds of beauty that are perceived by sight in the forms of visible objects. Accordingly, some are due to one of the particular characteristics in the form, whereas others are due only to a conjunction of characteristics, but not to the characteristics themselves, and others yet are due to the combining of characteristics and their [resulting] combination.¹⁶⁹ So sight perceives each of the characteristics that are in a given form by itself, but it also perceives them together, and it perceives their combination or conjunction. Sight perceives beauty in different ways, then, but all the ways in which sight perceives beauty hark back to the perception of particular characteristics.

[3.202] Whether these particular or conjoined characteristics create beauty (to create beauty means to dispose the soul in such a way as to perceive that what is seen is a beautiful object) will be evident from a brief examination. For light creates beauty, which is why the sun, moon, and stars will appear beautiful, but there is nothing beyond the light in the sun, moon, or stars that will make them appear beautiful. Thus, light creates beauty on its own.

[3.203] Color also creates beauty, for any bright color, such as green,

rose-red, or the like, will appear beautiful to sight, and sight delights in them. Accordingly, dyed cloth, flowers, and gardens appear beautiful. On its own, then, color creates beauty.

[3.204] Distance, as well, sometimes creates beauty in an incidental way. For in certain beautiful forms there are spots or wrinkles that disfigure the forms, but when [the objects producing those forms] are removed some distance from the eye, those subtle characteristics that disfigure those forms disappear, and as soon as those characteristics disappear, the beauty of the form will be revealed. So too, in many beautiful forms there are subtle characteristics, such as design or pattern, that make the form beautiful, but many of these characteristics disappear from sight at a variety of moderate distances. When [the objects producing those forms] are near the eye, though, these subtle characteristics will be revealed to sight, and the form's beauty will appear. Thus, remoteness and nearness create beauty.

[3.205] Spatial disposition sometimes creates beauty, and several beautiful characteristics appear beautiful only according to arrangement or spatial disposition, for all distinctive designs that are arranged in tight order appear beautiful only because of their arrangement. Writing appears beautiful only according to its arrangement, for its beauty lies only in the configuration and evenness of the letters as well as the way in which they are conjoined to one another. If, however, the combination of letters and their arrangement are not proportional, so that it forms a hodge-podge, one letter being large, another small, then the writing will not be beautiful, even though the shapes of the letters, taken individually, are well proportioned.¹⁷⁰ Sometimes, too, writing appears beautiful when its overall composition is proportional, even though the [individual] letters are not as well proportioned as they might be.¹⁷¹ Likewise, several forms of visible objects appear beautiful only because of the relative disposition and arrangement of their parts.

[3.206] Corporeity also creates beauty, which is why the human body and those of many animals appear beautiful.¹⁷²

[3.207] Shape, as well, creates beauty, and it is for this reason that the moon and the beautiful forms of people, as well as of several animals, trees, and plants appear beautiful only according to their forms, or according to the shapes of their parts or to their [overall] shapes, or according to the shapes of the parts of the form.

[3.208] Magnitude creates beauty, which is why the moon appears more beautiful than the stars, whereas large stars appear more beautiful than small stars.

[3.209] Separation, too, creates beauty, and this is why individual stars are more beautiful than clustered stars and more beautiful than the stars

in the Milky Way, and it is also why individual candles are more beautiful than a fire.

[3.210] Continuity also creates beauty, which is why continuous vegetation or densely [clustered] plants are more beautiful than individual [plants].¹⁷³

[3.211] Number, as well, creates beauty, which is why places in the sky where there are many stars are more beautiful than places with few stars, and it is why a large number of candles in the same location creates beauty. It is also why places in the sky where there are many stars are more beautiful than surrounding places [with fewer].¹⁷⁴

[3.212] The motion of a person making a speech or carrying out some task [creates beauty].

[3.213] A person's immobility also creates beauty, and this is why gravity and reserve appear beautiful.

[3.214] Roughness, as well, creates beauty, which is why many shaggy fabrics appear beautiful.

[3.215] Smoothness, too, creates beauty, and it is for this reason that it appears beautiful in fabrics.

[3.216] Transparency creates beauty, which is why transparent objects appear to glitter at night.

[3.217] Furthermore, opacity creates beauty, for color, light, shape, design, and all [other] characteristics that appear beautiful in visible forms are perceived alike by sight on the basis only of opacity or shadow.¹⁷⁵

[3.218] Shadow also creates beauty, for in many visible forms there are blemishes and tiny pores that render them ugly, and when they are in sunlight their blemishes will be revealed, so their beauty will be obscured. But when they are in shadow or in weak light, those blemishes and wrinkles will disappear, so their beauty is apprehended. Furthermore, the complicated windings that appear in the feathers of birds and in the fabric called "alburalmun"¹⁷⁶ do not appear in shadow or in weak light.

[3.219] Darkness makes beauty appear, for the stars only appear in darkness. Likewise, their beauty only appears in the dark of night or in dark locations, and it disappears in daylight. Moreover, stars are more beautiful on dark nights than on moonlit nights.

[3.220] Similarity also creates beauty, for the members of an animal that are of the same kind, such as one eye in relation to [the other] eye, do not appear beautiful unless they are similar, for when the eyes are of different shapes, e.g., when one is round while the other is oblong, they will be extremely ugly. So, too, if one is black and the other green, they will be ugly, and the same holds if one is larger than the other. Similarly, if one cheek is hollow, and the other is bulbous, they will be extremely ugly; and, in the same vein, if one of the eyebrows is thick and the other thin, or

if one of them is long and the other short, they will be ugly. Thus, no members of this kind that belong to animals and are paired will be beautiful unless they are similar. So, too, depictions and letters do not appear beautiful unless letters of the same kind, as well as the equivalent parts of those letters, are similar.

[3.221] Difference creates beauty, as well, for the shapes of the members of an animal consist of different parts, and they are beautiful only because of such difference. For if the entire nose were of the same thickness throughout, it would be extremely ugly, so its beauty is due only to the difference [in thickness] of its two extremities and to the way it flares out [toward the nostrils]. Likewise, the beauty of the eyebrows is due only to the fact that their outer extremities are narrower than the portions toward the front. And the same holds for all the members of an animal; when they are in fact examined, it is found that their beauty is due only to the different shapes of their parts. So, too, with writing, for if the parts of the writing were of equal thickness [throughout], it would not appear beautiful, because the ends of the letters appear beautiful only if they are thinner than the remainder [of the letter], so that, if the ends, middle, and ligatures of the letters were of the same thickness, the writing would be extremely ugly. Thus, difference creates beauty in many forms of visible objects.

[3.222] From our discussion, therefore, it has been shown that, when they are perceived by sight, each of the particular characteristics [of the visible form] can sometimes create beauty on its own. And while the discussion was based on individual instances involving several objects, when all bodies are taken into account, it will be found that each of these characteristics creates beauty in many situations. So we have discussed what we have discussed in these cases only to provide examples so that other examples can be derived from them. Nonetheless, these characteristics do not create beauty in all situations, nor does any one of these characteristics create beauty in every form that possesses it; on the contrary, in some forms it does, and in some it does not. For instance, not every magnitude creates beauty in every body of a given size, and, by the same token, not every color creates beauty, nor, on that account, does a color create beauty in every body that happens to possess that color. Likewise, not every shape creates beauty. Some of the characteristics we have discussed create beauty on their own, but they do so in some situations and not in others, and they do so in certain ways and not in others.

[3.223] Moreover, these characteristics create beauty by being conjoined, for writing is beautiful if the shapes of the letters are beautiful and the way they are combined together is beautiful, for writing in which these two characteristics coexist is more beautiful than writing in which only

one of the two characteristics is present. The ultimate in beauty for writing is therefore based solely upon the combination of [appropriate] shape and spatial disposition.¹⁷⁷

[3.224] Likewise, when bright colors and depictions are arranged in a uniform way, they are more beautiful than colors and depictions that lack uniform arrangement. So too, beauty is revealed in the form of humans or animals through the conjunction or juxtaposition (which is the same thing) of particular characteristics in such forms. For an eye of moderate size that is almond-shaped is more beautiful than an eye that is of moderate size alone or that is only almond-shaped. Likewise, a round face with fine and subtle coloring is more beautiful than a face that has one of these attributes without the other. In the same vein, a small mouth with moderate-sized but slender lips is more beautiful than a small mouth with fat lips or a wide mouth with slender lips. But this case has many variants and subtypes.

[3.225] If you investigate beautiful forms in every type of visible object, you will find that a conjunction of particular characteristics in the forms create kinds of beauty in them that one characteristic does not create by itself. And, for the most part, beauty is created only through a conjunction of such characteristics, for the particular characteristics we have discussed create beauty on their own, but they also create beauty by being combined together.

[3.226] In addition, beauty is created from one [more] characteristic beyond the two we have discussed, i.e., proportionality or harmony.¹⁷⁸ For forms that consist of different members and different parts have different shapes, different sizes, and different spatial dispositions, as well as continuity and contiguity, and in each of them several particular characteristics converge. Still, not all of them are proportionate, for not every shape is beautiful in conjunction with every [other] shape, nor is every magnitude beautiful in conjunction with every [other] magnitude, nor is every spatial disposition beautiful in conjunction with every [other] spatial disposition, nor is every shape beautiful in conjunction with every magnitude, nor is every magnitude beautiful in conjunction with every spatial disposition. On the contrary, every particular characteristic is proportionate to certain characteristics but disproportionate to others. For instance, a flat nose along with deep-set eyes is not beautiful, and, by the same token, a large nose along with very large eyes is not beautiful. Likewise, a bulbous forehead along with deep-set eyes is not beautiful, but neither is a flat forehead along with protruding eyes. Thus, each of the members has a shape that makes its form beautiful, but in addition each shape of each member is proportionate only to some shapes of the remaining members, but not to others. So the form becomes beautiful by

the juxtaposition of proportionate shapes.¹⁷⁹

[3.227] The same holds for magnitudes and spatial dispositions, as well as for their arrangement, for large eyes having a beautiful shape, along with a moderately flat nose whose size is proportionate to that of the eyes, are beautiful. So, too, even if they are small, eyes of an almond shape, having a charming and delicate shape, will be beautiful when they occur along with a narrow nose of moderate shape and size. Likewise, slim lips along with a delicate mouth are beautiful when the delicacy of the mouth is proportionate to the slimness of the lips—i.e., when the lips are not inordinately slim, nor the mouth inordinately small, but the mouth must be moderately small while the lips are slim and, moreover, proportionate to the size of the mouth. So, too, when the width of the face is proportionate to the size of the facial members, it will be beautiful—i.e., when the face is not inordinately broad, and when the facial members are proportionate [in size] to the size of the whole face. For when the face is inordinately broad, but its members are too small to be proportionate in size to it, the face will not be beautiful, even though the size of the members may be proportionate [among each other], and even though they are beautifully shaped. Likewise, if the face is small and thin but its members are large (I mean the members of the face), the face will be ugly. But if the members are proportionate among each other as well as to the breadth of the face, the form will be beautiful, even if the members are not [particularly] beautiful by themselves.¹⁸⁰

[3.228] Proportionality by itself can create beauty. Accordingly, when there is beauty in the shape of each part of a form, and when the size and arrangement of such parts are beautiful, and when the members are proportionate in shape, size, and spatial disposition, as well as being proportionate to the shape and size of the face as a whole, the face will be extremely beautiful.

[3.229] Similarly, writing will not be beautiful unless the letters are proportionate in shape, size, spatial disposition, and arrangement. And the same holds for every kind of visible object that consists of disparate parts.

[3.230] And when you examine the beautiful forms of every kind of visible object, you will find that proportionality creates beauty more than any other characteristic on its own or, for that matter, any conjunction [of characteristics] on its own.¹⁸¹ Moreover, when the expressions of beauty created by particular characteristics in combination are examined, it will be found that the beauty that appears through their combinations appears only because of the proportionality of those characteristics that are combined with each other. For combinations of such characteristics will not always create beauty; in some forms they will, but in others they will not.

So the beauty expressed by these characteristics [in combination] is due to the proportionality that obtains among them. Beauty therefore is [ultimately contingent] upon particular characteristics alone, but its perfection comes from the proportionality or harmony that obtains among particular characteristics.¹⁸²

[3.231] From everything we have said, then, it is clear that the beautiful forms perceived by sight are only beautiful by dint of the particular characteristics that are perceived by the sense of sight, the conjunction of those characteristics among each other, and their proportionality to one another. But sight perceives the aforesaid particular characteristics either individually or in combination. Thus, when sight perceives some visible object, if there is a particular characteristic in that visible object that, by itself, makes the object beautiful, and if sight examines that lone characteristic, the form of that characteristic reaches the sensitive faculty after the process of visual scrutiny. Then the faculty of discrimination will perceive the beauty of the visible object possessing that characteristic, for the form of every visible object is composed of several of the characteristics we listed earlier.¹⁸³ Accordingly, when sight perceives a visible object but does not discern the characteristics the object possesses, it will not perceive its beauty. When it does discern the characteristics the object possesses, and when any of its characteristics somehow creates the impression of beauty in the soul, as soon as it apprehends this characteristic, sight will perceive that characteristic by itself. And when it perceives that characteristic by itself, that perception will reach the sensitive faculty, and thus the faculty of discrimination will perceive the beauty that it possesses. Moreover, by means of this perception it will perceive the beauty of that visible object. Thus, when sight perceives any visible object, if there is beauty in that object arising from a combination of characteristics, if sight examines that visible object and discerns the characteristics possessed by that object, if it then perceives the characteristics that create beauty by combining together or by being proportionate among one another, and if that perception occurs to the sensitive faculty, then, when the faculty of discrimination correlates those characteristics to one another, it will perceive the beauty of that visible object, which arises from the combination of characteristics the object possesses. Thus, sight will perceive the beauty of that visible object, which arises from the combination of characteristics the object possesses. Sight will therefore perceive beauty in visible objects by correlating those characteristics to one another in the way we explained.

[Perception of Ugliness]

[3.232] Ugliness, for its part, comes about when the form lacks any beautiful characteristic. For it has already been said that particular characteristics create beauty, but not in every situation or in every form; in some it does, but in others it does not. So, too, proportionality does not exist in every form; in some forms it does, but in others it does not. Therefore, forms whose particular characteristics do not create any beauty on their own or in combination, or forms whose parts are disproportionate to one another lack beauty entirely, and so they are ugly, because ugliness of forms consists in the absence of beauty in them. There may be a combination of beautiful and ugly characteristics in the same form, but sight will perceive beauty from what is beautiful and ugliness from what is ugly in the form when it differentiates and evaluates the characteristics the form possesses. Thus, ugliness is perceived by sight in forms that lack any beauty through the absence of beauty [that it senses] when it perceives the form.¹⁸⁴

[Perception of Similarity]

[3.233] Similarity consists of the equality of two forms or of two characteristics that are identical in an object. Thus, when sight perceives two identical forms or two identical characteristics at the same time, it will perceive their similarity through the perception of each of the two forms or characteristics and the correlation of one to the other. Sight will therefore perceive the similarity of forms or of identical characteristics by perceiving each of the forms or characteristics as they actually exist and by correlating them to one another.

[Perception of Difference]

[3.234] Difference, on the other hand, is perceived by sight in various forms through perception of each of the various forms, comparison of one to the other, and perception of the lack of equality among them. Thus, difference is perceived by the sense of sight through a perception of each of the forms or characteristics by itself, as well as through a comparison of them among each other and [the resulting] sensation of an absence of equality arising in the sensitive faculty.

[3.235] We have now finished, having explained how each of the particular characteristics [of visible objects] is perceived by the sense of sight. Moreover, from all we have discussed it has been shown that some particular characteristics are perceived by brute sensation, some are perceived

by recognition, and some are perceived by deduction and implication in the ways we have explained earlier. These are the things we meant to explain in this [chapter of the] work.

[CHAPTER 4]

[4.1] It has now been shown how sight perceives any of the particular characteristics that are perceived by the sense of sight, and sight perceives only the forms of visible objects, which are bodies. But the forms of visible objects are composed of the aforesaid particular characteristics, such as shape, size, color, spatial disposition, arrangement, and the like. Thus, sight perceives any such characteristic only by perceiving the forms of visible objects, those forms being composed of particular characteristics, and sight will perceive each of the forms of visible objects according to all of the particular characteristics that are in them [which it perceives] all at the same time. But sight perceives none of the particular characteristics by itself, because none of the aforementioned particular characteristics exists on its own, for these particular characteristics are all found in bodies, and only in bodies, and there is no body in which any of these characteristics exists by itself without some other. Sight therefore perceives only the forms of visible objects, and each of the forms of visible objects consists of several particular characteristics. Thus, sight perceives many particular characteristics in each of the forms of visible objects, and they will be differentiated individually in the imagination.¹⁸⁵ So, when a visible object is seen, sight perceives each of its particular characteristics in conjunction with some other particular characteristic, and by differentiating among the characteristics that are in the form, it perceives each characteristic by itself.

[4.2] It has already been shown and also explained how sight perceives the forms of visible objects that are composed of particular characteristics.¹⁸⁶ Some of the particular characteristics that comprise the forms of visible objects are seen as soon as the visible object is looked at, but others are seen only after visual scrutiny and careful evaluation, for instance, tiny writing, or subtle designs, or various colors that are almost identical in hue. Generally, no subtle characteristics are seen by sight when the visible object is first looked at, only after visual scrutiny and evaluation. The form of the visible object that is perceived by the sense of sight is composed of all the particular characteristics that can be grasped by the eye from the form of the visible object. So sight does not perceive the proper form of the visible object unless it perceives all the particular characteristics that are in the form of the visible object. And that being the

case, the proper form of a visible object that possesses subtle characteristics is perceived by sight only after visual scrutiny.

[4.3] Also, since sight perceives subtle characteristics only through visual scrutiny, and since subtle characteristics are not seen at first glance, then, when sight perceives some visible object and perceives its form, and when that visible object possesses subtle characteristics, those subtle characteristics are not seen at first glance, but only after visual scrutiny. Thus, when sight perceives some visible object that possesses no subtle characteristic, it will perceive its proper form, even though it will not determine that the form is proper until after it subjects each part of the visible object to intense visual scrutiny. It then determines that the object possesses no subtle characteristic, and thus it will determine that the form it is perceiving is the proper form.

[4.4] Without exception, then, sight determines [the true status] of a visible object's form by evaluating all parts of the visible object and by subjecting all of the characteristics that can be seen in the visible object to visual scrutiny.

[4.5] And now that this has been made clear, let us add that the perception of visible objects will occur in two ways: i.e., by superficial perception or by perception based on close visual scrutiny. For when the eye looks at a visible object, it will perceive the obvious characteristics the object possesses at first glance. Then, if it goes on to scrutinize the object and evaluate all of its parts, it will determine [the true status of] its form. On the other hand, if it does not scrutinize its parts, it will perceive its form in an indeterminate way,¹⁸⁷ and that form will either be its proper form (although sight does not determine that the form is proper), or it will not be its proper form. And since this is so, the perception of visible objects by sight will occur in two ways: either [by] superficial perception, which occurs at first glance, or [by] perception based on visual scrutiny. Moreover, perception at first glance is indeterminate, whereas perception based on visual scrutiny is the perception by means of which [the true status of] the forms of visible objects is determined.

[4.6] Having clarified this point, we should say that the visual scrutiny through which the proper forms of visible objects are perceived will be carried out by sight itself, or it will be carried out through differentiation. For it has already been shown in our account of radial lines that the forms perceived by sight along the [visual] axis, or along rays near that axis, are clearer and more determinate than forms that are perceived along the remaining rays.¹⁸⁸ Thus, when the eye faces any visible object, provided that the object is not inordinately small but is of some [perceptible] size, and when the eye, having looked at the object, focuses on the part of it directly opposite the middle of the eye's surface, so that it lies on or

near the visual axis, it will be [seen] more clear[ly] than the rest of the visible object. Moreover, sight perceives this fact, because, when it perceives the whole visible object, it will find that the location directly opposite, whose form reaches the middle of the eye[’s surface], is more clear[ly seen] than the rest of the object.

[4.7] It was shown above that this fact is evident to sense when the visible object is large.¹⁸⁹ Therefore, when the eye perceives the entire visible object, it will find that the form of the part directly opposite the center [of its surface] is clearer than all the remaining parts, so when it wants to determine the form of the visible object,¹⁹⁰ it will move in such way that its center lies directly opposite every area on every part of the visible object. Thus, it will perceive the form of every area on every part of the visible object in a clear and determinate way, just as it perceives the part directly opposite its center when it first looks at the visible object. When the sensitive faculty wishes to determine the visible object, then, it will move the eye in such a way that its center lies directly opposite every portion of every part of the visible object, and in this way it will perceive the form of every part of the visible object with utmost clarity.

[4.8] Meanwhile, the faculty of discrimination will differentiate all the forms reaching it, and it will differentiate the colors of the parts, the differences among the colors, and the arrangement of the parts among each other—and generally speaking [it will differentiate] all the characteristics of the visible object that are apprehended through visual scrutiny as well as the form of the entire visible object, that form being composed of its parts and its characteristics. This, then, is how every part of the visible object will be determined according to its actuality and how all the characteristics of the visible object will be determined. But the form of every part of the visible object is not determined unless the eye has scanned all the parts [of the object]. The eye, moreover, is naturally disposed to scan [objects for the sake of] visual scrutiny and to cause the visual axis to pass over all parts of a visible object. Thus, when the faculty of discrimination seeks to scrutinize the visible object, the visual axis will move over all parts of the visible object. And since the subtle characteristics possessed by the visible object are revealed only when the eye moves and the [visual] axis or the radial lines near it pass over every part of the visible object, the form of the visible object that reaches the sensitive faculty (assuming that the object is of a perceptible size) will not be determinate unless the eye moves so that the center of the eye lies directly opposite every part of the visible object.

[4.9] In addition, when the visible object is exceptionally small and does not lie directly opposite the middle [portion] of the eye, the visual scrutiny to which it is subject will not be accomplished until after the eye

moves so that the visual axis passes over that visible object; then the form of that visible object will reach the middle [portion] of the eye, and the form of the object may be revealed. And since this is the case, the visual scrutiny through which sight perceives the proper forms of visible objects may occur through sight *per se* or through [sight and] differentiation together. Thus, perception of the proper form of a visible object will occur only through visual scrutiny, and the scrutiny through which the form of the visible object is determined will only be accomplished through the motion of the eye. So when the body of the visible object is of a perceptible size, the scrutiny to which it is subjected will not be accomplished until the visual axis moves over all the cross-sections of the visible object. This is what was meant by whoever supposed that vision occurs only through the motion [of the eye] and that no visible object will be seen as a whole, all at once, for what he meant is that vision cannot be determinate except through visual scrutiny [which occurs] through the motion of the eye and the motion of the visual axis over all the cross-sections of the visible object.¹⁹¹

[4.10] How the sensitive faculty determines the form of a visible object through visual scrutiny and the motion [of the eye] is as follows. When the eye faces the visible object, the sensitive faculty will somehow perceive¹⁹² the whole form according to the facing disposition, and it will also perceive the part at the endpoint of the [visual] axis as accurately as possible. But in the process it will perceive every other part of the form in some way. Then, if the eye moves and the [visual] axis shifts its focus from where it was to somewhere else, the sensitive faculty will in that case perceive the form of the whole visible object a second time, and it will also perceive the part at the end of the [visual] axis a second time. Moreover, the part at the end of the [visual] axis will be perceived more clearly in the second case than it was in the first, and in this case the sensitive faculty will again perceive the remaining parts [of the form] in some way. By the same token, when the [visual] axis shifts to a third part, the sensitive faculty will perceive the entire visible object yet a third time, and it will also perceive the part [of the object] at the end of the [visual] axis in this third situation, and under these conditions it will perceive this part more clearly than it did in the first two instances. In this case, moreover, the sensitive faculty will also perceive each of the remaining parts [of the form] in some way. Thus, by moving the eye over the parts of the visible object, the sensitive faculty is affected in two [complementary] ways. First, it perceives the visible object as a whole at numerous reprises, and second, it perceives with clarity each part of the visible object along the visual axis or along a radial line that is near the visual axis. Thus, everything about those parts that can be seen is revealed to the sense [of sight].

And if the sensitive faculty perceives both the visible object as a whole and each of its parts frequently, it will then perceive everything that can be perceived about that visible object.

[4.11] In addition, as the perception occurs repeatedly in terms of the twofold [perception of whole and parts] and the repetition of the perception of the entire visible object, the faculty of discrimination differentiates what is revealed of the color of the parts, their light, their size, their distance, their shape, their spatial disposition, the equality of those things that are identical among what is differentiated, and differences among all these characteristics or among some of them, as well as the arrangement of their parts among one another. Moreover, by differentiating all of these characteristics and comparing these characteristics to ones that are known to be similar to them, it perceives the form comprising all of them. In this way the form comprising all similar characteristics is impressed in the imagination, and thus the visible object's form, which provides the means by which the visible object itself is apprehended by the sensitive faculty, is determined. This, therefore, is how the sensitive faculty determines the forms of visible objects by means of visual scrutiny.

[4.12] We should also say that when sight perceives some visible object, and when its form is determined by the sensitive faculty, the form of that visible object remains in the soul to be impressed in the imagination. So the perception of the visible object will be repeated, and its form will be more firmly implanted in the soul than the form of a visible object that sight perceives only once or on rare occasions. I also say that when sight perceives any individual and then perceives another individual of the same kind, if it perceives such individuals continually, a form of that kind [of individual] will become ensconced in the soul, and the form will come to be impressed as a general representation [of its kind] in the imagination. Evidence that the forms of visible objects persist in the soul and in the imagination is to be found in the fact that, when someone remembers a person he knew before, and when he determines his form and correctly recalls the time and place at which he saw that person, he will immediately imagine the form of that person, as well as the shape of his face and the situation he was in at that time. He will also imagine the place where he saw him, and he may imagine other visible objects that were present at the place where he saw him. This is clear evidence that the form of that person, as well as the form of that place, is implanted in the soul and persists in the imagination. Accordingly, when a person remembers some city that he has seen [before], he will imagine the form of that city, as well as the forms of the places he was in that city and the forms of individuals he knew in that city. And the same holds for all the visible objects a person has seen; when they crop up in [his] memory, he will imagine their

forms according to the actual disposition of those objects as they were perceived at that earlier time. Thus, imagining the forms of visible objects that a person saw before and still recalls when they are no longer present indicates that the forms of visible objects that sight perceives reach the soul and are impressed in the imagination.¹⁹³

[4.13] The reason that the form of a visible object that is continually perceived by sight is more firmly planted in the soul and in the imagination than the form of a visible object that is not repeatedly perceived is as follows: When some [sensible] impression comes to the soul, the form of that impression will immediately reach the soul, but as time continues to pass, and that impression fails to recur in the soul, the impression, or something characteristic of it, may be forgotten by the soul. But if it recurs to the soul before it is forgotten, its form is renewed in the soul, and the soul will remember the first form by means of the second form. And as this impression is made time and again on the soul, the soul will remember the impression better, and thus that impression will be more firmly implanted in the soul.

[4.14] In addition, the first time an impression or form of a visible object reaches the soul, the soul may not perceive or accurately determine all of the characteristics that belong to that form. But it will perceive some of the characteristics belonging to it, and when the form recurs a second time, the soul will perceive something about it that it did not perceive the first time, and the more often the form recurs to the soul, the more the characteristics of it that were not apparent before will become evident. And as the soul perceives the form's subtle characteristics and [thereby] determines the form, the more firmly implanted in the soul and imagination it will be than a form in which not all the characteristics belonging to it are [yet] properly perceived by the mind.¹⁹⁴ But when the soul perceives all of the characteristics in the form the first time, and then the form recurs to it, if it perceives the [same] impression a second time, it will more clearly determine that what it perceived the first time is the proper form. But a properly verified and determinate form is more firmly implanted in the soul and the imagination than a form that is not determinate. Therefore, as the form of a visible object is continually perceived, it will become more determinate in the soul and in the imagination. So it is by having their forms implanted in the soul and in the imagination that things are remembered by the soul.

[4.15] That impressions and forms that recur in the soul will be more firmly implanted than impressions and forms that do not recur is clearly borne out by the fact that, when someone wants to learn some speech or some verse by heart, he will rehearse the words over and over again, and they will thus become implanted in his soul. And the more he rehearses

the words, the more firmly they will be implanted in the soul, and the less likely they will be to be forgotten. But if he reads it once, the verse will not stay implanted in the soul. Likewise, if he goes through the verse a couple of times in his mind,¹⁹⁵ it [may or] may not be impressed in his soul, but if it is impressed, it will soon be forgotten. From this sort of experience, then, it is clear that the more often forms recur in the soul, the more firmly implanted they will be in the soul and in the imagination.

[4.16] That universal forms of visible aspects occur in the soul and are impressed in the imagination is due to the fact that there are certain kinds of visible characteristics, such as form or shape, according to which all individuals of a certain kind will be identical, whereas those individuals vary according to [other] particular characteristics that are perceived by the sense of sight. So there may be one color in all individuals of that kind; but form, shape, color, and all the [other] characteristics from which the form of every individual of a given kind derives is a universal form of that kind. So sight perceives that form, that shape, and all the [other] characteristics according to which every individual of a given kind will be identical to all individuals of that kind that are perceived by sight. The particular characteristics by dint of which the individuals of that species differ are perceived as well. It is thus through the effect of perceiving individuals of the same kind by sight that the universal form of their kind will recur [in the soul] along with the various particular forms of those individuals. And when the universal form recurs in the soul, it will be impressed in the soul and will become ensconced there, and from the various particular forms that arrive along with the universal forms after close visual scrutiny the soul perceives that the form according to which all of the individuals of that kind agree is the universal form of that kind. This, then, is how universal forms will arise in the soul and in the imagination from the perception by sight of [various] kinds of visible objects.¹⁹⁶

[4.17] Accordingly, the forms of individual visible objects, as well as the form of the kinds of visible objects that sight perceives, persist in the soul and are impressed in the imagination, and the more often they are perceived by sight, the more firmly implanted they will be in the soul and in the imagination. Moreover, the sensitive faculty's comprehension of what kinds of things visible objects are is based entirely upon the forms that reach the soul, for the perception of what kinds of things visible objects are will only occur through recognition. Recognition, for its part, depends upon a correlation of the form that sight perceives at the moment to a second form in the imagination that derives from the forms of visible objects that sight has perceived before, and [it also depends] upon a perception of how the form perceived at the moment compares to another of the forms occurring in the imagination. Thus, the perception of

what kind of thing a visible object is depends entirely on the perception of the similarity of the form of the visible object to one of the forms ensconced in the soul and implanted in the imagination. In perceiving what kinds of things visible objects are, then, the sensitive faculty depends entirely upon the universal form of the kinds of visible objects that occurs in the soul, whereas the sensitive faculty's recognition of individual visible objects depends entirely upon the forms of individuals that arise in the soul from each of the individuals that sight has perceived earlier, provided that their forms have been imagined and understood before. Furthermore, the faculty of discrimination naturally assimilates the forms of visible objects, as soon as they are seen, to forms that are derived by the soul from the forms of visible objects and that are implanted in the imagination. Hence, when sight perceives some visible object, the faculty of discrimination immediately seeks its counterpart among the forms persisting in the imagination, and when it finds some form in the imagination that is like the form of that visible object, it will recognize that visible object and will perceive what kind of thing it is. But if it does not find a form similar to the form of that visible object among the forms persisting in the imagination, it will not recognize that visible object or perceive what kind of thing it is. Also, on account of the speed with which the faculty of discrimination assimilates the form of the visible object at the moment it is seen, it may err by assimilating the visible object to another visible object [simply] because the visible object has some characteristic that the other object possesses. If it then subjects that visible object to close visual scrutiny and determines its form, it will assimilate that form to one that actually does resemble it, and it will become clear to it while carrying out this second assimilation that it erred the first time. It is in this way, therefore, that the sense of sight perceives what kinds of things visible objects are.

[4.18] Now that all these points are clarified, we should observe that the perception of visible objects through visual scrutiny will occur in two ways: perception through visual scrutiny alone and perception through visual scrutiny along with previous knowledge. Now perception through visual scrutiny alone involves a perception of unfamiliar visible objects that sight has not seen before or visible objects that sight has seen before but does not remember having seen. For when the visual faculty perceives some visible object it has not perceived by sight before, nor anything of its kind, and when the observer wishes to determine the form of this visible object, he will focus upon it and evaluate all the characteristics it possesses through visual scrutiny. Through [such] scrutiny he will then perceive its proper form, but since he never saw that object or anything of its kind before, he will not recognize its form when he perceives it. But in

such cases visual scrutiny is necessary for [the perception of] the actual proper form. Thus, the determination of the form of such visible objects occurs through visual scrutiny alone. Likewise, when sight perceives some visible object it has perceived before but fails to remember, it will not recognize its form the next time after visual scrutiny, so this kind of perception of visible objects will occur through visual scrutiny alone.

[4.19] Perception through visual scrutiny along with previous knowledge, on the other hand, is perception of all types of visible objects that sight has perceived before or about whose kind sight has perceived something before, so that the forms of their kinds as well as of their individuals reach the soul. Thus, when sight perceives some visible object it has perceived before, or when it perceives some object of the same kind, as soon as it glimpses that visible object it will perceive its entire form. Then, after a brief scrutiny, it will perceive its overall form,¹⁹⁷ which constitutes its universal form or the form specifying its kind. Therefore, if it has perceived visible objects of this sort before, and if the form specifying what kind of thing that visible object is occurs in the soul, and if the soul remembers the universal form of that kind of visible object, it will recognize the universal form that it perceives in that visible object as soon as it perceives it and recognizes the universal form it perceives in that object, so it will immediately recognize that visible object as of such-and-such a kind. Then, when it scrutinizes the rest of the characteristics possessed by that visible object, it will determine its particular form. If, however, it has not perceived that visible object before, or perhaps it has perceived it but does not remember having perceived it, it will not recognize the particular form. If it does not recognize the particular [form], though, it will not recognize that visible object, and so its recognition of that visible object will be according to kind alone. So it is through visual scrutiny and the determination of its form that the soul acquires the particular form belonging to that individual. If it has perceived that visible object before but has not perceived another individual of that kind, and if it remembers it as well as the form of that visible object that it perceived before, then, when it perceives its particular form it will recognize its particular form as soon as it apprehends it.¹⁹⁸ Moreover, as soon as it recognizes its particular form it will apprehend the visible object, and thus it is through the perception of its particular form that sight will determine the form of the visible object and will accordingly recognize the visible object itself. So its recognition of that visible object will be according to kind and individual at the same time. If, however, it has perceived that visible object before, but it has seen only an individual representation of that visible object and [thus] does not discern the universal form of that sort of visible object, then, when it perceives that visible object and perceives the universal charac-

teristics possessed by that object as well as by all other objects of that kind, it will not recognize that visible object or apprehend what kind of thing it is by perceiving its universal form. Therefore, when it perceives the remaining characteristics possessed by that visible object, and when it perceives its particular form and remembers the particular form it perceives in that visible object, it will recognize the particular form at the moment of perception. So when it recognizes the particular form, it will recognize the visible object itself, but its recognition of that visible object will be on the basis of its individuality. No visible object is perceived through visual scrutiny unless [it is perceived] according to these ways. Thus, the perception of all visible objects on the basis of visual scrutiny will occur in two ways: perception through visual scrutiny alone and perception through visual scrutiny along with previous knowledge. Moreover, such recognition or knowledge will sometimes be according to kind and sometimes according to kind and individual together.

[4.20] Furthermore, perception through visual scrutiny must occur over time. For visual scrutiny will only occur if the eye moves and examines [the object], but differentiation and motion will not take place except over time. Therefore, visual scrutiny will only occur over time. It has also been shown above that perception through recognition and perception through differentiation will occur only over time.¹⁹⁹ And now that it has been shown that the perception of visible objects through visual scrutiny will sometimes occur through visual scrutiny alone and sometimes through visual scrutiny along with previous knowledge, and [now that it has been shown] that whatever is perceived through visual scrutiny as well as whatever is perceived through recognition is perceived only over time, we shall add that perception occurring through visual scrutiny along with previous knowledge will generally take less time than perception through visual scrutiny alone. For, to recognize the impressions existing in the soul that are presented to the memory does not require that all of the characteristics which go into their actual formation be perceived; rather, a perception of certain of their specific properties is sufficient. Thus, when the faculty of discrimination perceives some specific property that characterizes a form reaching it, and when it remembers the first form, it will recognize all forms [of that kind] that reach it, for every specific property that characterizes a given form is a defining feature of such forms.²⁰⁰

[4.21] For instance, if sight perceives an individual person but only perceives the outline of his hand, it will immediately perceive that [what it sees] is human before it perceives the outline of his face or before it perceives the outline of his remaining features; and the same thing applies if sight perceives the outline of his face before perceiving his remaining features. From the perception of any of the properties that are specific

to the form of a human being, then, sight will perceive that this visible object is a human being without having to perceive the remaining features. For it will perceive the remaining features through previous knowledge on the basis of the forms residing in the soul, i.e., the forms of human beings. Likewise, when sight perceives certain properties that are specific to the particular form of some individual that sight has perceived before, e.g., a flat nose, green eyes, or arched eyebrows, it will perceive that individual when it perceives his entire form, and it will recognize him. So, too, sight will recognize a [given] horse from some spot on his forehead or from some variation in his color. By the same token, when a writer perceives the form of some word in a cursory way, he will recognize it before he examines its individual letters, and all words that the writer sees continually are likewise recognized by him as soon as they are perceived on the basis of his perception of certain of their letters.

[4.22] Hence, visible objects that sight has perceived earlier and whose forms it recognizes and remembers at the present moment are perceived by sight through defining features. On the other hand, unfamiliar visible objects that sight has not perceived before, or visible objects it has perceived before but does not yet remember are not perceived in this way. For when sight perceives some visible object it has not seen before and perceives the outline of some of its parts, it will not thereby perceive what kind of thing that visible object is, because the form of the remaining parts is not ensconced in the soul. Thus, sight does not gain a determinate perception of a visible object it has not seen before unless it evaluates all of its parts and all the characteristics it possesses. Likewise, the form of a visible object the eye has seen before but does not remember is only determined by it after an evaluation of all the characteristics it possesses. But the perception of certain characteristics possessed by a form will take less time than the perception of all the characteristics possessed by the form. Thus, vision that entails visual scrutiny along with previous knowledge will generally take less time than vision entailing visual scrutiny alone, and this is why sight perceives familiar visible objects with such extraordinary speed that the time it takes is imperceptible, so between the time sight is directed at a familiar visible object and the time it perceives what that familiar visible object is there will generally not be a perceptible time-interval. For from childhood and the beginning of his development, a person perceives visible objects, and individual visible objects as well as the universal forms of types of visible objects are continually presented to his sight. It has also been shown that the forms of visible objects perceived by sight reach the soul and are impressed in the imagination, and forms that are seen repeatedly are impressed in the soul so that such impressions become ensconced in the imagination.²⁰¹ Thus [the forms of] all

familiar objects and all familiar kinds of objects are present in the soul, and they remain impressed in the imagination and present to memory. Accordingly, when sight perceives some familiar visible object and perceives its overall form,²⁰² and after that it perceives some defining feature that specifies that visible object, it will perceive what kind of thing that visible object is when it perceives that defining feature, and it will perceive the visible object through previous perception as well as through brief visual scrutiny. Therefore, familiar visible objects are perceived by sight through defining features and through previous knowledge, so the perception of what kinds of things they are will generally occur in an imperceptible amount of time.

[4.23] Moreover, the reason that the perception of a visible object's general type takes less time than the perception of the visible object's individual nature is that, when sight perceives some individual human, it perceives him to be human before it will perceive his particular form. And it may perceive him to be human even though it does not perceive the outline of his face; instead sight will perceive him to be human from the upright stance of his body or the arrangement of the members of his body without having seen his face. Likewise, sight may perceive certain kinds of familiar visible objects as general types by means of certain defining features that specify that kind of thing. But this is not the case with the perception of a visible object's individual nature, for a visible object's individual nature will not be perceived until the particular characteristics that define that individual or some of those characteristics are perceived. But the perception of each of the particular characteristics defining that individual does not occur until after [all] or some of the universal characteristics possessed by that individual are perceived. Generally, the characteristics of the universal forms of those sorts of individuals are some of the characteristics possessed by the individual form, but the perception of the part takes less time than the perception of the whole. Thus, the perception by sight of a what kind of thing a visible object is takes less time than the perception of the individual nature of that visible object.

[4.24] Moreover, the time it takes to perceive visible objects (familiar ones, that is) according to general type varies, because certain kinds of familiar visible objects resemble other kinds, and certain do not, e.g., the general type "human" and the general type "horse," for the form of the general type "human" does not resemble the [form of the general type of] other kinds of animal. But that is not the case for a horse, since a horse resembles many animals in its overall form. Thus, the time it takes sight to perceive an individual human according to general type and to perceive that [what it sees] is human is not the same as the time it takes to perceive an [individual] horse according to general type and to perceive

that [what it sees] is a horse, especially if it perceives them both at some distance. For, when sight perceives some individual human who is walking, it will immediately perceive him to be an animal from his movement and then, by dint of his upright body, it will perceive him to be human. But that is not how it is when sight perceives a horse, for when sight perceives an individual horse that is moving and, along with that, perceives its motion as well as the number of its legs, it will not perceive it to be a horse on that basis, for those characteristics belong to several quadrupeds that share several characteristics with the horse, especially the mule, because the mule resembles the horse in numerous ways. Hence, the mule is only differentiated from the horse according to characteristics that are not particularly evident, such as the outline of the face, the length of the neck, the speed of the gait, and the length of the gait. But if sight fails to perceive any of those characteristics according to which a horse is perceived when its overall form is apprehended, then it will not perceive it to be a horse. Furthermore, the time it takes sight to perceive the upright posture of the human body is not the same as the time it takes to perceive the form of a horse along with the particular characteristics according to which a horse is distinguished from any other [quadruped]. Thus, the time it takes for a human to be perceived according to general type is less than the time it takes for a horse to be perceived according to general type. For, even though the two time-intervals are small, one of them is still smaller than the other, all things taken into account.

[4.25] Likewise, when sight perceives a rose-red color among the flowers in some garden, it will immediately perceive that the things in which that color inheres²⁰³ are roses because that color is specific to roses and, moreover, because that color is [found] in objects that are in a garden, [and it perceives this] before it perceives the roundness [of the flowers], or the roundness of their petals, or the way their petals fit upon one another, and before the perception of all the characteristics that go into making the form of a rose. But this does not happen when sight perceives a myrtle-green color in the garden. For when sight perceives only the myrtle-green in the garden, it will not perceive the [plant that is] myrtle-green to be myrtle simply from the perception of the green, because several plants are green, and, in addition, several plants resemble myrtle in greenness and shape. Thus, if sight does not perceive the shape of its leaves, its density, or a[ny other] defining characteristic of myrtle, it will not perceive that plant to be myrtle. Moreover, the time it takes sight to perceive the shape of the myrtle's leaves and the characteristics that are specific to myrtle, as well as to perceive its greenness, is not the same as the time it takes to perceive the color of roses alone. Likewise, the essential natures of all kinds [of things] that can resemble others are perceived by sight

only after considerable scrutiny. But the essential natures of visible objects that resemble others only a little are perceived by sight after brief scrutiny. And the same holds for individuals, for an individual that does not resemble another individual is perceived by sight after minimal scrutiny on the basis of defining features, but an individual known to sight and resembling another individual known to sight is perceived by sight [only] after considerable scrutiny.²⁰⁴

[4.26] Therefore, the general type or individual nature of all familiar visible objects is perceived by sight after minimal scrutiny when [the perception is based] upon previous knowledge, and, for the most part, that perception will take an imperceptible amount of time. Nonetheless, the time it takes to perceive such objects varies according to differences among their general types or their individual natures. The perception of general type will be quicker than the perception of individual nature, whereas the perception of a general type that scarcely resembles others will be quicker than the perception of a general type closely resembling others, and the perception of an individual that scarcely resembles others will be quicker than the perception of an individual closely resembling others.

[4.27] So, too, the time it takes for visual scrutiny varies according to the characteristics one scrutinizes in visible objects. For instance, when sight perceives an animal with several small legs, and if that animal is moving, it will perceive its motion on the basis of minimal scrutiny, and when it perceives its motion, it will perceive that it is an animal. Then, after briefly scrutinizing its legs it will perceive that it has several legs by perceiving the separation between its legs. But nonetheless it will not immediately apprehend the number of its legs, and if it wants to know the number of legs, it will have to spend more time scrutinizing it more intensely. Thus, the perception that it is an animal will take little time. The subsequent perception that the animal has many legs also takes little time, but the number of its legs is not perceived until sight has scrutinized each of its legs and counted them, and that can only happen during some measurable amount of time. Moreover, the amount of time [required] will depend upon how many or how few legs the animal has. Likewise, when sight perceives a circle circumscribing a polygon of many sides, and if the sides of that [inscribed] figure are small but not inordinately different in size, then, as soon as the whole figure is perceived sight will perceive it as circular. Furthermore, it will not immediately perceive that there is a polygon inside it if the sides of that polygon are extremely small, but when it scrutinizes the circular figure more closely, the inscribed polygon will be revealed to it. Thus, the perception of the circularity of the figure will be quicker than the perception of the polygon inside it. After having perceived the polygon, sight will not see the difference in sizes

among its sides, nor does it discern whether they are equal or not, nor will the inequality of the sides of the polygon be seen until after a very close scrutiny that takes place in a measurable amount of time.

[4.28] Also, when the sensitive faculty wishes to scrutinize the shape of the entire visible object, it only needs to pass the line-of-sight over the surface of the visible object. Likewise, when it wishes to scrutinize the color of a visible object, it only needs to pass the line-of-sight over it—and the same holds [if it wishes] to scrutinize the roughness of the surface of a visible object, or its smoothness, or its transparency, or its opacity. But such is not the case for the inconspicuous or subtle characteristics possessed by visible objects, characteristics such as the shapes of any of the parts of visible objects, the similarity of their shapes, the size of their parts, differences among their sizes or colors, similarities among them, or the relative arrangement of the small parts; these characteristics are perceived through visual scrutiny only after the eye focuses on every part, evaluates the shapes of those parts, and correlates them one to another. But this will be accomplished not in a short time or through a quick [axial] scan but in a measurable amount of time. Hence, the time it takes to scrutinize the characteristics of visible object varies according to differences among the characteristics that are being scrutinized.

[4.29] And having made this clear, we should add that vision that depends on previous knowledge, or defining features, or minimal visual scrutiny is not truly determinate. For perception of a visible object through previous knowledge or through defining features only involves the object as a whole according to its general nature, and the faculty of discrimination perceives the particular characteristics possessed by that visible object in the way that it apprehended those visible characteristics from the initial form of that visible object that exists in the soul. But these particular characteristics possessed by visible objects change with the passage of time, and, given this fact, sight does not, on the basis of previous knowledge, perceive the characteristics of the visible object that have changed. And when the change is inconspicuous or not very evident, it is not perceived by sight at first glance, nor is it perceived when it is not very evident unless [it is subjected] to visual scrutiny. For instance, when sight apprehends some person whose facial complexion is clear, and if sight determines his form, after which that person disappears from view for a long time, and if a blemish forms on his face, but that blemish is inconspicuous, then, when sight perceives that person after this development, it will recognize him as soon as it perceives him. Nonetheless, on the basis of its perception and recognition of that person, the visual faculty will not perceive the blemish on his face unless it is obvious; if it does not look carefully for that blemish, then, it will not perceive him as he

actually exists. But if the visual faculty scrutinizes him with a more intense focus, the blemish on his face will be revealed to it, and then it will perceive his form as it actually exists.

[4.30] By the same token, when sight perceives some tree, scrutinizes it, and accurately determines its form, if it then leaves it for awhile while the tree grows, gets larger, and changes shape, or if, as it grows, some redness in it intensifies (assuming it was there before), and if the change that occurs to the tree is not minimal, then, if sight refocuses on that tree and recognizes it, it will not perceive the slight change occurring in it at the time it perceives and recognizes it. However, if it scrutinizes it a second time and, in addition, remembers the proper form it initially possessed, then it will perceive the change occurring in it and will determine its form [during the] second [scrutiny]. But if sight does not scrutinize it [again in this way], the form that it perceives of the tree on the basis of previous knowledge will not be the proper form, which it acquires after the second scrutiny.

[4.31] Likewise, if sight perceives a wall somewhere, and if that wall is smooth but has depictions or etchings in it, and if sight scrutinizes that wall, accurately determines its form, and then shifts its focus away from it for awhile, and afterward, if there is some change in the texture of the surface of that wall or some change in the design of any of its depictions, but that change is not particularly obvious, then, if sight refocuses on that place and looks at the wall as it remembers the initial form, it will perceive the wall according to how it saw it the first time. But when it perceives and recognizes the wall, sight will not perceive the inconspicuous change occurring in it; so it will recognize its form without any change. Thus, if some roughness has developed in the wall, sight will judge it to be smooth, as it used to be, and if the original depictions in it were properly determined but have since changed, it will judge them to be accurately determined [as they were when previously apprehended].

[4.32] Now all the visible objects around us are susceptible to change in color, shape, size, spatial disposition, smoothness, roughness, arrangement of parts, and many [other] particular characteristics. For they are by nature changeable and disposed to be affected by what happens to them through external influences, and whatever change can be perceived by sight can occur in all of them. So, although there may be some [internal] change occurring in them that cannot be seen by sight, there is no kind of change produced by external agents that cannot be seen by sight.²⁰⁵ And since all visible objects are disposed to undergo changes that can be perceived by sight, no visible object that sight perceives at [any given] moment and that has been perceived and determined earlier, is accurately determined by sight when it is perceived a second time; that is, sight can-

not be certain at that second time that the object did not suffer change, since change is possible in all visible objects. Thus, when sight perceives some visible object it perceived before, and when it scrutinizes it, determines its form, and remembers its form when it perceives it, it will recognize it. And if some obvious change occurs in that visible object, sight will perceive that change as soon as it sees the object. But if the change is not obvious, sight will recognize that visible object and will judge it to be the way it was when it apprehended it the first time. Moreover, if it does not repeat its scrutiny, it will not be certain that the form it apprehended before remained as it was, since an inconspicuous change might occur in it that can only be revealed through visual scrutiny. If, therefore, sight repeats its scrutiny, it will accurately determine the object's form, but if it does not repeat its scrutiny, its perception of that visible object will not be truly determinate. Thus, the perception of visible objects on the basis of previous knowledge, or defining features, or minimal scrutiny is not proper perception; so sight does not properly perceive a visible object unless it scrutinizes the visible object when it perceives it and unless it examines all the characteristics possessed by that visible object and discerns them all when it perceives that visible object.

[4.33] Vision will therefore occur in two ways: vision at first glance and vision based on scrutiny. Through vision at first glance sight will perceive only the obvious characteristics of the visible object, but the form of the visible object is not accurately determined by such a glancing perusal. Moreover, vision at first glance is sometimes based on initial impression alone,²⁰⁶ whereas at other times it also entails previous knowledge. The kind of vision based on initial impression [alone] is vision of visible objects that sight does not recognize at first glance and does not scrutinize. Vision based on initial impression that also entails previous knowledge is vision of visible objects that sight has apprehended before but whose impressions sight does not scrutinize. In both cases, though, sight does not perceive the visible object as it actually is through initial impression, whether or not it has apprehended that visible object before.

[4.34] Vision based on scrutiny will also occur in two ways: vision based on scrutiny alone and vision based on scrutiny as well as previous knowledge. On the one hand, vision based on scrutiny alone involves visible objects that sight has not perceived before or that it does not remember having perceived before at the moment it scrutinizes them. On the other, vision based on scrutiny as well as previous knowledge is vision of all visible objects that sight has perceived [before] and remembers having perceived when it scrutinizes their impression and examines all the characteristics possessed by them. This kind of vision is also divided into two types, one of which is customary vision of familiar visible ob-

jects, this kind of vision occurring by means of defining features that are perceived after minimal scrutiny and after an evaluation of some of the characteristics possessed by that visible object, [and it is accomplished] along with previous knowledge. This type of vision, moreover, generally occurs in an imperceptible amount of time, so the perception of what is perceived in this way is not as determinate as it could be. The second subtype of vision will entail exquisite scrutiny as well as an evaluation of all the characteristics possessed by the visible object when that visible object is perceived, [and it is accomplished] along with previous knowledge. This type of vision will generally occur in a perceptible amount of time, but the amount of time depends on the characteristics the visible object possesses.²⁰⁷

[4.35] The type of vision according to which familiar visible objects are perceived in as determinate a way as possible occurs only through a scrutiny of all the characteristics possessed by the visible object, an evaluation of all the parts of the visible object, and a differentiation of all the characteristics possessed by the visible object when it is perceived, whether or not sight has recognized that visible object before. But this determination is determinate relative to the sense, which is to say that, in such situations, the determinateness [of the perception] is limited by what the sense is capable of perceiving. Furthermore, the perception of visible objects by sight depends on the acuity of vision, for the sense of sight varies [in capacity] with the strength or weakness of the eyes.

[4.36] These, then, are the ways in which visible objects will be perceived by sight, and they exhaust the ways in which vision occurs, so this is what we meant to show in this chapter. We have now finished discussing all of the visible objects and all of the visible properties, and we have explained all of the ways in which sight arrives at the perception of visible objects and visible characteristics, and we have laid out all of the categories into which the modes of vision can be subdivided. These are the things we meant to explain in this book.

NOTES TO BOOK TWO

¹In rendering the Latin phrase *ex verticationibus linearum radialium* as “along radial lines,” I have left *verticatio* untranslated, although later on I render it as “direction.” Accordingly, it must be understood to imply the specific directionality of such radial lines; see note 63 to book 1, p. 404 above. The term *dispositio* carries a bewildering array of meanings throughout this treatise. In this case, the varying “dispositions” of radial lines involve not only their relative spatial orientations to one another as well as to the physical surfaces they strike (e.g., whether they strike them orthogonally or at a slant), but also the dynamic effect of forms passing along them at their given slant (i.e., the sharper their inclination, the less intense the dynamic effect); see note 64 to book 1, pp. 404-405 above.

²I, 6.60, p. 374 above.

³I, 5.17, p. 350 above.

⁴I, 5.28, p. 353 above.

⁵I, 5.33, p. 354 above.

⁶I, 6.29, p. 364 above.

⁷I, 6.68, p. 376 above.

⁸In other words, being two-dimensional, the form cannot be contained in a point that, by Euclid’s definition in book 1 of the *Elements*, has no dimension whatever.

⁹Here, as in I, 6.33-37, pp. 365-367 above, the issue of image-inversion—and the obvious impossibility of its occurrence—forces a fundamental supposition to undergird the resulting visual model: i.e., that the radial lines along which the visual form abstracted at the anterior surface of the *glacialis* continues inward through the eye must be prevented from intersecting at the center of the eye.

¹⁰I, 5.10, p. 349 above.

¹¹Here “form” (*forma*) is to be taken in the sense of “qualitative structure” or “nature.”

¹²To this point Alhacen has treated the *glacialis* as a single body, focusing his analysis on its anterior, sensing surface. At this juncture, however, the interface between glacial and vitreous humors assumes crucial importance as the refracting interface between those humors.

¹³Accordingly, the entire front portion of the *glacialis*, which consists of glacial humor only and which forms the crystalline lens, must lie ahead of the eye’s center and, therefore, toward the front of the eye itself; cf. note 42 to book 1, p. 402 above; see also 2.10, pp. 420-421 above.

¹⁴Or, as Proclus asserts when commenting on book 1, def. 7 of Euclid’s *Elements*, the plane surface and spherical surface are the only two “simple” or “unmixed” surfaces; see Glenn R. Morrow, trans., *Proclus: A Commentary on the First Book of Euclid’s Elements* (Princeton, Princeton University Press, 1970), pp. 94-98.

¹⁵The reason that the interface between glacial and vitreous humor cannot be

concentric with the eye is that, if it were, it would also be concentric with the anterior surface of the *glacialis*; hence, all of the rays perpendicular to that surface would necessarily be perpendicular to the interface and would therefore intersect at the center of the eye and proceed in reverse order afterward. What Alhacen means by having the interface spherical and of "the right size not to have its curvature affect the arrangement of the form" is not as clear as it might be. For one thing, Alhacen does not specify here or later whether the vitreous humor is more or less refractive (i.e., more or less optically dense) than the glacial humor. For another, he does not specify whether the interface between glacial and vitreous humors, if spherical, has its concave or convex surface facing the anterior surface of the *glacialis*.

Bearing these points in mind, let us examine the three possibilities, assuming first that the interface between glacial and vitreous humors is plane, as illustrated in figure 2.1a, where **AB** represents the interface between the two humors, **C** is the center of the eye, and the two oblique rays pass orthogonally through the anterior surface of the *glacialis* to strike that interface at points **D** and **E**. In that case, if the rays were to be refracted away from the normal along **DG** and **EF**, they would meet in front of the eye's center **C**. In order to avoid intersecting ahead of or at **C**, therefore, they must be refracted toward the normal (e.g., along **DK** and **EL**), which can only happen if the vitreous humor is more refractive than the glacial humor in front of it. As figures 2.1b and 2.1c illustrate, the same will hold if the interface between glacial and vitreous humors is formed from a sphere whose ra-

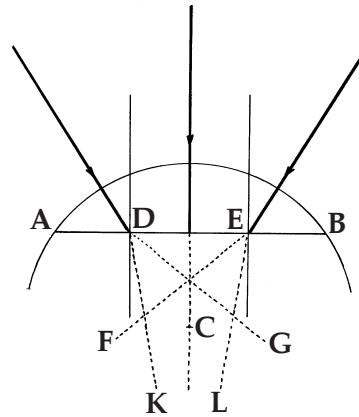


figure 2.1a

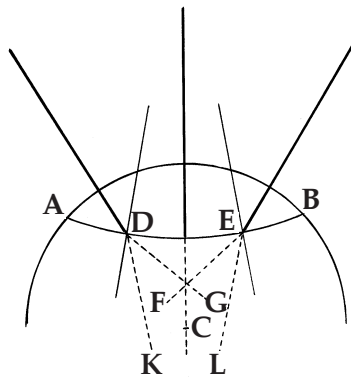


figure 2.1b

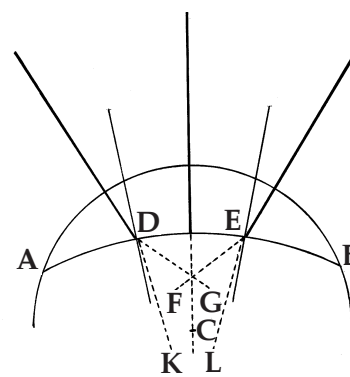


figure 2.1c

dus is larger than that from which the anterior surface of the *glacialis* is formed, no matter whether that interface is concave or convex with respect to that surface. Therefore, if we assume that the vitreous humor is more refractive than the glacial

humor, then any of the three surfaces will refract the rays in such a way that they will tend toward convergence beyond the center of the eye. Furthermore, the greater the difference in refractivity between the two humors, or the flatter the interface, the more gradual that convergence will be.

On the other hand, if the interface between the glacial and vitreous humors is formed from a sphere whose radius is less than that of the anterior surface of the

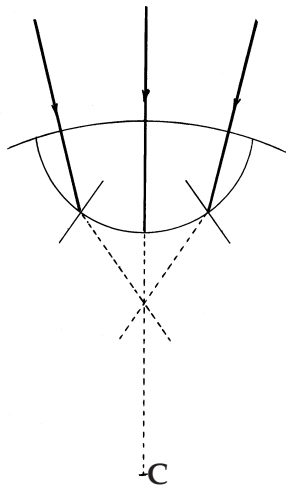


figure 2.2a

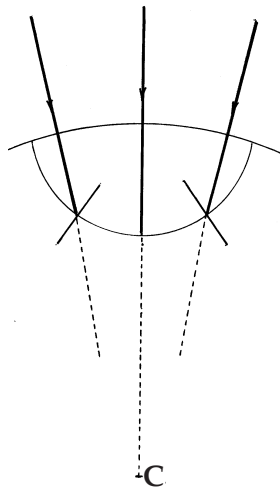


figure 2.2b

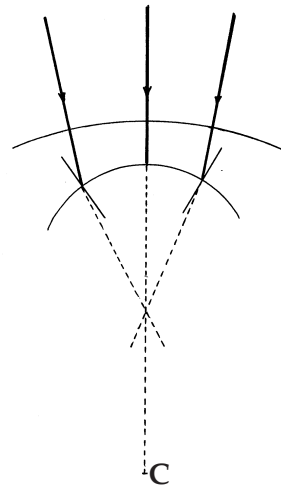


figure 2.3a

glacialis, then there are several possible outcomes, depending upon whether the vitreous humor is more or less refractive than the glacial humor and depending upon whether the interface is concave or convex with respect to the anterior surface of the *glacialis*. If the surface of the interface is concave, as in figure 2.2a, and if the vitreous humor is less refractive than the glacial humor, then the rays reaching the interface will necessarily be refracted in such a way as to converge in front of C, the center of the eye. If, however, we suppose the vitreous humor to be more refractive than the glacial humor, then, as is evident from figure 2.2b, it is possible for the rays to be refracted in such a way as to converge toward the axial ray at a point beyond center C of the eye. Conversely, if the interface is convex with respect to the anterior surface of the *glacialis*, as represented in figures 2.3a and 2.3b, the rays will invariably converge ahead of center C of the eye if the vitreous humor is more refractive than the glacial humor, whereas the rays may converge beyond point C when it is less refractive. Why, then, did Alhacen deny the possibility that the interface between vitreous and

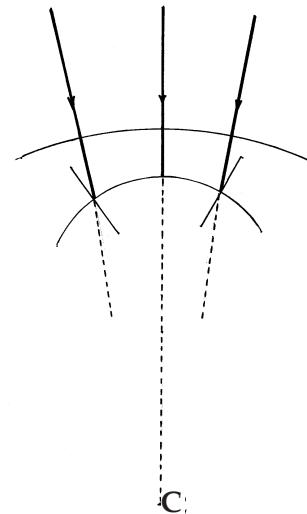


figure 2.3b

glacial humors could be more sharply curved than the anterior surface of the *glacialis*? His own rationale, that "if it were formed from a small sphere, then when the form is refracted at it and continues on, it will be distorted," is unclear and apparently misguided. What is clear, however, is that, in ruling out this possibility, he must have concluded that the vitreous is the more refractive of the two media, even though he never says so explicitly.

¹⁶I, 6.27, pp. 363-364 above.

¹⁷Here Alhacen is anticipating the question of how such forms can pass through the windings of the optic nerves in proper order and arrangement; see 2.15, p. 422 above

¹⁸This claim is only approximately true. Assume, for instance, that the object whose form is projected onto the anterior surface of the *glacialis* is planar. Let AE in

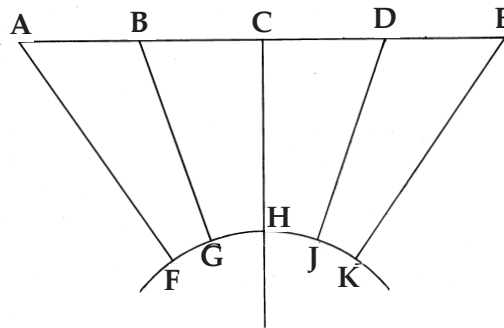


figure 2.4

figure 2.4 represent such an object, and let it be cut into equal segments AB, BC, CD, and DE. If the forms of points A, B, C, D, and E are projected along the orthogonals to points F, G, H, J, and K on the anterior surface of the *glacialis*, then the arcs they delineate will be unequal, GH and HJ being larger than FG and JK. Moreover, unless the interface between vitreous and glacial humors is perfectly flat, the form will remain somewhat distorted when it reaches this second surface. Thus, the form impressed on that surface will maintain the *relative*, but not the *absolute*, arrangement, of the original object-surface.

¹⁹As Roger Bacon explains it in *Perspectiva* 1.7.1, "since the [optic] nerve running from the vitreous humor to the common nerve contains a humor similar [to the vitreous humor], . . . the species [i.e., form] proceeds uniformly, without refraction; nor does it depart in any way from a rectilinear path, except to follow the twisting of the nerve. And in this we must admire the power of the soul's excellence, whereby it compels a species to follow the twisting of the nerve. . . . For as long as it is in a single inanimate medium, it always proceeds along straight lines, . . . but owing to the necessity and nobility of the works of the soul, a species in an animate medium follows the course of the medium and abandons the common laws of natural multiplications" (trans. Lindberg, *Roger Bacon and the Origins*, pp. 97-99).

²⁰See I, 6.69-77, esp. 6.77, pp. 376-378 above.

²³As we pointed out earlier in note 66 to book 1, p. 405 above, Alhacen's cone of radiation is mathematically equivalent in all respects to Ptolemy's visual cone, the vertex being at the center of the eye (which forms the center of sight) and the base being on the visible object. The axis of this cone thus represents the Ptolemaic visual axis.

Intellige qd a. g. abed. qe
 ut qd tunc ependiclar q
 et glacialem et ut inueni
 sunt
 tota glaci
 a. ab axe qe
 b. p. q.
 glaci
 e. q.
 c. glaci
 ut inueni

²⁵Figure 2.6a is provided by *P3* (f 45r) to illustrate this point, although it does so rather ineptly because it grossly understates the obliquity of axis **AC** with respect to interface **FGE**. The point becomes clearer when the figure is redrawn, as in figure 2.6b on the following page. With **FGE** as the interface between the glacial and vitreous humors, **C** the center of the eye, **AGC** the visual axis, and **DFC** and

363 and 369 above. This, of course, is why vision along the visual axis is clearest, a point to which Alhacen will have recourse later on in the fourth chapter of this book where he discusses the process of perceptual certification through visual scanning; see also 2.26-30, pp. 428-429 above.

³⁰This claim harks back to Alhacen's and Ptolemy's dynamic model, according to which orthogonal projection makes the most intense impression; hence, the less refracted a ray, the more orthogonal its projection both upon and from the surface of refraction; see note 64 to book 1, pp. 404-405 above.

³¹The expression *res visa*, translated here as "visible property," has two fundamental meanings in this treatise. The first, and most obvious, is "visible object" (i.e., "object that is seen"), which is how it has been used to this point. The second is "visible property" (i.e., "object of sight" taken in its broadest perceptual sense). Such "objects"—which include shape, size, and the like—are not visible *per se* but are nonetheless apprehended through vision; see note 90 to book 1, p. 409 above. These particular properties must, of course, have a physical subject within which to inhere—hence, they must be "embodied."

³²As opposed to inherent properties, which are intrinsic, accidental properties are not only extrinsic, but also contingent. Thus, the light in a self-luminous object represents an inherent property, whereas the light imparted to an opaque body by an external light-source represents an accidental property insofar as it originates elsewhere and is therefore contingent upon that source.

³³3.44, pp. 438-439 above.

³⁴In order to emphasize the fundamental passivity of *sensus solus* ("sense by itself" or "sense per se") in the visual process, I have chosen to render the phrase "brute sensation."

³⁵By the form of each of those individuals, Alhacen means the actual physical form embodied in those individuals.

³⁶In short, the perception of similarity or difference is discursive and therefore inferential.

³⁷Throughout the Latin text color, like light, is qualified by the terms *fortis* ("strong," "intense," "vivid") and *debilis* ("weak," "faint"); see, e.g., chs. 1-4 of book I, pp. 343-347 above. In the case of light, of course, the intent of these qualifiers is obvious: "strong" light has greater illuminative effect than "weak" light. In the case of color, however, the intent is far less obvious. At times—e.g., in this passage—the intensity of the color seems to be a function of its vividness or brightness (*claritas*, as opposed to *scintillatio*, which is its brightness in the sense of dazzle). Thus, a bright-green object (e.g., a lawn) will make a more intense visual impression than one that is dark-green (e.g., a stand of fir trees). At other times, however, the intensity of color seems to be a function of its "depth" or darkness. For instance, in 3.53, pp. 442-443 above, "deep-green" (*viriditas profunda*) and "brown" (*fuscus*) are characterized as "strong," as is the color of robust wine, whose color is of such depth that it renders the transparency of the wine and the containing glass difficult to discern; see I, 4.22, p. 347 above.

³⁸See note 22, p. 535 above.

³⁹The term *ratio* is most obviously translated as "reason," but I have chosen to render it "judgment" to highlight that fact that, although indeed discursive and

logical, the process of drawing perceptual conclusions is of a relatively low intellectual order in comparison, for example, to the process of logically understanding how solar eclipses occur; see 3.28, p. 433 above.

⁴⁰There are several ways to render the term *distinctio* as it is used in this treatise. Among those that are used in my translation are “distinguishing,” “discerning,” “differentiating,” “discriminating,” and “determining.” Whatever the English version, *distinctio* is used throughout the Latin text to denote a process of perceptually homing in on specific characteristics or characterizations inherent in physical objects. Thus, it is through such differentiation (homing in on and isolating specific features) that the faculty of discrimination is able to carry out the comparisons necessary in assimilation (“x is like y”) or distinction (“x is unlike y”); see note 66, p. 541 below.

⁴¹The Latin term here is *scriptor*, i.e., “writer,” rather than the expected *lector* (“reader”); see also II, 3.23, p. 432 above. Although Sabra renders it as “literate person,” the Arabic term at this point also translates literally as “writer.” Presumably, then, Ibn al-Haytham regarded a literate person as one who could write, not just read. Such an understanding of literacy is especially interesting in view of recent attempts to explain how literacy was understood and defined in the Middle Ages and how that understanding changed over time. See, e.g., Rosamund McKitterick, *The Carolingians and the Written Word* (Cambridge: Cambridge University Press, 1989), Brian Stock, *The Implications of Literacy: Written Language and Models of Interpretation in the Eleventh and Twelfth Centuries* (Princeton: Princeton University Press, 1983), and M. T. Clanchy, *From Memory to Written Record, England 1066-1307*, 2nd ed. (Oxford: Blackwell, 1993).

⁴²The *virtus distinctiva* (“faculty of discrimination”) does not represent a discrete faculty as, for instance, does the imagination. Rather, it designates a peculiar capacity possessed by the final sensor. As such, it serves as an active complement to the more passive sensitive faculty (*virtus sensitiva*); see 3.46, p. 439 above. The final sensor, for its part, does seem to represent a discrete faculty, one that may well be identical, or at least similar, to Aristotle’s common sensibility.

⁴³*Intentio*, which I have rendered as “characteristic,” has a spectrum of meanings, all of them informed by a sense of “proffering” or “holding forth.” Thus, an entire argument may have a specific “intention” or “meaning” in terms of the conclusion or understanding that it demands of us as we follow it through its logical steps. In the case of physical objects, they “hold forth” a large variety of specific qualities or characteristics (many of them “signs”) that go into defining them. Each such object also carries a general intentionality that indicates its essential “meaning,” which tells the perceiver what it is in terms of general or specific kind (i.e., this thing is a “man” and, moreover, the man named “Socrates”).

⁴⁴In scholastic Latin parlance, *quidditas* (or *quidditas*, which is often rendered as “quiddity”) denotes the essence or nature of a given thing and, therefore, what makes that thing what it is. In terms of its “quiddity,” therefore, each member of humankind is what it is by virtue of being animate, rational, and mortal. As will become clear later on (see note 55, p. 540 below), “quiddity,” as used in the *De aspectibus*, is neither as abstract nor as intellectual as this: rather, it constitutes the physical denotation—by means of various superficial characteristics—of sensible

objects. Accordingly, individual humans belong to the general type Human (their *quiditas*) by virtue of such superficial attributes as being bipedal or having an upright posture; see 4.22, pp. 522-523 above.

⁴⁵From this and subsequent paragraphs it is clear that Alhacen subscribes to an empiricist epistemology based solely on sense-induction and presupposing little or nothing in the way of innate ideas or conceptual capacities on our part. In this he has far more in common with Aristotle than with Plato.

⁴⁶See I, 6.61, p. 374 above.

⁴⁷See note 39, p. 537-538 above.

⁴⁸Henceforth the term *anima* ("soul") will recur frequently to indicate in a general way where all the interpretive steps of visual perception take place with the arrival of the visible form at the common nerve. As will become clear in due course (esp. chapter 4), several specific faculties, including imagination, memory, and mind, are involved in this process; and "soul" is often used to stand generally for these specific faculties; see note 194, p. 556 below.

⁴⁹That the whole is greater than the part is the fifth common notion listed by Euclid in the first book of his *Elements*. As such, it constitutes a supposedly self-evident (and presumably innate) truth. In deriving it logically from its constituent parts, Alhacen manifests a belief that, as far as logic is concerned, the propositional content of any statement is a product of sense-induction alone (i.e., *nichil in intellectu quod non prius in sensu*). Therefore, it is only the capacity to juxtapose such propositional content in logical order that is innate; see 3.38-39, pp. 436-437 above.

⁵⁰I have chosen to render *propositio generalis* as "major premise" to highlight the basic Aristotelian structure of syllogism as reflected in this example. According to Aristotle, the quest for logical understanding starts with the major premise, which, though grasped through sense-induction, is nonetheless universal. Given that, the search for new conclusions depends on the search for appropriate minor premises, which invariably lead to those new conclusions by relating some newly chosen middle term to the two terms in the major premise. Thus, assuming that we do not yet know that the whole is greater than the part but do know that the whole exceeds the part (major premise), then, as soon as it occurs to us that exceeding means "greater than" (minor premise), the conclusion comes to us. See Aristotle, *Posterior Analytics* II, 3.

⁵¹*Solus intellectus* ("pure understanding") is just like *solus sensus* ("brute sensation") in that it grasps its proper object ("first principles") absolutely immediately, without any deliberation or interpretation.

⁵²That is, it will become a first principle that may then be used to form the major premise in a new syllogism.

⁵³In this instance "naturally" means "unconsciously" or "without any deliberation whatever"; see note 51 above.

⁵⁴It is difficult to convey the full meaning of *quiescere* ("to be quiet" or "to come to rest") as used here and later in the *De aspectibus*. Such a state of intellectual rest culminates the discursive process (fraught with effort) that leads to understanding. Thus, to achieve a full and true understanding of something is to achieve a *quies mentis* ("a quiet of the mind"). I have chosen to render the term *quiescere* as "to ensconce" in order to convey the underlying notion that a given percept or concept

deriving from the sense eventually finds a niche in the soul or mind where it is subject to mnemonic retrieval.

⁵⁵As used by Alhacen, the universal form represents a distillation of repeated visible impressions. Thus, the universal form of “green” derives from repeated impressions of green, the repetition yielding a sort of vague or general notion of green. The resulting distillate is not equivalent to the Universal as the epistemological construct underlying either Plato’s or Aristotle’s theory of knowledge. For one thing, as an archempiricist, Alhacen does not share Plato’s belief in *a priori*, or innate, knowledge (see notes 45 and 49, p. 539 above). For another, the universal form is not intellectually abstract; it is inextricably tied to the sensible object or characteristic it represents. Yet at the same time it has a sort of nebulous generality. Or, to put it in Roger Bacon’s terms, it constitutes a “diffuse particularity . . . that is as common [i.e., as extensive in its representation] as the universal and is convertible with it” (*Perspectiva* I.10.3, in Lindberg, *Roger Bacon*, pp. 156-157). For further discussion, see “Introduction,” pp. lxxxvii-lxxxix above.

⁵⁶As Aristotle points out in *De anima* II, 6, brute sense-perception (i.e., *solo sensu*) cannot be true or false; a given sense-impression, such as the impression “green,” is logically value-neutral. Judgments about those impressions can, however, be false. Thus, while it cannot be false that, at a given time, I am undergoing the impression of “green,” my judgments about that impression (“I see blue” or “That thing I see before me is green”) can, and often do, err. Indeed, it is to examine the grounds of such erroneous judgments that Alhacen devotes the third book of the *De aspectibus*.

⁵⁷By *remotio* (“distance”) Alhacen has in mind the state of being remote from the viewer. It is, in short, the fact, not the specific measure, of remoteness, which is generally referred to later as *quantitas remotionis* or *mensura remotionis*—i.e., the “extent” or “magnitude” of the remoteness; see, e.g., 3.67, p. 448 above.

⁵⁸*Situs* must be distinguished from *locus*, the latter meaning “place.” *Situs* refers to a given object’s overall “situation” or relative placement with respect to the viewer—e.g., directly facing him, at a slant to him, far to his left, etc. Place or location, for its part, depends upon the object’s distance (in terms of spatial extent) and direction vis-à-vis the center of sight; see 3.67, p. 448 above.

⁵⁹*Corporeitas*, which I have translated as “corporeity,” is the property of “bodiliness” in terms of occupying three spatial dimensions (see 3.121, pp. 469-470 above). It could as well be translated by “solidity,” except that I wanted to avoid any confusion with the term *soliditas*, which is used throughout the Latin text to mean “opacity” or “capacity to resist the passage of light.”

⁶⁰This list of “visible intentions” can, of course, be interpreted as an elaboration on Ptolemy’s list of seven “visible properties” (*res vidende*)—corporeity, size, color, shape, place, activity, and rest—that list, in turn, quite likely deriving from Aristotle’s list of “commons sensibles”; see Ptolemy, *Optics* II, 2, in Smith, *Ptolemy’s Theory*, p. 72. In his commentary on this passage in *Optics*, vol. 2, p. 83, Sabra implies that this lineage may only be apparent. “As things stand,” he therefore concludes, “I am not inclined to believe that it would be helpful to try to explain Ptolemy’s and Alhacen’s treatment of visual perception in terms of Aristotle’s own doctrines and concerns. It would seem to me that such an approach can only lead to confusion.”

Suffice it to say, I do not share Sabra's misgivings in this regard, although I hasten to add that Alhacen's list goes well beyond Aristotle's common sensible in terms of both quantity and intention inasmuch as transparency, opacity, shadow, darkness, beauty, and ugliness are clearly not accessible or "common" to any sense but sight.

⁶¹Cf. note 39, pp. 537-538 above.

⁶²2.10-12, pp. 420-421 above.

⁶³By "relative arrangement" I mean the arrangement of objects or parts among each other.

⁶⁴The visible form presented to the final sensor is thus nothing more than a pointillist depiction of the object it represents, so its actual, physical content is limited to light and color, and color-contrasts. Yet, like a mosaic, this depiction conveys (or "intends") things that are not really contained by it. For those intentions to be grasped, then, that mosaic must be properly interpreted, which is what the faculty of discrimination does, thereby serving as ulterior viewer.

⁶⁵Bear in mind that this notional entity, which comes to rest in the soul, is a proposition (indeed, a "general" or major premise). Thus, the sorts of universal forms that become ensconced in the soul seem to include not only forms of specific visible objects or characteristics, but also propositional forms.

⁶⁶The process of comparison (*comparatio*) adverted to here is more in the way of correlation than of comparison in the strict sense. Hence, in an effort to identify a given color, the faculty of discrimination correlates that color with one already known and ensconced in the soul that resembles it. Later in the text I will render *comparatio* as "correlation" rather than comparison in order to make the distinction crystal-clear.

⁶⁷By "assimilation" (*assimulatio*) is meant not the process of incorporation or absorption but, rather, the process of finding the given object's or characteristic's likeness in memory.

⁶⁸The distinction between "essential" and "accidental" light is basically the same as that between *lux* (intrinsic luminosity) and *lumen* (the physical effect of *lux*) as discussed in note 2 to book 1, p. 395 above. When shining on an opaque body, accidental light acts like essential light in that it radiates omnidirectionally in straight lines from every point on that body and, in the process, confers visibility on the color in that object. Alhacen discusses accidental light and its properties at length in I, 3.22-98, in Sabra, *Optics*, vol. 1, pp. 20-40.

⁶⁹In this case the "strength" of the two listed colors—deep-green and brown—can hardly be due to their vividness. As we shall see later, one key index to the strength of such colors is that, when they tint transparent media, they tend to mask the transparency of those media, rendering them apparently opaque until they are put up against the light.

⁷⁰Figure 2.8, labeled *tocus* ("top"), is provided in ms P3 (f. 57v) by way of illustration. This, and many of the figures that follow it in P3, have minimal explanatory purpose and may have been included more for mnemonic than for pedagogical reasons.

⁷¹This example clearly derives from Ptolemy's discussion



figure 2.8

of the blending of color on a spinning potter's wheel in *Optics* II, 96, in Smith, *Ptolemy's Theory*, pp. 109-110.

⁷²Such distortion can lead to the spot of color's being seen according to the path of its motion (e.g., the circle of revolution) as delineated on the surface of the *glacialis* rather than according to its individual situation in relation to its surroundings.

⁷³In other words, the inferential step between sensing color, *qua* color, and differentiating it (i.e., perceiving that it is red or green) is shorter than the inferential step between sensing and perceiving any other visible characteristic except, presumably, light.

⁷⁴Figure 2.9 is provided in ms P3 (f 58r) by way of illustration. It shows a ray of light, labeled *lumen*, passing from the sun, represented by the circle to the left labeled *sol*, through the opening (*foramen*) in the black rectangle at the center, to the smaller black rectangle to the right, labeled *corpus oppositum* ("facing body").

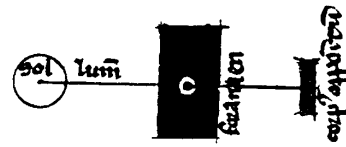


figure 2.9

⁷⁵This putative demonstration of the temporal propagation of light and color is puzzling for several reasons. First, it is far from clear what purpose it serves except, perhaps, to repudiate Aristotle's claim that the transmission of light through transparent media represents an alteration akin to the freezing of water, which occurs instantaneously throughout the medium (see *De sensu* 6, 446b26-447a10). Or perhaps it is meant to establish a kinetic basis, however tenuous, to support the dynamic aspects of light- and color-radiation that are instrumental in Alhacen's account of visual selectivity at the surface of the *glacialis* (see I, 6.27, pp. 363-364 above). The demonstration itself poses some problems insofar as it seems to be based primarily on—and to respond primarily to—the supposition that the air as a whole receives incoming light all at once. At any rate, as Sabra points out in his commentary on 3.60-61 in *Optics*, vol. 2, pp. 87-88, the conclusions to be drawn from Alhacen's argument are as equivocal as the demonstration leading to them. Indeed, whatever is demonstrated, it is not the temporal propagation of light *seriatim* along the line of radiation; see 3.62 and 3.64, pp. 446-448 above. It is worth noting that only one of Alhacen's Perspectivist followers, Roger Bacon, accepted the temporal propagation of light and color; but his rationale in support of that idea had little or nothing to do with Alhacen's; see David C. Lindberg, "Medieval Latin Theories of the Speed of Light," in René Taton, ed., *Roemer et la Vitesse de la Lumière* (Paris: Vrin, 1978).

⁷⁶In other words, as the eye turns toward the light-source, its surface, and with that its interior, is more fully exposed over time to that light, so it takes time for the full, direct effect of that light to be felt by the final sensor at the common nerve. The temporal "passage" here would thus seem to be lateral, not along the line-of-sight, and the motion that underlies it belongs to the eye, not the light.

⁷⁷What Alhacen seems to be getting at here is that the brute sensation of color, *qua* color, and of light, *qua* light, does not constitute realization of the fact that color and light have been sensed; brute sensation is therefore unconscious. The conscious realization that color and light have been sensed comes only after the color

and light have reached the final sensor.

⁷⁸The *quiditas* of the light (i.e., what kind of light it is) depends on its source (e.g., firelight versus sunlight or moonlight), whereas its *qualitas* ("quality") is a matter of its intensity.

⁷⁹Clearly, then, as far as the Latin translator is concerned, *quantitas* and *mensura* are interchangeable in denoting the extent or magnitude of the spatial separation (i.e., distance) between objects; see Sabra, *Optics*, vol. 2, pp. 88-89 for a comparative analysis of the Arabic and Latin terminology used in the subsequent discussion of distance and its measure.

⁸⁰That is, Aristotle and any of his intromissionist followers.

⁸¹The primary point of this argument, of course, is that, since visual perception is not based on extramission and, therefore, that the visual faculty does not reach out to external objects to get in visual touch with them, the visual perception of the spatial characteristics of things is not immediate in the way our tactile perception of those things seems to be. The ulterior implication of the argument is that there is absolutely nothing intuitive about spatial perception; it is an entirely inferential process. As is clear in 3.73. p. 450 above, even our perception that the visible world lies apart from, and outside of us, depends upon inference.

⁸²See I, 6.47, p. 370 above.

⁸³3.94-114, pp. 457-466 above.

⁸⁴The process of visual certification (*certificare*) involves a determination whose accuracy is a matter more of certainty (i.e., of careful scrutiny) than of numerical exactitude. Thus, a certified measure of distance is accurate in terms of definiteness (e.g., "within touching distance" or "a hundred paces away") rather than computational precision (e.g., "307 cubits away"). However, as Alhacen establishes in 3.151, pp. 481-482 above, the ultimate yardstick by which we measure distances at ground-level is the size of the human body and its pace or arm's-length.

⁸⁵As will become evident later on, in 3.150, p. 481 above, the intervening body Alhacen has in mind is the ground between eye and object.

⁸⁶When we turn to Alhacen's discussion of the various threshold conditions of visual perception in chapter 3 of the third book, we will see that the range of moderateness for distance is variable, depending on a variety of factors, including the size of the object under scrutiny, how intensely it is illuminated, and so forth.

⁸⁷In I, 8.7, pp. 392-393 above, Alhacen adverts to the limitations of sense-capacity. Thus, sense-capacity represents another threshold condition for visual perception, and it too is subject to variation, depending on such things as the state of the sense-organ itself. By "a continuous, ordered range of bodies" Alhacen means a succession of bodies between eye and object whose sizes and interrelated distances are determined, or at least determinable. An obvious example would be a row of trees, all of roughly the same height and separated by roughly the same interval, stretching between the eye and the visible object whose distance is to be determined. In reality, of course, the heights and intervals of such bodies are considerably less uniform; but the crucial point is that, in order to determine long distances (e.g., between the viewer and a distant building), there must be some intermediate reference-objects to put that distance into proper perspective.

⁸⁸The failure of the visual faculty to determine untoward distances properly,

even when that distance is (or at least seems to be) spanned by a continuous, ordered range of bodies is exemplified in the Moon Illusion, which Alhacen explains much later, in the seventh book, on the basis of our tendency to underestimate the distances (and, thus, the sizes) of celestial objects at zenith and, conversely, to overestimate their distance and size when they lie near the horizon because we refer them to objects that lie far away toward the horizon; see A. I. Sabra, "Psychology versus Mathematics: Ptolemy and Alhazen on the Moon Illusion," in Edward Grant and John Murdoch, eds., *Mathematics and its Applications to Science and Natural Philosophy in the Middle Ages* (Cambridge: Cambridge University Press, 1987), pp. 217-247.

⁸⁹Figure 2.10, which is labeled *nubes* ("clouds"), is provided in ms P3 (f 62v) by way of illustration.

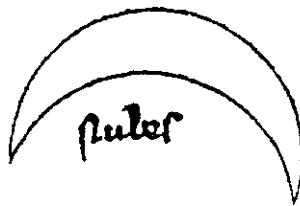


figure 2.10

⁹⁰Note that, in this example, the ground serves as "the continuous, ordered range of bodies" by means of which the distance to and between walls would be measured; see note 85, p. 543 above.

⁹¹Figure 2.11 is provided in ms P3 (f 63r) by way of illustration. The viewer to the left looks into the room (or "house," labeled *domus*) through an aperture (labeled *foramen*) at the two walls, which are set up one behind the other. The text

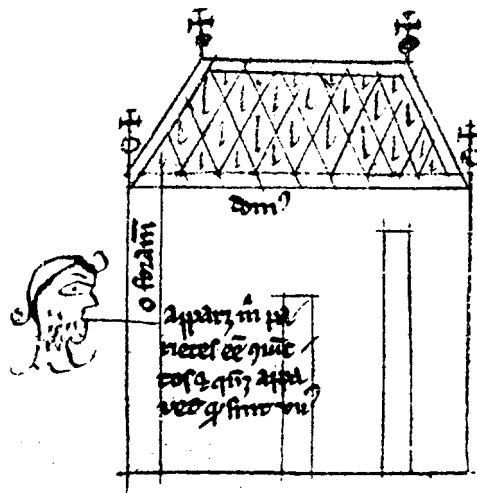


figure 2.11

inside the figure reads: *Apparet mihi parietes esse coniunctes, et quandoque apparet quod sint unus* ("It looks to me as though the walls are joined [i.e., contiguous], and sometimes it looks as though they are one [wall]").

⁹²This simple experiment offers a definitive refutation of Ptolemy's idea that we perceive eye-to-object distance on the basis of an innate sense of ray-length; see note 106, p. 546 below.

⁹³To this point the measure of distance has been along the line-of-sight, perpendicular to the plane of the visual field. Now the measure of distance is along the horizontal within that plane. Note, incidentally, that for Alhacen, as for Ptolemy, the visual field (or horopter) is planar rather than curved; see III, 2.4, p. 563 below; see also Smith, *Ptolemy's Theory*, p. 34.

⁹⁴See note 88, pp. 543-544 above.

⁹⁵In other words, if we see something that looks like a horse from afar, then we assume that it actually is a horse and, therefore, that it is the same size as horses of which we have had previous experience. On the basis of that experience, which includes seeing horses at different distances and noting how their apparent size varies with those distances, we assimilate the form of the horse we think we see to the equivalent form of a horse we remember (as of such-and-such an apparent size at such-and-such a distance) and conclude that the horse we think we see from afar lies at that remembered distance. Of course the apparent horse could actually be a pony, in which case we might overestimate the distance.

⁹⁶As the analysis continues, it will become clear that an object is in "opposition" when it faces the eye.

⁹⁷This second subtype of spatial disposition involves the orientation or slant of a facing surface or line.

⁹⁸3.74, pp. 450-451 above. Note that for the subsequent analysis of "opposition," distance (*remotio*) is taken as the *fact* of, not the extent of, spatial separation; see note 57, p. 540 above.

⁹⁹I, 6.60, p. 374 above.

¹⁰⁰I, 6.66, pp. 375-376 above. The actual radial passage is through the body of the *glacialis* only because, as has been established in chapter 2 of this book, the radial lines are refracted at the interface between glacial and vitreous humors. However, and this is the point that is being established here, the form *would* pass along straight, uninterrupted lines to the very center of the eye were it not for that refractive interface.

¹⁰¹Here the vectorial implication of *verticatio* is clear; the sensitive faculty does not sense the radial line itself but, rather, the trajectory represented by that line. This sensation is crucial for spatial perception, because it provides the means whereby the final sensor can determine the relative orientation within the visual field (i.e., to determine the relative rightwardness, leftwardness, upwardness, or downwardness) of the object-point seen along that vector.

¹⁰²According to Alhacen's analysis, then, "location" or "place" (*locus*) is a subtype of spatial disposition (*situs*). Indeed, as he defines it in 3.67, p. 448 above, location is specified by three variables: direction, distance (i.e., remoteness), and magnitude of distance; see 3.100, pp. 460-461 above.

¹⁰³In I, 6.61, p. 374 above, the Latin term *signum* was rendered as "defining fea-

ture," whereas here it has been rendered directly as "sign." Whatever its English rendering, however, the term is used throughout the Latin text to designate something (be it defining feature, indicator, or symbol) that implies or betokens something deeper or more complex.

¹⁰⁴Up to now, location or place (*locus*) has been defined generally in terms of the body's lying at some remove from the eye in a given direction. Here Alhacen makes clear that the full specification of location requires a determination of how far removed the object is. Compare this to Aristotle's definition of place in *Physics*, 4, 4, 212a as "the innermost motionless boundary of what contains it" (trans. R. P. Hardie and R. K. Gaye, in Barnes, *Complete Works*, p. 361).

¹⁰⁵Such lines include the demarcations between discrete objects or segments that are contiguous, as well as the juncture between intersecting surfaces (e.g., two plane surfaces meeting each other at an angle); the gaps in question include intervals of spatial separation between discrete objects or segments and would presumably extend to channels or troughs cut into a surface.

¹⁰⁶The "center of sight" is the perceptual counterpart of the physical center of the eye; both of them, of course, lie at the vertex of the cone of radiation, which is mathematically equivalent to the visual cone of Ptolemaic optics; see note 66 to book 1, p. 405 above. When it is a matter of perceptual perspective, then, I will render *centrum visus* as "center of sight."

¹⁰⁷Figure 2.12a is provided by ms P3 (f 68r) to explain a directly facing position. The vertex of the triangle within the circle is labeled *centrum visus* ("center of sight" or "center of the eye"). The text applied to the diagram reads as follows: *AB res visa directe est opposita visui si inter centrum oculi et A et B sunt lineae equales; tunc axis*

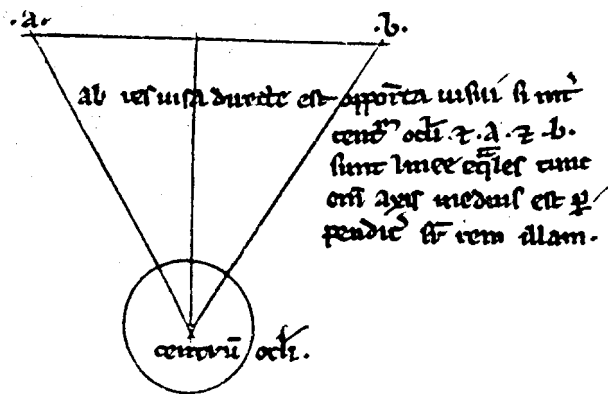


figure 2.12a

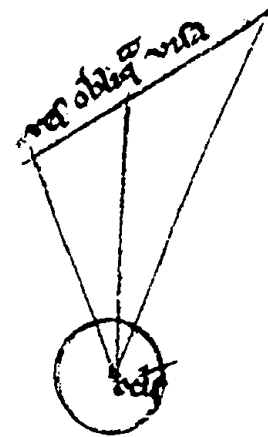


figure 2.12b

medius est perpendicularis super rem illam ("Visible object **AB** faces the eye directly if the lines between the center of the eye and **A** and **B** are equal; in that case the central axis is perpendicular to it"). Figure 2.12b, which occurs on f 69r of the same ms illustrates an obliquely facing disposition, the circle at the bottom being labeled

oculus ("eye"), and the line at the top being labeled *res obliqua visa* ("slanted visible object").

¹⁰⁸I take "in the line of opposition" to mean "straight out in a facing direction."

¹⁰⁹That, of course, is why the moon and sun appear flat, even though we know they are spherical.

¹¹⁰Figure 2.13 is provided by ms P3 (f 74r) to illustrate the visual perception of a convex surface by the eye, labeled *oculus*.

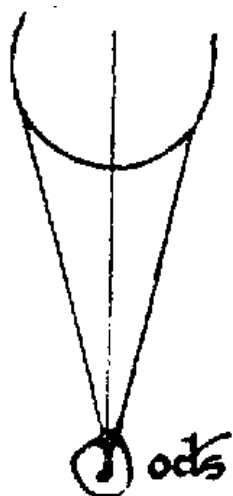


figure 2.13

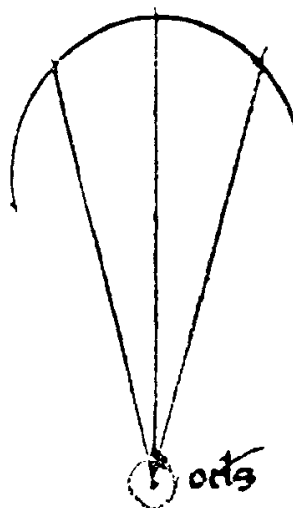


figure 2.14

¹¹¹Why should a concave surface not be perceived as part of a solid body when a convex surface is? Although Alhacen has nothing to say on this score, perhaps he had the following in mind: Even though the visual faculty may perceive that the concave surface extends in depth, it has no way of determining whether that surface stands alone or forms part of a body whose mass lies behind it. It does, however, have a clear perception that the depression facing us is unenclosed (i.e., that it does not envelop a body on the side facing us). With a convex surface, on the other hand, the situation is fundamentally different, because the surface's depression faces in the opposite direction, away from rather than toward the viewer. Unable, therefore, to tell whether it is enclosed from behind (i.e., whether it envelops a body on the side not facing us), we take it to be solid by default. Figure 2.14 is provided by ms P3 (f 74r) to illustrate the visual perception of a concave surface by the eye, labeled *oculus*.

¹¹²Indeed, since it is an established principle that sight perceives nothing unless it is embodied (see 3.1, p. 429 above), then whenever we see something we almost always conclude that it occupies some volume (i.e., exists in three dimensions), even when we cannot actually see its extension in depth.

¹¹³This, of course, is the configuration of the object's boundary, or the boundary of the given part, as perceived according solely to length and breadth—e.g., the

circularity of a sphere according to its planar representation on the surface of the *glacialis*.

¹¹⁴The “form” referred to here is thus the actual volumetric shape of the object—e.g., spherical, conical, cylindrical.

¹¹⁵Here Alhacen is discussing the form of the object in three-dimensional, rather than two-dimensional, terms.

¹¹⁶It is presumably on the basis of previous acquaintance, deductively achieved, that we perceive the moon as a sphere rather than the flat disk that actually appears to us in the sky.

¹¹⁷In this context, *figura* designates the shape of the body’s outline whereas *forma* designates its volumetric shape.

¹¹⁸In the fourth “definition” (i.e., postulate) of his *Optics* Euclid relates size-perception directly to the size of the angle at the vertex of the visual cone; and nowhere in the subsequent analysis does he cite any other factor in size-perception. Who the others are among the “several” Alhacen mentions here is uncertain, but it presumably included various Arab followers of Euclid.

¹¹⁹Foremost among those taking this position (assuming there are others) is Ptolemy, who has size-perception contingent on three interdependent factors: the size of the visual angle, the distance of the object, and the obliquity of the object with respect to the center of sight; see *Optics*, II, 47-63, in Smith, *Ptolemy’s Theory*, pp. 90-98.

¹²⁰That is, within the limits of moderation, which allows fairly ample latitude under normal conditions.

¹²¹In this analysis Alhacen is arguing in support of what modern perceptual psychologists refer to as size-distance invariance, according to which the perceived size of a given object does not vary as it recedes or approaches the center of sight. As far as Alhacen’s analysis is concerned, the primary factor that permits us to follow this perceptual principle is familiarity. That is, if a given object is presented to us for the first time and we start by accurately determining its size at some initial distance, then, in knowing throughout all subsequent distance-changes that it is the same object, we “see” it as the same size. Likewise, with familiar objects whose acquaintance we have made earlier (e.g., a given person), when we see such objects over time at varying distances, we “see” them as the same size throughout. However, as Alhacen points out, the invariance of size-perception with distance holds only at moderate distances. It is worth noting, finally, that, in the eighth proposition of his *Optics*, Euclid admits that apparent size (as measured by the visual angle) varies with distance, but not in a one-to-one fashion (i.e., that an object does not appear half as big at twice the distance).

¹²²Figures 2.15a and 2.15b on the following page are provided by ms P3 (ff 77r and 77v) to illustrate the discussion in 3.138-139, pp. 475-476 above, of a square and circle viewed aslant from the eye at right, labeled *oculus*.

¹²³3.52, p. 442 above.

¹²⁴3.97, pp. 458-459 above.

¹²⁵3.86-90, p. 454-456 above.

¹²⁶Two things are crucial to the faculty of discrimination’s ability to determine the visual angle: 1) the sensation of radial directionality that accompanies the im-

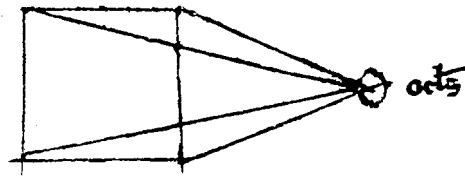


figure 2.15a

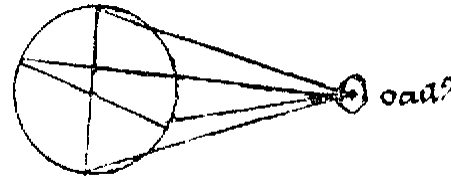


figure 2.15b

pressions of the object's circumferential point-forms on the surface of the *glacialis*, and 2) the perception of the size of the object's overall form on that surface. On the basis of these two givens, the faculty of discrimination is able to imagine the visual cone extending between the center of sight and the form on the surface of the *glacialis* and thereby to imagine the visual angle at the vertex of that cone. Then, granted a determinate perception of the object's distance from the center of sight, the faculty of discrimination is fully prepared to determine the size of that object; see 3.148, p. 480 above.

¹²⁷3.81, p. 454 above.

¹²⁸3.87, p. 455 above.

¹²⁹3.90, p. 456 above.

¹³⁰This portion of ground is presumably the one upon which the viewer stands while measuring the portions immediately surrounding him.

¹³¹As is clear from the analysis in 3.156, pp. 484-485 above, perception of the spatial disposition (relative orientation) of the two rays is tantamount to perception of the angle they form at the center of sight. Thus, the point of this discussion is that the faculty of discrimination is able to correlate both visual angle and ray-lengths to the size of the portion of ground subtending that angle.

¹³²As we have already seen in Alhacen's account of the perception of the spatial separation between ourselves and objective reality (see 3.71 and 3.73, pp. 449-450 above), spatial perception is inferential, not immediate or intuitive for Alhacen. This point is abundantly clear in the analysis of distance-perception in 3.151-154, pp. 481-484 above. But why fall back upon such a complex inferential account when an intuitionist one would have been so much more straightforward? The answer is simple: By rejecting the visual-ray theory and all its entailments, Alhacen left himself no choice. One obvious virtue of the visual ray theory is that it makes spatial perception almost self-explanatory: Using the visual ray as a tactile instrument, we can visually feel things in much the same way we feel them with our hands. Thus, our visual apprehension of space and the spatial characteristics of external objects will be as immediate and intuitive as our tactile apprehension of them—a conclusion that accords with our own unreflective sense that we simply "see" physical space. Accordingly, just as we locate a given object through physical reach ("an arm's-length away") without any, or at least with minimal, inferential mediation, so we locate things visually without inferential mediation. We do so, according to Ptolemy, by an innate sense of ray-length; see *Optics*, II, 26, in Smith, *Ptolemy's Theory*, pp. 81-82. Denied this expedient, Alhacen is forced to fall back upon inferential mediation to account for spatial perception. It is worth noting, however, that his explanation, like Ptolemy's, is based upon a subjective sense

of the place and space we occupy with our bodies.

¹³³A cubit is the length of the forearm from elbow to the tip of the middle finger. What Alhacen seems to have in mind in this passage is that the cubit is not some absolute, *a priori* spatial measure but an empirical yardstick that is unconsciously applied when we want to specify particular spatial extents. Our initial perception of spatial extent is therefore not in such specific terms; it is only later in the process of measuring space that we intellectualize it in such terms. Note, however, that the specific measures Alhacen mentions—the pace, the cubit, the palm's-breadth—have the human body as their ultimate referent.

¹³⁴See note 130, p. 549 above.

¹³⁵At such large distances, the sensitive faculty can no longer detect the difference in the lengths of the two rays that flank the portion of ground at its front and rear edges. It can, however, still detect the angle. Therefore, as figure 2.16 illustrates, the visual faculty will perceive the space as if it faced the eye directly rather than obliquely, as it actually does—i.e., in viewing portion **AB** of the ground from **E**, the perceiver will judge its size according to the directly facing segment **AC**. Hence, the actual extent of that portion of ground will be greater than its perceived extent.

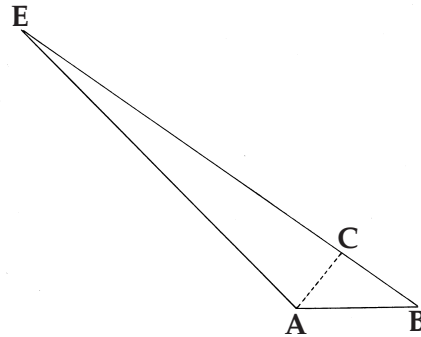


figure 2.16

¹³⁶Here Alhacen is referring to color-perspective in a somewhat oblique way: i.e., the farther from the center of sight an object gets, the less vivid its color becomes. Hence, vividness of color is a gauge for determining, as well as misperceiving, the relative distance of objects—a point that Alhacen makes explicitly in III, 7.250-251, p. 625 below.

¹³⁷This method of determining distance by correlating visual angle and size is a back formation from the method described in 3.146, p. 479 above, for determining size by correlating visual angle and distance. This latter method, of course, depends upon a direct determination of distance that is ultimately grounded in our bodily sense of place and space (i.e., in terms of paces, palm's-breadths, etc.).

¹³⁸See note 118, p. 548 above.

¹³⁹3.143, pp. 477-478 above.

¹⁴⁰3.87, p. 455 above.

¹⁴¹The point of this rather confusing passage seems to be that, if one wants to determine the eye-to-object distance accurately, and if there is some continuous body (i.e., the ground) spanning that distance, the viewer will submit that body to an axial scan that will result in the conclusion that, by the rough reckoning of sense, the overall eye-to-object distance is equal to the length of the radial lines between eye and object.

¹⁴²I, 5.35, pp. 354-355 above.

¹⁴³In other words, the visual axis does not oscillate freely within the visual cone from its anchor-point at the vertex—which is how Euclid seems to conceive of the scanning motion of visual rays in the first proposition of his *Optics*, whose point is

to show that no object is seen at once in its entirety but, rather, viewed segment-by-segment through a radial scan. Against this view, Alhacen argues that, when the eye carries out the axial scan that is necessary to visual certification, it moves the entire visual cone, the axis thus remaining perfectly immobile within it.

¹⁴⁴These operations are carried out naturally (*naturaliter*) insofar as they are virtually innate and instinctive to the sense of sight. Such “natural” operations, which include simple logical deduction, are therefore unconscious and effortless, even though they may be relatively complex; see 3.38-39, pp. 436-437 above.

¹⁴⁵In rendering the Latin phrase *pars partium* as “portion of the parts,” I am trying to reflect in English the dual meaning of “part” (*pars*) as used throughout the Latin text. On the one hand, it can be taken in the indefinite sense, as a mere quantum within the context of physical whole, in which case I have tended to render it “portion.” On the other hand, *pars* can be taken in the specific sense, as a constituent element that helps define the body of which it is a part. In this latter sense, various members or organs, such as hands, feet, eyes, and ears, constitute parts of the human body and thereby define it as such. Unfortunately, beyond context, there is no way to be certain about which sense of *pars* is intended in the Latin text.

¹⁴⁶Figure 2.17 is provided in P3 (f 88v) by way of illustration. The accompanying text reads: *Ut AB subtenditur maiori angulo quam GH, que est eis equalis* (“For instance, **AB** subtends a greater angle than **GH**, which is equal to them” [“them” presumably referring to **AB** and all the other cross-sections]).

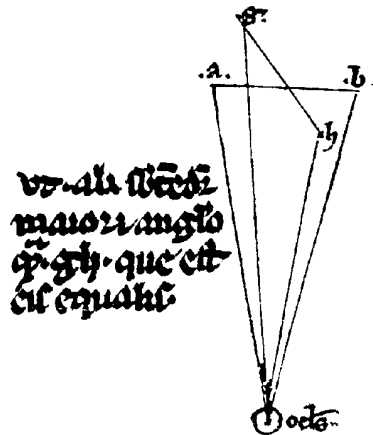


figure 2.17

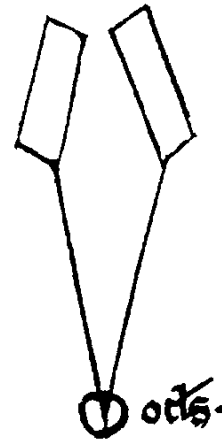


figure 2.18

¹⁴⁷The Latin term translated as “to extend” here is *exire* (“to go out” or “to go forth”), which of course implies actual physical emission, a point that leads Sabra to charge Alhacen with “lapsing into a terminology [he] had abandoned” (i.e., the terminology of visual extramission); see *Optics*, vol. 2, p. 96. As we have noted, however, Alhacen has no qualms about framing his discussion of visual perception within the structure of what amounts to the Ptolemaic visual cone. Moreover, in the Latin text, at least, *exire* is used in a variety of contexts where it denotes the sort of imaginary extension of a line or plane that is carried out in mathematical con-

struction (cf., e.g., 2.19-23, pp. 423-427 above).

¹⁴⁸III, 7.13-16, p. 603 below, and III, 7.24-25, pp. 605-606 below.

¹⁴⁹Figure 2.18 is provided in *P3* (f 89v) to illustrate perception of the spatial separation between two distinct objects that slope toward one another in the direction away from the eye (*oculus*).

¹⁵⁰Figure 2.19 is provided in *P3* (f 91r) to illustrate both lateral and longitudinal motion. Hence, from the eye (*oculus*), the arcal trajectory will be perceived as lat-

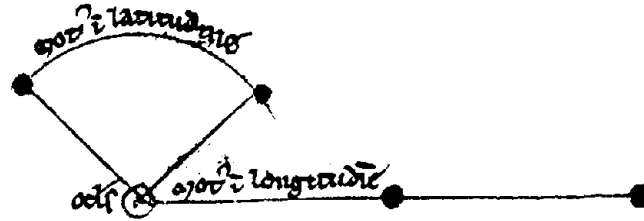


figure 2.19

eral motion (*motus in latitudine*), whereas motion along the line outward from the eye and to its right will be longitudinal (*motus in longitudine*).

¹⁵¹As with the perception of distance, so with the perception of motion, Alhacen is forced to explain it in mediate rather than immediate terms. The “immediatist” account, as offered by Ptolemy, has the visual flux sensing the passage of a moving object as it moves through or within the visual cone. Thus, lateral motion is sensed by the visual flux as it feels the crosswise passage of an object, whereas motion toward or away from the center of sight is felt by the flux in terms of the shortening or lengthening of the ray. And we are able to distinguish our own motion from the proper motion of external objects by an innate sense of self-reference; see *Optics*, II, 76-81, in Smith, *Ptolemy’s Theory*, pp. 103-105. For Alhacen, of course, there is no flux to sense motion, so motion has to be referred to something other than the center of sight: i.e., to one or more external objects against which the motion of the specific object under scrutiny can be gauged.

¹⁵²An example of motion according to some of an object’s parts would be a person waving his arms while standing still.

¹⁵³The account offered here differs from its Ptolemaic counterpart in one fundamental respect. For Ptolemy, the perception of lateral motion depends only on the eye-object relationship, the passage of the object being felt immediately by the flux through which it passes. For Alhacen, on the other hand, the perception of lateral motion depends not simply on the eye-object relationship but on the reference-frame provided by the visual field against which the motion is ultimately detected; see 3.181, pp. 497-498 above.

¹⁵⁴According to the Ptolemaic account, the perception of motion toward or away from the center of sight is due to a sense of the resultant lengthening or shortening of the visual ray. For Alhacen, on the other hand, perception of such motion along the line-of-sight depends on a perception of the change in apparent size of the object as it approaches or recedes from the center of sight.

¹⁵⁵See note 151, p. 552 above.

¹⁵⁶Indeed, such motion of forms on the eye's (or, rather, the *glacialis*) surface is integral to the scanning process by means of which we regularly certify our visual perception of size; see 3.164-167, pp. 489-492 above.

¹⁵⁷Although Aristotle includes rotation and rectilinear motion (i.e., pushing, pulling, and carrying) among the four species of locomotion in *Physics*, 7, 2, rotation is fundamentally different from straight-line motion insofar as it involves no change in place, since the rotating object maintains a constant location while rotating. Furthermore, rotary motion has no specific *terminus a quo* or *terminus ad quem*. The Latin text seems to reflect this distinction by referring to circular motion as a change in spatial disposition (*mutatio situs*) and rectilinear motion, or locomotion, as a change in place (*mutatio loci*).

¹⁵⁸The Latin phrase *superficies plana* would normally be rendered as "flat surface" or "plane surface" but in this case *planus* clearly means "smooth" insofar as it connotes perfectly uniform flatness, which is of course what renders a surface smooth; see 3.192, pp. 501-502 above.

¹⁵⁹In other words, since no shadows will be cast in this situation, the light on that surface, being perfectly uniform, will provide no indication of its roughness.

¹⁶⁰This type of separation is due not to spatial separation but to a clear distinction between integral parts; see 3.173, pp. 494-495 above.

¹⁶¹Such a placement will allow the viewer to see that the surface is reflective and, on that basis, to infer its polish; see 3.193, p. 502 above.

¹⁶²Note that the Latin term for "smoothness" here is *planities* rather than *lenitas*, which is the term used in the full list of visible characteristics or "intentions" provided in 3.44, pp. 438-439 above; see note 158 above.

¹⁶³It is not so much the perception of *transparency* as the perception of *embodied* transparency that is at issue here. Thus, if a transparent body is just as transparent as the air through which it is looked at, its defining features (e.g., its inherent color and its demarcating boundary) will be invisible, so the body itself cannot possibly be seen. On the other hand, the very fact of seeing any object at a distance necessarily implies that something (or some things) transparent intervenes between eye and object.

¹⁶⁴According to Sabra's translation, it is the encompassing, opaque body, not the transparent body, that is supposed to be dark, which makes sense in light of 3.196, p. 503 above.

¹⁶⁵Sabra's translation indicates some ellipsis here. According to his version, the situation entails darkness behind the transparent body and a brightly colored body placed within that dark area so that it can receive adequate illumination to be visible. The body's transparency will then become evident by means of the colored body's showing through it from behind.

¹⁶⁶Shadow constitutes a relative darkening, so the shaded area must still have some light in it to be recognized as shadow rather than true darkness; see 3.199, p. 504 above.

¹⁶⁷*Obscuritas* is therefore absolute darkness (or complete absence of light), as opposed to *umbra* which is relative darkness (or partial absence of light).

¹⁶⁸In other words, beauty is not a distinct primary characteristic, like shape or

size; it is a secondary characteristic derived from such primary characteristics. Or, to put it another way, it is a characteristic of such primary characteristics. As will become clear from the subsequent analysis, Alhacen's aesthetic theory is relativistic (as Panofsky asserts) insofar as it is grounded in a subjective assessment of visible characteristics which may, or may not, seem beautiful to the beholder depending on circumstances. However, *pace* Panofsky and, to some extent, Sabra, there is also a strong undercurrent of absolutism in Alhacen's account. For one thing, although he acknowledges that beauty is what *we* make of it, he implies a universality among human aesthetic judgments that allows for no differences across cultural lines or over time. Thus, for instance, in the Arabic text as translated by Sabra, Alhacen mentions in III, 7.124 such traits as blond hair or blue eyes that "mar [a person's] appearance and detract from his beauty"—a judgment to which a Swede or Norwegian might take exception (suffice to say the Latin version of this passage, admittedly much abbreviated, makes no mention of this example). Furthermore, we have already seen two occasions where beauty is, in essence, predetermined by God: His doubling of the eyes to make the face more comely and His whitening of the sclera for the same purpose; see I, 7.9 and I, 7.14, pp. 388 and 389 above. Hence, though beauty may be subjective or relative by Alhacen's account, it is not subject to choice or change.

¹⁶⁹The threefold division of beauty by specific causes is thus as follows: beauty that is characteristic of a single visible characteristic; beauty that derives from the conjunction of more than one visible characteristic—such a conjunction being analogous to a chemical mixture, where the integral elements retain their individual characteristics; beauty that derives from the combination of characteristics in such a way that the beauty transcends the individual characteristics, the analogue in this case being a chemical compound.

¹⁷⁰This is an instance of beauty by conjunction insofar as the beauty that is due to the form of the letters is distinct from the beauty that is due to their relative size.

¹⁷¹This is a case in which the beauty is due to combination insofar as it transcends the beauty of the individual elements or characteristics.

¹⁷²Here Alhacen seems to be stretching his analysis for the sake of completeness because it is far from obvious how the solidity of something somehow accounts for its beauty.

¹⁷³According to Sabra's version of this passage, the point is that a thickly planted, luxuriant lawn will appear more beautiful than one that is sparsely planted in clumps; see Sabra, *Optics*, vol. 1, p. 201.

¹⁷⁴This claim for beauty in behalf of number seems to contradict the point of 3.209, pp. 505-506 above, where the Milky Way—which surely represents a place *par excellence* where there are many stars—is claimed to be less beautiful than any individual star.

¹⁷⁵The phrase "or shadow" seems to be a gratuitous and infelicitous addition. It does not, moreover, show up in the Arabic text as interpreted by Sabra: see *Optics*, vol. 1, p. 202.

¹⁷⁶See I, 4.25, p. 347 above. Note that the transliteration for *abu qalamun* has changed, from "amilialmon" to "alburalmon," perhaps because of a change in translators.

¹⁷⁷Characteristics can thus be conjoined to heighten the effect of beauty; accordingly, as Sabra characterizes it—and quite aptly—beauty by conjunction has an “additive effect”; see *Optics*, vol. 2, p. 98.

¹⁷⁸In citing proportionality or harmony as an aesthetic principle, Alhacen is of course harking back to the Greek aesthetic ideal; see Sabra, *Optics*, vol. 2, pp. 99-100 for elaboration on this point.

¹⁷⁹It is in the expression of proportionality or harmony that various characteristics combine together in such a way as to create a beauty that is not necessarily in any them taken by itself. This sort of beauty, moreover, is not additive insofar as it transcends any of its individual characteristics, whose contribution to the overall beauty of the form depends entirely upon how and with what characteristics it is conjoined.

¹⁸⁰The force of proportionality as a principle of beauty is such, then, that it will even confer beauty on an object whose constituent characteristics are not in themselves beautiful.

¹⁸¹This suggests rather strongly that, for Alhacen, as for the Greeks, proportionality or harmony is the sovereign aesthetic principle.

¹⁸²Alhacen’s account of beauty by proportionality brings to mind Copernicus’ criticism of Ptolemaic astronomy at the beginning of the *De revolutionibus orbium coelestium*. Those who follow Ptolemy, he complains in the prefatory letter to Pope Paul III, “are like someone including in a picture hands, feet, head, and other limbs from different places, well painted indeed, but not modelled from the same body, and not the least matching each other, so that a monster would be produced from them rather than a man” (trans. A. W. Duncan, *Copernicus: On the Revolutions of the Heavenly Spheres* [New York: Barnes & Noble, 1976]).

¹⁸³3.44, pp. 438-439 above.

¹⁸⁴Ugliness would thus seem to be absolute insofar as it consists in the complete absence of beauty, a conclusion that is borne out by Alhacen’s claim that the coexistence of beauty and ugliness in a given object does not yield some intermediate aesthetic state. Note, however, the implication in 3.220, pp. 506-507 above, that ugliness can vary in degree, for in that passage Alhacen characterizes a face with one round and one oblong eye as “extremely ugly” (*in fine turpitudinis* = “at the very limit of ugliness”).

¹⁸⁵In other words, the distinction among individual characteristics is intellectual or analytic, not physical or real. Hence, no single physical characteristic can actually subsist by itself, even if it is embodied: e.g., shape cannot effectively exist apart from size, nor motion from separation.

¹⁸⁶Chapter 3 above, especially, 3.1-48, pp. 429-441 above.

¹⁸⁷In this case “indeterminate” (*non certificata*) is to be taken not in the sense of indefinite or inaccurate but, rather, in the sense of not offering grounds for assurance that what we think we see is actually what we are looking at. At first glance, for example, we may think with full certainty that we see a horse, when in fact we are looking at a mule. Our error in that case will be revealed to us only after close inspection.

¹⁸⁸2.25, pp. 427-428 above.

¹⁸⁹2.27, p. 428 above.

¹⁹⁰To “determine” (*certificare*) the object’s form is to get a clear sense of what, precisely, that form represents. Hence, certification of forms involves definition, which in turn entails an effective apprehension of *quiditas*, i.e., what the thing looked at actually is.

¹⁹¹See note 143, pp. 550-551 above.

¹⁹²By “somehow perceive” Alhacen means to emphasize not the indefiniteness of the perceptual process in this case but, rather, the fact that the perception will depend upon where the form as a whole lies in relation to the point on it that is intersected by the visual axis. Thus, when that point lies roughly at the center of the form, that form as a whole will be seen according to an entirely different perspective than it is when the point of intersection lies at the outer edge of the form.

¹⁹³The imagination, therefore, serves as a mnemonic storehouse for all the forms that are passed to it from the senses, and these forms range in specificity from the most particular to the most general (i.e., universal forms). It is difficult not to understand the process of memorization outlined here in terms of impression or engraving. Accordingly, the more often a given impression occurs in the imagination, the more deeply it is etched there; see, e.g., Aristotle’s analogy between memory and etching in *De memoria et reminscientia* 1, 451a26-451b10. On the other hand, it must be emphasized that there is nothing *explicit* in Alhacen’s account to indicate that he had that analogy in mind.

¹⁹⁴With the addition of *mens* (“mind”) at this point, we have been introduced to five specific faculties involved in the process of visual perception: 1) the sensitive faculty (*virtus sensitiva*) is responsible for brute sensation; 2) the final sensor (*ultimus sentiens*), which may well correspond to Aristotle’s common sensibility, apprehends the sensible form in its physical particularity (via color, light, and formal arrangement in the common nerve); 3) the faculty of discrimination (*virtus distinctiva*) is responsible for differentiating among forms as well as formal characteristics (e.g., shape, size, etc.); 4) the imagination (*imaginatio*) serves as the storehouse of forms abstracted by the differentiating faculty; 5) the mind (*mens*) is presumably responsible for the intellectual aspects of perception (i.e., the deductive and judgmental stages). These faculties represent various capacities unified within the soul (*anima*), whose sensitive and intellectual functions are carried out in the brain.

¹⁹⁵The Latin term is *anima* (“soul”), but clearly what is meant is that place in the soul where internal dialogue is carried out.

¹⁹⁶The universal form is thus abstracted, or distilled, from particular forms that are brought to the imagination by the various senses. As such, it may represent a physical object or a single characteristics, but, in either case, it will represent that thing by type (man) rather than by individual (Socrates).

¹⁹⁷By *tota forma* (“overall form”) is meant the most comprehensive and general form that can be derived from any given sensible impression.

¹⁹⁸As it stands, the Latin *cognosceat apud cognitionem formam particularem* is confusing insofar as it translates literally into “it will recognize its particular form at the moment of recognition.” I take the intended sense of *apud cognitionem* to be “at the moment of apprehension” or “at the moment of perception,” an intention that would have been expressed better—or at least with less confusion—by the Latin phrase *apud comprehensionem*.

¹⁹⁹3.57-3.59, pp. 444-445 above.

²⁰⁰At this point the analysis seems to reflect the Peripatetic distinction between “accidents” (mere *intentiones*), which are inessential attributes or predicates, and “properties” (*intentiones proprie*), which are essential attributes or predicates and, as such, serve as crucial markers of what a given object is. Thus, while skin color is merely accidental to being a human being, the ability to communicate verbally is essential. In the context of Alhacen’s analysis, however, “property” is construed quite broadly to include a variety of features (e.g., bipedalism or featherlessness) that might, strictly speaking, constitute mere accidents; see 4.23-24, pp. 523-524 above.

²⁰¹4.11-13, pp. 516-517 above.

²⁰²See note 197, p. 556 above.

²⁰³*Substantie illorum colorum*, which I have translated as “in which that color inheres” does not mean “the substances of that color [or, literally, ‘those colors’]” in the classical sense of the *ousia* (as, e.g., in Aristotle’s *Categories* 5) of that color, but, rather, “what underlies” or “what supports” it—i.e., the roses in which it occurs.

²⁰⁴An obvious—perhaps too obvious—example would be the differentiation of identical twins, which takes extremely close scrutiny until familiarity teaches one to distinguish them through very subtle defining features.

²⁰⁵Such changes by external agent (*ex extrinseco*) are superficial in the most literal sense in that they only occur at, and affect, the surfaces of things. Thus, even though an object may suffer a radical change in temperature on being exposed to the sun, that change will not be visible since it affects the inner recesses rather than the mere surface of the object.

²⁰⁶I take vision based on initial impression (*visio fantastica* or *visio per fantasiam* = “vision based on imagination”) to be the sort of vision that involves no attention on the viewer’s part, the visible forms thus reaching the imagination, where they are “depicted” without having been perceptually analyzed in any but the most superficial way necessary to the basic act of visual perception. An example would be seeing a horse without realizing that a horse is being seen, in much the way we hear ambient sounds without actually listening to them or trying to make sense of them.

²⁰⁷See 4.27, pp. 525-526 above.

BOOK THREE OF ALHACEN'S *DE ASPECTIBUS*

Topical Synopsis

CHAPTER 1: *Prologue* 561

[1.1-1.3] General observations showing how things can be misperceived according to the particular circumstances under which they are seen.

CHAPTER 2: *Binocular Vision and Diplopia* 562

[2.1-2.18] How the images formed in both eyes are fused in binocular vision. [2.19-21] How visual acuity varies within the visual field in binocular vision. [2.22-2.24] The causes of diplopia, or double-vision. [2.25-2.54] Various experiments designed to show how and why the doubling of images in diplopia occurs. [2.55-2.79] Various experiments designed to show how and why visual acuity varies within the visual field. [2.80-2.86] Why visual and perceptual acuity depends upon the obliquity of the facing surface that is viewed.

CHAPTER 3: *The Causes of Visual Illusion* 588

[3.1-3.5] Brief discussion of the eight preconditions for sight. [3.6-3.14] How each of these preconditions has thresholds of moderation beyond which visual perception cannot be carried out properly. [3.15-3.34] How the range of moderation is determined for each of the eight preconditions and how they are interdependent.

CHAPTER 4: *The Three Types of Visual Illusion* 593

[4.1-4.4] Résumé of the three types. [4.5] Example of error in brute sensation. [4.6] Example of error in recognition. [4.7-4.9] Examples of error in deduction.

CHAPTER 5: *Visual Illusions Due to Errors in Brute Sensation* 595

[5.1] Preliminary statement. [5.4] How immoderate distance can

cause an error in brute sensation. [5.7] How an immoderate spatial disposition can cause an error in brute sensation. [5.8] How immoderate light can cause an error in brute sensation. [5.9] How immoderate size can cause an error in brute sensation. [5.10] How immoderate (i.e., inadequate) opacity can cause an error in brute sensation. [5.11] How immoderate (i.e., inadequate) transparency can cause an error in brute sensation. [5.12-5.13] How an immoderate time-interval for perception can cause an error in brute sensation. [5.14-5.15] How an immoderate condition in the eye can cause an error in brute sensation.

CHAPTER 6: *Visual Illusions Due to Errors in Recognition* 597

[6.1-6.3] Brief explanation of what visual perception by means of recognition involves. [6.4-6.7] How immoderate distance can cause errors in visual recognition. [6.8-6.10] How an immoderate spatial disposition can cause errors in visual recognition. [6.11-6.12] How immoderate light can cause an error in visual recognition. [6.14] How immoderate size can cause an error in visual recognition. [6.16-6.17] How immoderate opacity can cause an error in visual recognition. [6.18-6.24] How immoderate transparency can cause an error in visual recognition. [6.25] How an immoderate time-interval for perception can cause an error in visual recognition. [6.17-6.31] How an immoderate condition in the eye can cause an error in visual recognition.

CHAPTER 7: *Visual Illusions Due to Errors in Deduction* 600

[7.1] Brief explanation of what visual perception by means of deduction entails. [7.2-7.60] How immoderate distance can cause errors in visual deduction. [7.63-103] How an immoderate spatial disposition can cause errors in visual deduction. [7.104-7.130] How immoderate light can cause an error in visual deduction. [7.131-7.162] How immoderate size can cause an error in visual deduction. [7.163-7.192] How immoderate opacity can cause an error in visual deduction. [7.193-7.216] How immoderate transparency can cause an error in visual deduction. [7.217-7.249] How an immoderate time-interval for perception can cause an error in visual deduction. [7.250-7.278] How an immoderate condition in the eye can cause an error in visual deduction. [7.279-7.288] Brief discussion of how visual errors can arise from a combination of immoderate conditions.

THE THIRD BOOK

[This is the third book], and it consists of seven chapters.

The first chapter comprises the prologue.

The second [concerns certain] things that need to be set forth for the analysis of visual illusions.

The third [concerns] the reasons why visual illusions occur.

The fourth describes [the various kinds of] visual illusions.

The fifth [deals with] the sorts of visual illusions that occur during brute sensation.

The sixth [deals with] the sorts of visual illusions that occur during recognition.

The seventh [deals with] the sorts of visual illusions that occur during judgment.

[CHAPTER 1]

[1.1] It has been shown in the first and second books how sight perceives visible objects as they actually exist when they are perceived directly,¹ and [it has been shown] how sight determines the form of the thing seen, how it perceives each particular [visible] attribute as it actually exists, and how it determines every such attribute. But not everything that is perceptible to sight is perceived by it as it actually exists, nor is everything that seems to the viewer to be perceived as it actually exists correctly perceived. On the contrary, sight is frequently deceived about many of the things it perceives about visible objects, and it perceives them other than they really are. Moreover, sight sometimes perceives that it is being deceived even as it is being deceived, but it sometimes does not, thinking, rather, that it is perceiving properly. For when sight perceives some visible object from a great distance, that object will look smaller than it really is, whereas when that [same] visible object lies quite near the eye, sight will perceive it as larger than it really is. Furthermore, when sight perceives a quadrilateral or polygon from a distance, it will perceive it as circular if its diagonals are equal, or oblong, if its diagonals are unequal, and if it perceives a sphere from a very great distance, it will perceive it as flat. Such cases are numer-

ous and variegated, and everything that is perceived by sight in such a way is subject to deception.

[1.2] In addition, when sight looks at some star, it will perceive it to be immobile, even though the star actually moves at the time; but when the viewer thinks about it, he will realize that the star is moving while he looks at it. And when the viewer discerns this fact, he immediately realizes that he is being deceived in his perception that the star is immobile. Also, if someone stares at something standing on the ground extremely far away, and if that thing is moving quite slowly, then, if the observer does not look at it long [enough], he will perceive it as immobile. And if the viewer has not perceived that thing's motion before and does not keep watching it for awhile, he will not perceive that he is deceived in perceiving that thing as immobile, so he will be deceived in this sort of perception. He will nonetheless not perceive that he is deceived. Sight may therefore happen to be deceived about many things it perceives, and sometimes it perceives [that it is deceived], and sometimes it does not.

[1.3] Since it has been shown in the two previous books how sight perceives visible objects as they actually exist, whereas in this chapter it has been shown on the basis of what we have said that sight often happens to be deceived about many things it perceives, it remains for us to explain why, when, and how sight happens to be deceived. In this book, however, we limit ourselves to visual illusions regarding things that sight perceives directly, and we shall explain the reason for such [illusions], the different illusions [that can arise], and how each illusion occurs.

[CHAPTER 2]

[2.1] It was shown in the first book that sight perceives no visible object unless it does so along radial lines and that the arrangement of visible objects and their parts is perceived only according to the arrangement of the radial lines.² And it was also pointed out that a single visible object perceived simultaneously by both eyes is perceived as single only when its situation with respect to both eyes is equivalent; if its situation is not equivalent, then a single object will be perceived as double.³ However, every familiar visible object that is continually perceived by both eyes will always be perceived as single. So we need to explain how a single visible object is generally perceived as single by both eyes in many [different] situations, as well as how the situation of a single visible object will generally be equivalent with respect to both eyes under various conditions. And we shall also explain how the situation of a single visible object may not be equivalent with respect to both eyes, as well as explaining the conditions under which

this happens. We have already made this claim in the first book, but we explained it in a general rather than a definitive way.⁴

[2.2] We should point out that, when an observer looks at some visible object, each eye will face that visible object directly, so when the observer directs his gaze on that visible object, he will direct both eyes on that visible object in a corresponding way, and when his sight passes over the visible object, both eyes will pass [correspondingly] over it.

[2.3] Moreover, when the observer directs his gaze on a visible object, the axes of both eyes will meet on that visible object and intersect at some point on its surface, so if the observer passes his sight over that visible object, those two axes will pass together over the surface of the visible object and will scan all of its parts.⁵ Generally, the two eyes correspond in all their dispositions, and the sensitive power in each of them is the same, so the way they act and are affected is invariably the same. And if either eye is moved for the sake of viewing [something], the other one will immediately move toward that object with a matching movement, whereas if either eye remains fixed, the other will remain fixed as well; and it is impossible for either eye to move for the sake of viewing [something] while the other remains fixed unless there is interference.

[2.4] It has also been shown in an earlier discussion that, when vision occurs, a cone can be imagined [to extend] between any visible object and the center of the eye, the vertex [of that cone] being the center of sight and the base the surface of the visible object that sight perceives.⁶ But this cone contains all the radial lines according to which sight perceives that visible object. Thus, when the [visual] axes of both eyes intersect at some point on the surface of a visible object, the surface of the visible object will form a common base for both visual cones described between the centers of both eyes and the visible object, and thus the situation of the point where the two [visual] axes intersect is equivalent with respect to both eyes, since it faces the middle [of the surfaces] of both eyes, and the [visual] axes extending between the visible object and the two eyes are perpendicular to the surfaces of both eyes.⁷ For any [other] point on the surface of the visible object, there are two lines that can be drawn from it to the centers of both eyes so as to be equivalently situated with regard to the [visual] axes as far as direction is concerned—i.e., any two lines imagined [to extend] between the centers of both eyes and the point on the surface of the visible object where the [visual] axes of both eyes meet will incline toward the same side of the two [visual] axes. Now every point on the surface of the visible object upon which the two [visual] axes intersect will lie on the same side of the point where the axes intersect; but the point of intersection lies upon both [visual] axes. Moreover, these [two] lines are equidistant from the two [visual] axes, for any two lines extending from the centers of both eyes to

any of the points quite near the point of intersection [of the visible axes] are equidistant from the two [visual] axes as far as sense is concerned. For the two [visual] axes extending to the point of intersection will be equal, or else there will not be a perceptible difference between them when the visible object is not too near the eye, but, rather, its distance from the eye is moderate. And the same applies to the situation of any point that is very near the point of intersection—i.e., any two lines extending from the centers of the two eyes to any point [on the visible surface] scarcely differ in length as far as sense is concerned, and sometimes they will actually be equal [as far as sense is concerned]. However, since the two lines that intersect [somewhere] beside [the point of intersection of the visual axis] lie on the plane of the two [visual] axes, they will be unequal [in length], for the line extending from the point where the two [visual] axes intersect to some point beside it forms unequal angles with the two [visual] axes. But the two axes are equal, while the line joining the two points is common, so the two lines to the side [of the visual axes] will be unequal. However, this difference in length does not affect the sense if the point beside the point where the visual axes intersect is near it. On the other hand, if the two lines lie below or above the [visual] axes, they can be equal, for the two angles formed by the two [visual] axes with the line extended between the two points [of intersection] can be equal if the [other] point lies below or above [the point of intersection of] the [visual] axes.⁸ Furthermore, in the situations lying between these two the difference between the two lines beside [the visual axes] will be less than the difference between the first [set of] lines beside [the visual axes], so there will be no effective difference between them as far as sense is concerned.

[2.5] Hence the two lines extending from the centers of the two eyes to points near the point where the two [visual] axes intersect scarcely differ in length as far as sense is concerned. Moreover, the two [visual] axes are equal, and the line joining the point of [their] intersection with the point beside it to which the [other] two lines are extended from the two centers [of sight] is common to both triangles formed by these lines. Therefore, the two angles at the centers of both eyes subtended by that common line on the surface of the visible object will be equal, or else there will be scarcely any perceptible difference between them. And these two angles will always be minimal when the point is extremely close to the point where the two [visual] axes intersect.⁹

[2.6] In addition, if the two lines extending to any point near the point of intersection [of the visual axes] form equal angles with the two [visual] axes, then the distance [from the two visual axes] of any of the two lines extending to the same point among the points that are near the point of intersection [of the two visual axes] will be equal.¹⁰

[2.7] Hence the situation of every point on the surface of the visible object upon which the two visual axes intersect, assuming that it lies near the point of intersection [of those axes] with respect to both eyes, constitutes a corresponding situation in terms of direction and distance from the two [visual] axes. On the other hand, the situation in the case of points lying far to one side of the point of intersection of the two [visual] axes is such that the angles formed by the two lines extending to some point [on the visible surface] and the two [visual] axes may differ by a measurable amount, so all such points that are [significantly] distant from the point of intersection [of the visual axes] in respect to the eyes have a corresponding situation as far as direction alone is concerned, but not as far as the distance from both [visual] axes is concerned.¹¹ Hence, as long as a visible object perceived by both eyes is of measurable size and its cross-sections are roughly equal in size, any point on it has a corresponding situation vis-à-vis the two eyes in terms of both direction and distance, so its form will occupy corresponding locations on each of the two eyes. But if the visible object perceived by both eyes is extremely large in cross-section, then the point on it where the two [visual] axes intersect will have a corresponding situation vis-à-vis the two eyes, and the closer to that point the [other] points are on the surface of that visible object, the more those points will have a corresponding situation vis-à-vis the eyes in terms of both direction and distance. However, points on the surface of that visible object that lie far away from the point of intersection and that lie on one side of the two [visual] axes have a corresponding situation vis-à-vis the two eyes in terms of direction, but as far as distance is concerned, they may or may not. Hence, the form of the area on such a visible object where the intersection [of the visual axes] occurs, as well as the form that includes the point of [that] intersection and everything surrounding it, is impressed at two areas on the two eyes that have a corresponding situation under all circumstances. Meanwhile the forms of the remaining parts that are distant from the point of intersection and that surround the area that has a corresponding situation [in each eye] are continuous with the form of the area that has a corresponding situation. Hence, every pair of forms is impressed on two areas on the two eyes that do not differ much in relative situation. And when there is difference, it will only be between the extremities, and it will be slight on account of the continuity of the extremities with the intermediate parts that are correspondingly situated; and this will be the case as long as the two eyes are focused on a directly facing visible object and the two axes remain focused on one of its points. Moreover, as the two eyes move over the visible object and the two [visual] axes are shifted from that point to move together over the surface of that visible object, the situation of every point on that visible object, as well as the situation of the points that are near it relative to the two eyes at

the intersection of the two [visual] axes will be in nearly perfect correspondence, so the form of every part of the visible object as the two axes move over its surface will have a corresponding situation at two places on both the eyes. And thus, as movement and visual scrutiny continue, the form of all parts of the visible object will have a corresponding situation in both eyes.

[2.8] So, too, when sight perceives separate visible objects together at the same time, and the two [visual] axes intersect on one of them, if the visible object on which the two [visual] axes intersect has nearly equal cross-sections, then the form of that visible object will be impressed on two correspondingly situated places on the two eyes. Moreover, the form of whatever lies near that visible object, if it is small, will be impressed on two places on the two eyes that do not differ perceptibly in relative situation. However, when both eyes perceive a visible object far from the one on which the two [visual] axes intersect, and if the two [visual] axes remain focused on the original object, the form of the far object will be impressed on two places on the two eyes that are correspondingly situated in terms of direction only, not in terms of distance; not all of its parts will be correspondingly situated with respect to the two [visual] axes as far as distance is concerned, nor will its form be determinate. If the two eyes are then moved along with the two [visual] axes so that they intersect on each of [the other] visible objects perceived at the same time, the form of each of them will be impressed on two places on the two eyes that are correspondingly situated in terms of both direction and distance; and in that case the form of each of those visible objects will be determinate.

[2.9] Furthermore, the axes of both eyes often intersect on some visible object while the two eyes perceive another visible object that is not correspondingly situated with respect to the eyes in terms of direction. This will happen when that other visible object lies nearer both eyes than the visible object on which the two [visual] axes intersect and, moreover, falls between the two axes, or when it lies farther from both eyes than the visible object on which the two visual axes intersect but still falls between the two [visual] axes as we imagine them extended beyond their intersection, provided that the visible object on which the axes intersect does not block the visible object lying beyond it or [only] blocks part of that object.¹²

[2.10] In these ways, then, both eyes perceive visible objects.

[2.11] It was also shown in the second book that the visual axis in each eye constitutes a unique and unchanging line, and that it passes through the centers of all the tunics of the eye and extends directly through the center of all the tunics to the middle of the place where the hollow of the nerve to which the eye is attached flexes, this place being at the opening in the eye socket,¹³ [and it was shown] that the visual axis is inseparable from all the

[ocular] centerpoints, that its situation with respect to all parts of the eye is always the same, remaining unaffected by the motion or immobility of the eye,¹⁴ and that the two axes in the two eyes have a corresponding situation with respect to both eyes from the hollow of the common nerve where the final sensor perceives the forms of visible objects.¹⁵ Let us therefore imagine a straight line joining the centers of the two openings in the two sockets containing the eyes, and let us imagine two lines extending from the centers of both openings in the eyesockets through the middle of [each of] the two hollow nerves. These lines therefore intersect in the middle of the hollow of the common nerve, because both nerves are correspondingly situated with respect to the hollow of the common nerve; so these two lines will be correspondingly situated with respect to the line joining the centers of the two openings [in the eyesockets], because the two nerves will be correspondingly situated with respect to those two openings. Hence, the two angles formed by these two lines and the line joining the centers of the two openings [in the eyesockets] will be equal.

[2.12] Let us also imagine that the line joining the centers of the two openings [in the eye sockets] is bisected, and let us imagine a line extending from the midpoint of the hollow of the common nerve where the two lines passing through the hollows of the two nerves intersect so as to continue to the point where the line joining the centers of the two openings [in the eyesockets] is bisected. This line will therefore be perpendicular to the line joining the centers of the two openings [in the eye sockets]. Now let us imagine that this perpendicular line is extended straight outward from the eye[s]; and so this line will remain fixed, and its situation will not change, because the point at the middle of the hollow of the common nerve where the two lines passing through the middle of the hollows of the two nerves intersect is unique and invariant. In addition, the point where the line joining the centers of the two openings [in the eye sockets] is bisected is also unique and invariant, so the straight line passing through those [two unique and invariant] points has a unique and invariant situation as well. Accordingly, this line will be referred to as the "common axis."¹⁶

[2.13] Now let us imagine some visible object facing the eye at some point on this line, and let us imagine that the two eyes look at this object while the two [visual] axes intersect at the point on the surface of the visible object where the common axis meets that surface, which is certainly possible for any visible object that is correspondingly situated with respect to the two eyes. When the two [visual] axes intersect at some point on the common axis, then the two [visual] axes, the common axis, the line joining the centers of the two openings in the eye sockets, and the two lines passing through the hollows of the two nerves will all lie in the same plane. For the two [visual] axes pass through the centers of the two openings [in the eye-

sockets], since they pass through the middle of the hollow of the two nerves where the two nerves funnel outward [toward the front of the eyeball]. Therefore, if the two [visual] axes intersect on the common axis, they will all lie on the same surface as the common axis and the line intersecting it that joins the centers of the openings in the two eye sockets. In addition, the two [visual] axes [extending] from the centers of both openings [in the eye sockets] to the point of intersection on the common axis will be equal. Also, they will be correspondingly situated with respect to the common axis, the two segments of the two [visual] axes [that extend] from the centers of the two eyes to the point of intersection will be equal, and the distance of the centers of both eyes from the openings in the two eye sockets as well as from the centers of those two openings is equal. Meanwhile, the two segments of the two [visual] axes extending from the surfaces of the two eyes to the point of intersection will also be equal. For the radii of the two ocular spheres are equal, and since that is so, the point on the surface of the visible object where the two [visual] axes meet will be correspondingly situated with respect to the two points through which the two [visual] axes pass [through the surfaces of the eye], so its distance from those [two points] will be equal. And these two points on the surfaces of the eyes are the ones upon which the form of the point where the two [visual] axes intersect is impressed.

[2.14] Moreover, the two points on the surfaces of the two eyes that lie on the two [visual] axes will be correspondingly situated with respect to the hollow of the common nerve, and these two points will also be correspondingly situated with respect to any point on the common axis. Thus, the situation of the two points on the surfaces of the two eyes that lie on the two [visual] axes is perfectly uniform and equal with respect to the point on the common axis at the middle of the hollow of the common nerve where the two lines passing [inward] from the centers of the two openings [in the eye sockets] intersect. So when they reach the hollow of the common nerve, both forms that are impressed on the two points where the two [visual] axes intersect the surfaces of the two eyes will be impressed on the point of the common axis that lies in the middle of the hollow of the common nerve, where the lines intersect, so they will produce a single form.

[2.15] Furthermore, when the two forms at the two points where the two [visual] axes intersect the surfaces of the two eyes are impressed on the point of the common axis that lies in the middle of the common nerve, the forms that are [impressed] on points surrounding both of the points where the two [visual] axes intersect the surfaces of the two eyes are impressed on points in the hollow of the common nerve that surround the point on the common axis. And any two points on the surfaces of the two eyes that are correspondingly situated with respect to the points in the middle of the

surfaces of the two eyes where the two [visual] axes lie are also correspondingly situated in terms of direction and distance with respect to the same point in the hollow of the common nerve. And points that are correspondingly situated with respect to these points will lie on the same side of the point on the common axis where the lines intersect in the hollow of the common nerve as the two points on the surfaces of the two eyes, and their distance from that point will depend on their distance from the two [visual] axes. So the two forms impressed on the two points that are correspondingly situated with respect to the surfaces of the two eyes reach to that same point in the hollow of the common nerve, and they will be superimposed at that point so as to produce a single form; and every one of the points on the surface of the visible object that are in the vicinity of the point on the common axis is correspondingly situated with respect to the axes of the two eyes.¹⁷ Thus, the form of any of those points will be impressed on both eyes at two locations that are correspondingly situated with respect to the two points where the two [visual] axes intersect the surfaces of the two eyes. Accordingly, the two forms of the visible object upon which the three axes intersect are impressed on the middle of the surfaces of the two eyes, and the two forms of the point where the three axes intersect will be impressed on the two points where the two [visual] axes intersect the surfaces of the two eyes, and any point on the two forms will be impressed on two correspondingly situated locations on both eyes. Afterward, the two forms that are seen will reach the hollow of the common nerve, and the two forms will reach from their [respective] points on the two [visual] axes to a point on the common axis and will produce a single form. Each of the two forms on the two points that are correspondingly situated on the two eyes will then reach the same point among the surrounding points on the common axis, and so the two forms of the whole visible object will be superimposed and will produce a single form, and sight will thus perceive it as single.

[2.16] In this way, then, the two forms of a single object that is uniformly situated with respect to both eyes will be impressed on the two eyes and produce a single form, and so the sensitive faculty perceives the visible object as single, even though two forms of it are impressed on the two eyes.

[2.17] Moreover, when the two forms on the two points in the middle of the surfaces of both eyes where the two [visual] axes lie reach the point on the common axis, both of the forms impressed on the surfaces of the two eyes will be impressed on two points on the two [visual] axes, and they will always reach the same point in the hollow of the common nerve, that point lying on the common axis. For the two points at which the two [visual] axes pass through the [ir respective] eyes do not change, because the situation of the two axes is always the same and invariant with respect to the two eyes. Thus, the point in the hollow of the common nerve reached by

the forms impressed on the two points on the surfaces of the two eyes where the two [visual] axes lie is invariably the same point, that point lying on the common axis where the two lines passing from the centers of the two openings in the two eye sockets through the middle of the hollows of the two nerves intersect. Accordingly, this point, which lies on the common axis in the hollow of the common nerve, will be referred to as the "center."

[2.18] This then having been shown, it has been demonstrated that, when the axes of the two eyes intersect on the surface of anything perceived by both eyes, the form of that object is impressed on two places at the very middle of the surfaces of two eyes. Afterward, these two forms reach from the two eyes to the same place in the hollow of the common nerve, where they are superimposed to produce a single form. Moreover, the two forms of the point where the two [visual] axes intersect on the visible object will be impressed on two points on the surfaces of both eyes where the two [visual] axes lie, and they will proceed from these two points to the point in the center of the hollow of the common nerve, and it is irrelevant whether the point at which the two [visual] axes intersect lies on the common axis or beyond it. Nonetheless, if the visible object lies on the common axis and the two [visual] axes intersect on the point where the common axis meets that object, then the two forms of that point will correspond as perfectly as possible.¹⁸ For the distance of that point from the two points on the surfaces of the eyes where the two forms of that point are impressed (and those two points lie on the [visual] axes) will be equal, since the two [visual] axes will be equal in length under these circumstances. Likewise, as far as sense is concerned, every point near that point lies an equal distance from the two points [on the surface of the eyes] where their forms are impressed, and their forms will be in closer correspondence than the two forms of a visible object that lies [farther] beyond the common axis, so, when it is impressed in the hollow of the common nerve, the form of a visible object that lies on the common axis will be as definite as possible. But if what is seen lies outside the common axis, but not too far away, then the two forms of it that are impressed in the two eyes do not differ by much, so the forms of it that are impressed in the hollow of the common nerve will not be doubled.

[2.19] If what is seen lies beyond the common axis at a considerable distance from it, but the axes of both eyes intersect at some point on it, then its form will be impressed singly in the hollow of the common nerve, and the form of its point where the two [visual] axes intersect will be impressed in the central point. Nevertheless, its form will be indefinite rather than definite. Thus, under all conditions, the form of the point on the visible object where the two [visual] axes intersect will be impressed in the point at the center of the hollow of the common nerve, whether the intersection-point lies on the common axis, or whether it lies beyond it. The rest of the

form of the visible object, for its part, will be impressed around the central point. Moreover, if what is seen is quite small and of approximately equal cross-sections, and if it lies on or near the common axis, then its form will be impressed in the hollow of the common nerve as a single form; it will also be definite, and each of its points is correspondingly situated with respect to the two eyes, as we explained before. If, however, what is seen is large and has long cross-sections, but if it also lies on the common axis, then the form of that part of it at the spot that includes the point where the two [visual] axes intersect and the surrounding points will be impressed in the common nerve as a single, definite form. The form of the remaining parts [of the object] will be impressed to form a continuum with the form of this part, so the form of the entire visible object will be impressed singly under all circumstances; but the form of its extremities and of those parts that lie far away from the point of intersection will not be definite, for not every point lying far from the point of intersection will have its form impressed on two points whose situations correspond very well with respect to both eyes. Rather, the form of every point that lies far from the point of intersection will be impressed on two points of the two eyes that correspond in direction with respect to those eyes, but they may or may not lie at corresponding distances from the two [visual] axes. The forms of points that do not lie at corresponding distances will be impressed in the hollow of the common nerve at two points lying on the same side of the center, but they will be double; and if the visible object is of one color, then the effect of doubling will hardly be noticed because of the correspondence in color and the sameness of the form. If, however, what is seen is multicolored, or if there is some design, or depiction, or [if there are] subtle features in it, then the effect of doubling will be noticeable, so the form of its extremities will be indefinite rather than definite.¹⁹

[2.20] Now if what is seen is large and has long cross-sections, and if the axes of both eyes are focused on one of its points and remain fixed, then its form appears single, and the point of intersection, as well as whatever surrounds that point, will be determinate and definite. Its extremities, though, and the points near its extremities will not appear definite for two reasons: first, because the extremities are perceived by rays lying far from the [common] axis, so [what is seen along those rays] will not be clear, and second, because not every one of those points has its form impressed at a single point in the hollow of the common nerve; instead, some of them have their form impressed at two points rather than one. Therefore, [only] when the two [visual] axes are moved over all the parts of such a visible object will its form be defined. But if what is seen lies beyond and at a considerable distance from the common axis, then its form will not be determinate, for none of its points is correspondingly situated with respect to the two eyes be-

cause of the unequal distance that any point on such a visible object lies from the two points on the surfaces of the two eyes where the two forms of that point are impressed as well as from the two [visual] axes. Accordingly, [only] when both eyes are inclined toward such a visible object so that the common axis ends up on or near that visible object will its form be determinate.

[2.21] Likewise, when both eyes perceive several visible objects at once, and when the axes of both eyes intersect on one of those visible objects and remain focused on it so that the rest of the visible objects lie outside the two axes, and when the visible object upon which the two [visual] axes intersect is quite small, the form of the visible object upon which the two [visual] axes intersect, [when it is impressed] in the hollow of the common nerve, will be single and determinate. And if the visible object lies upon the common axis, then its form will be more determinate than the form of a visible object that lies outside the common axis. Finally, if the two axes also intersect on that same visible object, then, in this case, if any of the objects lying near the object upon which the two [visual] axes intersect is perceived by sight—assuming that [such neighboring] objects are quite small—its form is impressed in the hollow of the common nerve as a single form that will not be at all indefinite, for its form will lie near the center. On the other hand, in that same situation, when any of the visible objects that lie far from the visible object on which the two [visual] axes intersect is perceived, the form of it that is impressed in the hollow of the common nerve will be indefinite. And so there will be two forms that overlap, because they lie on the same side and the difference between their relative situations in terms of distance will not be inordinate, so the two forms will overlap, or else the form of some of the object's parts will be doubled while the form of others will be single.²⁰ And so the form of such visible objects will be indefinite under all circumstances because of the difference in relative situation among the rays extending to it and because the rays extending to it will lie far from the two [visual] axes. Moreover, the form of a visible object that lies to the side of the two [visual] axes and far from the intersection-point of the two [visual] axes will not be determinate as long as it lies far from the intersection-point of the two [visual] axes. When, however, the two [visual] axes are shifted to intersect upon that object, its form will be defined.

[2.22] If the axes of the two eyes intersect on some visible object, and, in addition, the two eyes perceive another visible object nearer or farther away from the two eyes than the visible object on which the two [visual] axes intersect, and if that object falls between the two axes, then it will [appear to] lie on opposite sides with respect to the two eyes. For since it lies between the two [visual] axes, it will lie to the right of one axis and to the left of the other, and the rays extending to it from the one eye will lie to the right

of the [visual] axis, whereas the rays extending to it from the other eye will lie to the left [of the visual axis]; on that account it will [appear to] lie on opposite sides with respect to the two eyes.²¹ So the form of such visible objects is impressed on the two eyes at two spots that are not correspondingly situated, and the two forms of it that are impressed on the two eyes reach two different locations in the hollow of the common nerve, and the [forms] will lie on both sides of the center, so there will be two forms, and they will not be superimposed upon each other.

[2.23] Likewise, if the visible object lies on one [visual] axis but outside the other, its form will be impressed in two locations in the hollow of the common nerve, i.e., one in the center and the other to the side of the center, and those forms will not be superimposed.²²

[2.24] These, then, are the ways in which the form[s] of visible objects will be impressed on both eyes as well as in the hollow of the common nerve.

[2.25] Moreover, everything we have discussed can be tested by experiment so we will attain certainty about it.

[2.26] Take a smooth wooden plaque that is one cubit long and four digits wide, and let it be perfectly flat, even, and smooth.²³ Let the edges along its length, as well as those along its width, be parallel, and let there be two diagonals intersecting one another at a point through which a straight line is drawn parallel to the edges along the length. Then, through that [same] intersection-point let a straight line be drawn perpendicular to the first line, passing through [the plaque's] middle, and let [each of] these [two perpendicular] lines be painted a different color, both colors being bright so that they are readily visible, but let the two diagonals be painted the same color. Then, in the middle of the bottom edge of the plaque, between the [endpoints of the] two diagonals, let a rounded notch be cut, but one that narrows inward so that, when the plaque is brought up to it, the bridge of the nose can fit into it in such a way that the two corners of the plaque almost touch, but do not actually touch, the two midpoints of the surfaces of the two eyes.

[2.27] Accordingly, let **ABCD** in figure [3.8] represent the plaque, let **AD** and **BC** be the diagonals, and let the intersection-point be **Q**; let line **HQZ** be the line passing longitudinally through the middle of the plaque, and let line **KQT** be the line that intersects this line at right angles. Finally, let the notch in the middle of the bottom edge of the plaque be circumscribed by [curved] line **MHN**.

[2.28] With the plaque thus constructed, take some white wax and make three small, cylindrical pegs out of it, and paint them different colors; then stand one of the pegs on the center of the plaque at point **Q**, fix it to the plaque so that it cannot be displaced, and stand it straight up on the plaque.

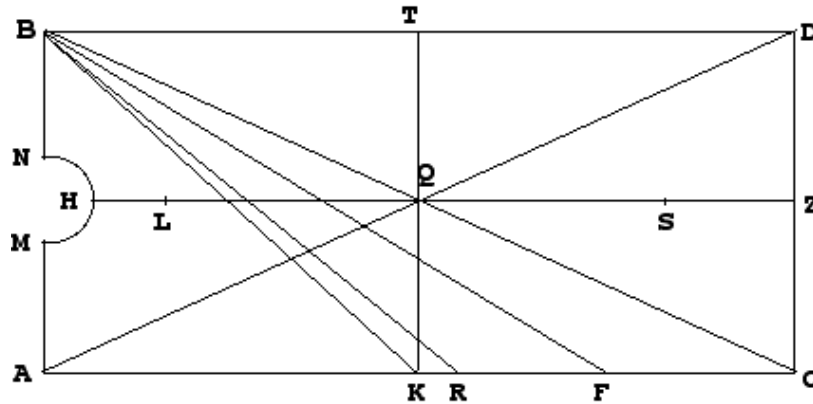


figure 3.8

Now stand the other two pegs at endpoints **K** and **T** of the line [passing through the middle of the plaque] along the width so that the three pegs will lie on a single line. When this is accomplished, the experimenter should lift the plaque and place the notch in the middle of the bottom edge against the bridge of his nose between the eyes so that the bridge of the nose will lie snug against the plaque, while the corners of the plaque will be set at the two midpoints of the surfaces of the eyes and nearly touching them. Then the experimenter should look at the peg placed in the center of the plaque and focus his gaze intensely upon it. Accordingly, when the experimenter stares in this way at the peg placed at the center [of the plaque], the axes of the two eyes will intersect on that peg and will either coincide with, or be parallel to, the two diagonals. Also, the common axis, which we defined earlier,²⁴ will coincide with line **HZ** drawn lengthwise through the middle of the plaque.

[2.29] Then, maintaining this situation, the experimenter should look at everything²⁵ on the surface of the plaque. He will then find that each of the three pegs at points **K**, **Q**, and **T** [appears] single, and he will also find that line **KQT** [appears] single. Line **HZ**, however, which is drawn lengthwise through the middle of the table, will appear double, [its two images] intersecting at the peg placed in the center [of the plaque]. Likewise, in the same situation, when the experimenter looks at the two diagonals, they will appear quadruple, that is, each of them [will appear] double.²⁶

[2.30] Then the experimenter should direct his gaze toward either of the pegs at the two points **K** and **T** so that the two [visual] axes intersect on [either] one of the pegs placed at the endpoint. Then, in this situation, he should again look around, and he will find that each of the three pegs [appears] single, as well as the line passing [through the middle of the plaque] along the width, but he will find that the line passing lengthwise through

the middle [of the plaque appears] double, as does each of the two diagonals.

[2.31] Thus, when the experimenter has perceived these lines and the pegs that are placed on the table, he should remove the two pegs at the two points **K** and **T** and place them upon line **HZ** that extends lengthwise [through the middle of the plaque], one of them at point **L**, which is near the eyes, and the other at point **S**, which lies beyond the peg placed in the center [of the plaque]. Then he should reposition the plaque as before [against his nose] and direct his gaze at the peg placed in the center [of the plaque]. He will then find that the two pegs [appear as] four and [lie] to the sides of the central peg, i.e., two to the right and two to the left, and he will find that [they appear] to lie on two lines which are, in actuality, the one line [**HZ**] in the middle [of the plaque] which nonetheless appears double; he will also find that each of the pairs [of pegs appears to lie] upon one of those two lines.²⁷

[2.32] Likewise, if he removes the two pegs from that line and places them upon either of the two diagonals, one on the side of the eye and the other beyond the peg that is placed at the center [of the plaque], he will find that they [appear] quadruple. For each of the diagonals will appear double, so upon each of the two [diagonal] lines that are actually [produced from] one [original] diagonal two pegs will appear, one on the side of the eyes and the other beyond the peg placed in the center [of the plaque].²⁸ Likewise, if the two pegs are placed on the two diagonals, one upon each, and if they are [both] placed on the side of the eyes, the experimenter will find that they [appear] quadruple, two near [each other] and two far away [from each other].²⁹

[2.33] Then the experimenter should remove the two pegs from the plaque and place one of them at the edge of the plaque beyond point **K** but quite near it, e.g., at point **R**, and he should reposition the plaque as before [against his nose] and direct his gaze at the peg that is placed in the center [of the plaque]. In that case, he will definitely find that the peg placed at **R** [appears] single. Then he should remove the peg from point **R** and place it at the edge of the plaque beyond point **K** at a point far from point **K**, e.g., at point **F**, and he should direct his gaze at the peg placed in the center [of the plaque], for then he will find that the peg placed at point **F** [appears] double.

[2.34] Now the experimenter will encounter everything we have described when he directs his gaze at the peg placed in the center [of the plaque], or at a peg placed on the straight line [passing through the middle of the plaque] along the width, or at a point on that line, whatever point it may be, as long as the two [visual] axes intersect at the peg placed in the center [of the plaque] or at some point on the line [passing through the middle of the plaque] along the width. Under these circumstances, then, if

the experimenter directs his gaze at the peg that is placed beyond the line [passing through the middle of the plaque] along the width or at a point located beyond that line, and if the two [visual] axes intersect at some point beyond the line passing through the middle, then the peg that is placed in the center [of the plaque] will appear doubled. Meanwhile, if the remaining pegs lie at the two points **K** and **T**, then each of them will also appear double. Then, if the experimenter directs his gaze to the central peg or to some place on the line [passing through the middle of the plaque] along the width, everything will revert right back to the original situation, as represented in the first figure.

[2.35] Accordingly, let lines **BK**, **BR**, and **BF** [in figure 3.8] be drawn from point **B**. Line **KB** is therefore longer than line **BT**, while line **KQ** is equal to [line] **QT**. So angle **TBQ** is greater than angle **QBK**.

[2.36] But angle **TBQ** is equal to angle **KAQ**. Thus, angle **KAQ** is greater than angle **KBQ**.

[2.37] Therefore, line **AK** lies farther from axis **AQ** than line **BK** does from axis **BQ**. But the difference in the distance between these two is minimal because the difference between the two angles **KAQ** and **KBQ** is slight.

[2.38] Now the peg at point **K** always appears single to the two eyes when the two [visual] axes intersect at the peg that lies at point **Q**. Moreover, the two lines **AK** and **BK** are parallel to the two rays extending to the peg at point **K** as long as the two axes intersect at the peg that lies at point **Q**.³⁰

[2.39] So, too, the situation of the peg at point **R** is known, for the rays extending to it will line up with the two lines **AR** and **BR**, so it will appear single.

[2.40] Moreover, the two angles **RAQ** and **RBQ** do not differ much in size, whereas angle **KBR** has no perceptible size when point **R** lies very near point **K**.

[2.41] From this example it will be obvious that, when a visible object lies on the same side of the two axes, and the rays extending to that object from the two eyes do not differ very much in their distance [from the visual axes], that visible object will appear single to the two eyes.

[2.42] On the other hand, angles **FAQ** and **FBQ** differ considerably in size, so the peg at point **F** will appear double when the two [visual] axes intersect at the peg that is at point **Q**.

[2.43] From this example it will therefore be evident that, if the rays extending from the two eyes to a visible object lie at significantly different distances from the two [visual] axes, the object appears double, even if it lies on the same side of those axes.

[2.44] Line **HQZ**, however, does not lie on the same side of the two [visual] axes, for the rays extending toward [segment] **HQ** from the right eye

lie to the left of [visual] axis **AQ**, whereas the rays extending toward it from the left eye lie to the right of [visual] axis **BQ**. On the other hand, the rays extending toward [segment] **QZ** from the right eye lie to the right of axis **AQ**, whereas the rays extending to it from the left eye lie to the left of axis **BQ**, so the rays extending to it lie on opposite sides [from those extending to **HQ**]. But the distance between the two rays extending to each point on this line from the two eyes and the two [visual] axes is equal; yet this line, and everything that lies on it, except for the peg that is placed in the center, invariably appears double if the two [visual] axes intersect at the peg placed in the center.³¹

[2.45] On this basis it has therefore been shown that a visible object that lies on different sides of the two [visual] axes always appears double, even if the rays extending to it from the two eyes lie at equal distances from the two [visual] axes. For any of the two rays extending from the two eyes to any point on the object will lie on opposite sides [of the eyes], so the two forms of each of its points will be impressed on two points on both sides of the centerpoint in the hollow of the common nerve.

[2.46] The same thing also holds for the two diagonals, i.e., the rays extending to either of them from the eye will follow in order from the center of the eye, being near the [visual] axis, below the [visual] axis, or above the [visual] axis; and the rays extending to the diagonal from the other eye will be inclined to the other axis. The rays extending from the right eye to the left-hand diagonal will lie to the left of the [visual] axis, whereas the rays extending from the left eye to the right-hand diagonal will lie to the right of the [visual] axis.³² The forms of these diagonals, and everything else that lies upon them, appear double except for the peg in the center [of the plaque] when the two [visual] axes intersect on that central peg.

[2.47] From this it will be clear that a visible object that lies directly opposite the middle of one eye but lies to the side of the middle of the other appears double. For the form of the point that is impressed in the middle of the one eye reaches [straight through to] the center [of the common nerve]. But the form of a point to the side of the middle of the other eye will reach some point other than the center [of the common nerve], and its displacement from the center will depend upon its displacement on the surface of the eye.

[2.48] Thus, on the basis of this experiment and its explanation it is quite evident that if the two [visual] axes intersect on an object, it always appears single; and [it is evident] that, if the rays that converge on an object lie on the same side [of their respective axes], and if their distance from the two [visual] axes does not differ by much, the object appears single; and [it is evident] that, if the rays that converge on an object lie on the same side but at substantially different distances from the two [visual] axes, the object

appears double; and [it is evident] that, if the rays that apprehend an object lie on different sides [of the visual axes], the object appears double, even if the rays extending to it are equidistant from the two [visual] axes; and [it is obvious] that all of this will obtain as long as the two [visual] axes intersect on a single visible object.

[2.49] All ordinary visible objects face both eyes, and both eyes look at any such object. Thus, the two axes of the two eyes always intersect on them, and the remaining rays that intersect at a common point on them lie on the same side [of their respective visual axes], and their distances from the two [visual] axes do not differ by much. As a result, any of the ordinary visible objects appears single to the two eyes, and none of them appears double except on rare occasions. For none of the [ordinary] visible objects appears double unless its situation with respect to both eyes is inordinately skewed in terms of direction or distance, or in terms of both; but it is only rarely that the situation of a given visible object with respect to the two eyes is inordinately skewed.

[2.50] Thus, the reason that any of the ordinary visible objects appears single to both eyes has been shown through deduction and experiment.

[2.51] Now, if the experimenter removes the peg at the center of the plaque and focuses on the point of intersection at the plaque's center, and if he then looks at the lines that are drawn on the plaque, he will find that the two diagonals [appear to be] four. He will also find that two of the four diagonals [appear to lie] near each other, and two [appear to lie] far from one another, but still, all of them [appear to] intersect at the centerpoint, which is the point of intersection for the two diagonals and lies on the common axis. He will find, as well, that each of the [apparent] diagonals that lie far apart [from one another] lie farther from the middle than the actual diagonals do. Then, if the experimenter covers one eye, he will see two diagonals, and he will see that the separation between them [seems] larger than it really is according to their actual divergence, and this [divergence] is widest at the top edge of the plaque. Moreover, the diagonal that appears to lie far from the centerpoint will be the one in line with the eye that is covered.

[2.52] From this is evident that the two diagonals that appear [to lie] near [one another] when vision takes place through either eye are the ones that are seen in line with [their respective] eye, whereas the two diagonals that appear [to lie] far [from one another] are the ones that are seen by the eye that lies to their sides. Moreover, the reason two of the four [appear to lie] near [each other] is that, when the two axes intersect on the peg that is placed in the center [of the plaque], each of the diagonals will be perceived by the eye in line with it according to rays that are quite near the [visual] axis, so their forms will lie quite near the centerpoint in the hollow of the

common nerve.³³ But the intersection-point of those diagonals will be at the centerpoint itself, so they appear [to lie] close to one another as well as to the centerpoint. On the other hand, the reason two of the four [appear to lie] far [from one another] is that each of the diagonals will also be perceived by the alternate eye that lies to its side, so it is perceived by rays that lie far from the [visual] axis. Moreover, one of them is perceived by rays that lie to the right of the axis, whereas the other [is perceived] by rays to the left of the other axis, so their forms will be impressed at disparate locations in the hollow of the common nerve. For they are impressed on opposite sides of the centerpoint and far from it, as well, so the two diagonals have two forms [that appear to lie] near each other and two [that appear to lie] far from one another. Now the reason that each [of the diagonals that appear to lie] farther [from one another] appear to lie farther from the centerpoint than they actually do is that the distance between the two diagonals is perceived by each eye to be greater than it actually is. And this is made clear when the experimenter covers either eye and looks with the other. As a result, when the experimenter covers one eye and looks with the other, he will find that the separation between the two diagonals [appears] greater than it actually is, because the separation between the two diagonals is perceived by each eye from up close, and whatever is very close to the eye appears larger than it actually is. But we shall explain the reason for this later when we discuss visual illusions.³⁴

[2.53] By thus examining the dispositions of the diagonals on the plaque, as well as of the pegs that are placed upon them apart from the center [of the plaque], one sees that every visible object that is placed on the common axis and that is perceived by sight along the visual axis will be perceived where it actually lies, whether it is perceived with one eye along one of the axes of the two eyes, or whether it is perceived by both eyes along both [visual] axes. And it is evident that, if it does not lie on the common axis, any visible object that is perceived by one eye along the visual axis will be perceived to lie closer to the common axis than it actually does. This is also the case for visible objects that are perceived by the rest of the rays beyond the axis. For, if sight perceives the visible object as it actually exists, and if its form is impressed at one spot in the hollow of the common nerve in continuous order [of parts] according to the continuous order [of parts] in the visible object itself, then, since the point that lies on the visual axis, assuming it does not lie on the common axis, appears nearer to the common axis than it actually is, the remaining points [on the object] also appear nearer the common axis than they really are, because they are continuous with the part at the endpoint of the [visual] axis.

[2.54] If the axes of the two eyes intersect on some visible object lying outside the common axis, the same thing follows, i.e., the object appears to

lie nearer the common axis than it actually does. But this situation rarely occurs, for, when the axes of the two eyes intersect on some visible object, it is often the case that the common axis will pass through that visible object. Moreover, the axes of the two eyes will never intersect on a visible object that lies outside the common axis without effort or without some outside interference forcing the eyes into such a situation, but this situation does not show up in the case of ordinary visible objects. For when this occurs in the case of any visible object, it will happen for all the visible objects continuous with that one, so the situation of the visible objects among each other will not be changed on this account.³⁵ But if the situation of that visible object does not change with respect to neighboring visible objects, then it will not appear to change when the change occurs among ordinary visible objects. Thus, when this is investigated according to the method described earlier, it will be clear from the experiment that this follows for all visible objects that lie outside the common axis when the axes of both eyes intersect on them.

[2.55] Now the experimenter should take three small strips of parchment of equal size, and he should write some clearly lettered word on one of them. On the rest he should write that same word [making it] the same size and shape, and he should place one of the [wax] pegs at the center of the plaque, as before, and he should place another at point **K**. Then he should fasten one of the strips to the peg at the center of the plaque and another to the peg at point **K**, and he should take care to keep it oriented the same way as the first strip. He should then position the plaque [against the bridge of his nose], as he did before, and he should direct his gaze to the strip attached to the central peg and focus on it. In that case, of course, he will have a clear perception of the word written on it. In this same situation, moreover, he will also see the other strip and the word written on it, but not as clearly as he does the identical word written on the middle strip, even though the words are identical in shape, form, and size.

[2.56] Then, keeping the same arrangement, the experimenter should take the third strip with the hand that lies on the side of point **K**, and he should place that strip in line with the two strips that are [already] on the plaque along the extension of the line passing through the [middle of the] plaque along its width and lying on the plaque's surface as far as sense is concerned, but let the strip be [placed] beyond the plaque. Now this sort of alignment will be called a facing alignment. And when he puts it in place, the experimenter should make certain that the third strip and the word written on it are oriented the same way as the two strips on the plaque. He should then focus both eyes on the strip placed in the center and direct his gaze toward it, and in that case he will certainly perceive the third strip if it does not lie too far from the plaque, but he will perceive the form of the

word on it in an indistinct and undecipherable way. So he will not find it to be like the form of the word that is identical to it at the center of the plaque, nor does he find it to be like the form of the word at point **K** as long as both eyes are focused on the strip at the center.

[2.57] At this point the experimenter should remove the peg at point **K**, along with the strip attached to it, and he should bring the strip he is holding in his hand nearer [the middle of the plaque] until he can stand it next to the strip that is affixed to the peg placed in the center [of the plaque], and he should take care to stand the strip straight up along the line passing through [the middle of the plaque] along the width. Then, as before, he should direct his gaze toward the strip placed in the center. In that case, he will indeed perceive both words on the two parchment strips clearly and distinctly, and there will be no perceptible difference in clarity and distinctness between the forms of the two words.

[2.58] The experimenter should then slowly move the strip he is holding in his hand along the line passing through [the middle of] the plaque along its width, and he should make certain that its orientation remains as it was before. He should maintain his focus on the middle strip and examine both strips closely as they are so disposed. In that case, he will see that, the farther the moving strip is displaced from the center, the less distinct the word written on it becomes. Thus, when it reaches point **K**, the experimenter will find that the form of the word is [still] decipherable, but not as clearly as it was when it was placed next to the other strip placed in the center.

[2.59] The experimenter should now continue to move the strip, drawing it away from the plaque, and he should move it little-by-little along the line passing [through the plaque's middle] along its width. And he should examine it closely while directing his gaze at the strip placed in the center. In that case he will find that the farther the moving strip is displaced from the center, the less [clearly] the word written on it will appear until it will become wholly undecipherable. And when he moves it beyond this point, he will see that the farther it is moved from the center the less visible the form of the word written on it becomes.

[2.60] The experimenter should now cover the eye that corresponds with point **T**, and he should maintain the plaque in the same arrangement, and he should direct the gaze of the eye corresponding with point **K** at the strip placed in the center. He should then place the other strip beside the strip placed in the center, just as he did before. In that case he will find that the word on that other strip is still clear and that there is no perceptible difference [in clarity] between it and [the word written on] the strip placed in the center. Then he should move the second strip, as he did initially, and focus on the strip placed in the center, directing his gaze at it. In that case he will

find that the word on the second strip loses visibility as it is moved, and when it arrives at point **K**, there will be a perceptible difference between its clarity at this position and its clarity when it was placed next to the strip at the center. He should then move the strip, drawing it away from the plaque, as he did before, and he should focus on the strip placed in the center. Accordingly, he will find that the farther the moving strip is displaced from the center, the less distinct what is on it becomes until its form will no longer be decipherable, and the more it continues to be displaced from the center, the less discernible it becomes.

[2.61] From this investigation it is thus evident that a facing visible object is seen most clearly with both eyes when it lies at the intersection of the two [visual] axes, and [it is evident] that what lies nearer to the intersection of the two [visual] axes appears more clearly than what lies farther away from it and that the form of a visible object that lies far from the intersection of the two [visual] axes is indeterminate, even if it is perceived with both eyes. Moreover, if an object in facing alignment is perceived with one eye, it also becomes evident through this investigation that the object is perceived most clearly with one eye along the visual axis, and [it is evident, as well] that what lies near it appears more clearly than what lies farther from it and that the form of any visible object lying far from the visual axis is indistinct and indeterminate. Furthermore, it is apparent that sight does not correctly perceive a visible object that has large cross-sections unless it moves the visual axis over all its cross-sections and all its parts, whether it is perceived with both eyes or with one. For when it is focused on a facing visible object that has exceptionally large cross-sections, sight will not perceive the entire object correctly but [will] only [perceive] what lies on or near the [visual] axis in a determinate way. It will perceive the remaining parts of that object, specifically those parts that lie far from the [visual] axis, but not distinctly, even when the visible object has a facing alignment—and it does not matter whether the perception occurs with both eyes or with one alone.

[2.62] Next, the experimenter should take a square piece of parchment that is four digits on a side with lines of tiny writing on it, but writing that is still clear and decipherable. Then he should remove the peg that is placed on the plaque and position the plaque up to the eyes, as he did before, and stand the parchment [sheet] up on the line passing through the center of the plaque along its width. He should then direct the gaze of both eyes at the middle of the parchment and focus on it. Accordingly, he will find that the writing on the parchment is clear and decipherable but that the writing on the middle of the parchment is even clearer than the writing toward the edges when the eye directs its gaze toward the center of the parchment and does not move over all its cross-sections.

[2.63] He should then incline the parchment so that it intersects the line passing [through the plaque's middle] along the width at the centerpoint of the plaque, which is the point of intersection. But the obliquity of the parchment should be slight with respect to the line passing along the width. The experimenter should then look at the middle of the parchment with both eyes. Accordingly, he will find the writing legible, but not as legible as when the parchment faced him directly.

[2.64] The experimenter should now incline the parchment more sharply than before so that its midpoint stays over the point of intersection, and he should again direct the gaze of both eyes at its middle. In that case, he will see the writing less clearly than before. He should then continue to incline the parchment little-by-little so that its midpoint remains over the point of intersection, and he should examine it at each point as it is turned. He will then find that the writing loses visibility as the parchment is [increasingly] slanted, and the more sharply the parchment is slanted, the less visible the writing will be until the parchment nearly coincides with the line drawn lengthwise through the center of the plaque. At that point the writing on the parchment will appear quite indistinct, [being] wholly indecipherable and indeterminate.

[2.65] The experimenter should then replace the parchment to its original position and stand it up on the line passing [through the plaque's center] along its width, and he should cover one eye and look at the parchment with the other. He will then find the writing to be clear and legible. Then he should incline the parchment, as he did before, and look at it with one eye. In that case he will find the writing to be less visible than it was when it faced him directly. He should then continue to incline the parchment little-by-little while [re]examining it frequently. He will thus find that, the more sharply it is inclined, the less visible the text written [on it] becomes until the parchment nearly coincides with the diagonal that corresponds with the open eye.

[2.66] From this investigation it will thus be obvious that a visible object lying on the visual axis and directly facing the eye is most clearly seen and that one facing the eye more directly is seen more clearly than one that faces it less directly, and [it is obvious] that an object that is sharply slanted with respect to the visual axis appears indistinct and undecipherable, whether vision occurs through both eyes or through one eye.

[2.67] At this point the experimenter should replace the peg that was on the plaque, and he should place it at the middle of the plaque and fasten it at the point of intersection, as it was during the first investigation. Then he should stand the parchment on one side of the line passing [through the plaque's center] along its width so that it faces the eye directly, and he should direct the gaze of both eyes at the peg placed in the center. In this situation

he will perceive the parchment, as well as the writing on it, but what lies nearer the peg placed in the center will be clear, whereas what lies far from it is indistinct and lacking in visibility. Moreover, the farther the writing is displaced from the peg, the less visible it gets.

[2.68] The experimenter should also incline the parchment in this situation so that it intersects the line passing [through the plaque's center] along its width at some point on the side [of the center] where it stands, but the inclination should be slight. He should then direct his gaze to the peg placed in the center. In that case, he will see that the writing on the parchment is less visible than it was when the parchment faced the eye directly. Then he should incline the parchment more sharply while directing his gaze at the peg placed in the center. Accordingly, he will see that the writing is indistinct, and [therefore] unclear and illegible.

[2.69] The experimenter should then cover one eye and look with the other eye, and he should replace the parchment in its original position and stand it up on the side of the line passing [through the plaque's center] along its width that corresponds to the open eye, and he should direct the gaze of that eye toward the peg placed in the center. Accordingly, he will perceive the writing on the parchment, but he will see what lies near the peg [at the center] more clearly than what lies far from it, and he will see that what lies farthest from that peg appears indistinct and illegible.

[2.70] Next, he should incline the parchment so that it intersects the line passing [through the plaque's center] along its width at the point on the side where it has been stood, and he should look at the peg placed at the center with that same eye. He will then see that the writing on the parchment is more indistinct and less legible than it was when the parchment faced the eye directly. He should continue inclining the parchment little-by-little, and he will see that the more sharply inclined the parchment is, the less visible the writing becomes.

[2.71] From this investigation it is thus evident that a visible object that faces the eye directly is [seen] more clearly than one that is oblique, even if the visible object does not lie on the visual axis but lies outside the axis. For when a visible object is very sharply slanted, it loses visibility to a considerable extent, even if it lies on the visual axis, whether vision takes place through both eyes or through one alone.

[2.72] The experimenter should now remove the peg from the plaque and stand the parchment at the top edge of the plaque, placing its [left] side flush with side **CD** of the plaque, and he should direct the gaze of both eyes on the middle of the parchment. He will then find that the writing is clear and legible.

[2.73] Then he should incline the parchment so that it intersects the upper edge of the plaque at point **Z**, which bisects the plaque's upper edge,

and he should direct the gaze of both eyes at the middle of the parchment. In this situation he will see that the writing is less visible than before. He should then increase the slant of the parchment little-by-little, and he will see the writing become less and less visible until the parchment becomes so sharply slanted that the writing will lose visibility to an inordinate extent, just as was the case when he was examining the parchment in the center of the plaque; and the same holds in this case if he carries out the examination with one eye.

[2.74] At this point the experimenter should place the peg at point *Z* and stand the parchment to one side at the top of the plaque, just as he did in the middle of the plaque, and he will direct his gaze at the peg placed in the center [of the top edge] while looking at the parchment and examining the writing [on it]. He will see that the situation is the same as the one he observed when the experiment was carried out in the middle of the plaque, whether the examination is made with both eyes or with one.

[2.75] The experimenter should then try the three small strips we described earlier, [placing them] at the top edge of the plaque, and he will see the situation in this case to be like the one when the strips were tried in the middle of the plaque, i.e., the word on the middle strip is clearer than the word on a strip that lies away from the middle. And the farther the strip is displaced from the center, the less visible the word [on it] will become. However, he will notice that the distance from the middle according to which the word loses visibility when the experiment is carried out at the top edge of the plaque is proportional to the distance from the middle according to which the word loses visibility when the experiment is carried out at the center of the plaque, for it depends on the length of the ray extending to the top edge along the [visual] axis. Thus, at the point when the form loses visibility, the ratio of the eye-to-object distance to the distance of the object from the middle [of the plaque] is the same whether the examination is carried out at the center of the plaque or at its top edge.³⁶

[2.76] So, too, if the experimenter sets the plaque aside and positions the parchment with the writing on it farther away than the length of the plaque, but where he can read it, and if he keeps it directly facing the eye while examining it, then inclines it while it remains in place, he will find that the writing loses visibility. And as he continues to incline the parchment, the writing will lose more visibility so that, when he inclines it so sharply that it nearly coincides in orientation with the rays extending to the parchment's center, he will then see that the writing on the parchment loses a great deal of its visibility until it can no longer be read. And he will observe this whether he looks with both eyes or with one eye only.

[2.77] Likewise, when he focuses on one of the small strips facing the eye at a greater distance than the length of the plaque and holds it so that it

faces him directly while he directs his gaze at it with both eyes, then, when he places another strip to its right or left side and stands it so that it faces him directly, he will find that it is less visible [than the middle strip].

[2.78] Then, if someone moves the second strip farther and farther from the strip upon which he directs his gaze, he will find that the farther the remote strip gets from the second strip [in the middle], the less visible the form of the word [on the remote strip] gets until it will become absolutely illegible. So, too, if he carries out the examination with the two strips using one eye, he will get the same results.

[2.79] From all of these investigations, then, it is evident that, whatever its distance [from the eye], an object that lies on the visual axis is [seen] most clearly, while what lies nearer that axis is [seen] more clearly than what lies farther from it, and [it is evident] that when a visible object lies extremely far from the [visual] axis its form is indistinct and indeterminate, no matter whether vision takes place with one eye or with two. It is also evident that a visible object facing the eye directly, whatever its distance from the eye, is [seen] more clearly than one that is inclined and that the closer the visible object gets to a directly facing alignment the more clearly it will be [seen], and [it is evident] that when a visible object is slanted very sharply with respect to the radial lines, its form is quite indistinct and indeterminate, whether vision takes place through one eye or through two, and whether the object lies on the [visual] axis or outside it.

[2.80] Now the reason why a sharply slanted visible object has an indistinct form, even if the object lies at a moderate distance and its size is perceived as it actually is, and the reason why a visible object that faces the eye directly is [seen] more clearly than an oblique one is that the form of a sharply slanted visible object is impressed on the surface of the eye according to the compression that is due to its obliquity. For, if the visible object is sharply slanted, then the angle subtended by the object at the center of sight will be small, and the area on the eye upon which the form of that visible object is impressed will be much smaller than the area upon which the object's form is impressed when it faces the eye directly. So the small parts [of that form] subtend imperceptible angles at the center of sight on account of the sharp slant [of the object], for when [such] a small part is sharply slanted, the two [radial] lines extending from the center of sight to the edges of that small part will form what amounts to a single line; the sensitive faculty will therefore not perceive the angle formed by them or the area on the surface of the eye that they demarcate.

[2.81] Moreover, a visible object that is sharply slanted will be indistinct because the form of it that is impressed in the eye will be inordinately compressed, and its small parts will [then] be imperceptible, so its form will be indistinct. If, therefore, there are subtle characteristics in such a visible ob-

ject, they will not be perceived by sight because of the invisibility of its small parts as well as the compression of its form. On the other hand, a visible object that faces the eye directly presents the opposite case, for the form of it that is impressed on the eye will be arranged just as it is on the surface of the visible object, and the small parts [on it] that can be perceived by sight will be evident. And since the small parts of the visible object are evident and are arranged on the surface of the eye as they are arranged on the visible object's surface, the form will be clear, not indistinct.

[2.82] Generally, subtle characteristics, subtle parts, and the arrangement of the parts of a visible object are not perceived correctly by sight unless the form is impressed on the surface of the sensitive organ and each of its parts is impressed³⁷ on a perceptible part of the sensitive organ's surface. But when the visible object is extremely slanted, its form will not be [adequately] impressed on the eye, nor will the form of any of its small parts be impressed on a perceptible part of the eye. For this happens only when the visible object faces the eye directly, or when its inclination is slight and, in addition, it lies at a moderate distance in respect to the characteristics possessed by that visible object.

[2.83] Now the correct perception of the size of a sharply slanted visible object when it lies at a moderate distance, even when its slant is inordinate, is not based solely upon the actual form of the visible object impressed on the eye, but upon a deduction that goes beyond the [simple perception of the] form, i.e., from the perceiver's grasp of the difference in distance [from the center of sight] between the two edges of the object along with the perception of the form's size. When sight perceives the difference in distance [from the center of sight] of the two edges of a sharply slanted visible object and perceives the full amount of this difference, the faculty of discrimination will immediately imagine the orientation of that visible object and will perceive its size according to the difference in distance [from the center of sight] of its two edges, as well as according to the size of the area upon which the form [of the object] is impressed and the size of the angle subtended by that area at the center of sight, [so the overall perception is] not based upon the form alone. And when the faculty of discrimination perceives the difference in distance [from the center of sight] of the two edges of a sharply slanted visible object and [thus] perceives its obliquity, it will immediately perceive the compression of [its] form. Accordingly, it perceives its size when it senses the amount of its obliquity, not according to the size of the form but according to its orientation. But the subtle parts and features possessed by the visible object cannot be perceived through deduction if sight does not sense those parts or those features.

[2.84] Hence the form of the visible object loses visibility because of the compression of the form on the eye as well as from the invisibility of its

small parts. The form of a visible object that lies at a moderate distance becomes visible because the form impressed in the eye [represents the object] as it actually is and because sight senses its small parts.

[2.85] Why the form of an sharply slanted visible object is indistinct, whereas the form of a visible object that faces the eye directly is clear has thus been explained.

[2.86] And now that these points have been explained, it is time to begin the discussion of visual illusions and to describe their causes and their kinds.

[CHAPTER 3]

The third chapter [discusses] the causes of visual illusion.

[3.1] In the very first book of this treatise it was demonstrated that sight perceives none of the visible objects that lie in the same air with it and are perceived directly unless all the following conditions are met, namely: [there must be some] distance [between eye and object]; [the object must be] facing [the eye]; [there must be] light; the object must be of some [perceptible] magnitude; the object must be opaque or have some opacity in it; and the air between the object and the eye must be continuously transparent, with no opaque body interposed [between eye and object]. When these conditions are met and the eye that does the looking is free of injuries or obstructions, sight will perceive that visible object. If, however, any of these conditions is not met, sight will not perceive a visible object that lacks that particular qualification.³⁸

[3.2] It was also shown in the second book that sight perceives every visible object in some amount of time;³⁹ time, therefore, is also one of the things necessary for vision to be accomplished.

[3.3] The eye must also be healthy.

[3.4] In the preceding chapter it was also shown that, when the visible object lies far outside the visual axis, it will not be perceived in a determinate way by sight, even if it faces the eye directly.⁴⁰ And it was also shown that, if the visible object is sharply slanted with respect to the radial lines, it will not be correctly perceived by sight, even if it lies on the visual axis directly opposite the middle of the eye.⁴¹ Thus, sight does not perceive the visible object as it actually exists, even when it faces the eye, unless the visible object is properly oriented, i.e., unless it is directly facing the eye, or nearly so, and unless it lies on or near the visual axis.

[3.5] The conditions, moreover, according to which a visible object is perceived as it actually exists number eight: first, distance; [then] a facing orientation; light; some bulk; opacity; transparency in the air; time; and a

healthy eye. When all of these conditions are met a visible object will be correctly perceived; if the object lacks any of them yet is still perceived by sight, then it will not be correctly perceived.

[3.6] Accordingly, we should observe that, for every visible object, each of these conditions has a range within which sight perceives the object as it actually exists, and as long as all these conditions are met during the visual process, and as long as each of them falls within the normal range according to which the visible object is perceived as it actually exists, sight will perceive that visible object as it actually exists. But if one or more of these conditions falls very far outside that range, sight will not perceive the object as it actually exists. For when a visible object lies too far from the eye, it is not correctly perceived by sight, and, by the same token, when a visible object lies too close to the eye it will not be correctly perceived by sight, but between these limits there are numerous distances at which sight correctly perceives the visible object without any uncertainty. Nevertheless, the distances at which sight perceives a visible object correctly are limited, none of them having been too great or too small in extent; and for each visible object there is a corresponding range of distances. Indeed, a visible object with a large bulk is correctly perceived by sight at a distance in which a visible object of small bulk disappears from sight, and likewise, an intensely luminous visible object is perceived by sight at a distance in which a feebly lit visible object disappears from sight.

[3.7] Furthermore, a visible object that does not face the middle of the eye directly but lies so far to the side that none of its parts touches the visual axis or lies near it is not correctly perceived by sight. Moreover, if a visible object is perceived with both eyes but the axes of both eyes do not intersect on it, or if the rays that are correspondingly situated with respect to the two eyes are not correspondingly situated [on the object], then it will not be correctly perceived by sight. But if a visible object faces the middle of the eye, and the visual axis touches some point on it, or nearly does, then, if that object does not have excessively large cross-sections, it will be correctly perceived by sight, even if the [visual] axis does not scan all of the cross-sections. Also, when an object is perceived by both eyes, and the two visual axes intersect on it, or rays that are correspondingly situated with respect to the two eyes touch it at corresponding locations, it will be correctly perceived by sight. Moreover, a visible object that faces the eye directly or that is [only] slightly oblique [to it] will be correctly perceived by sight, but how slight the obliquity must be for sight to perceive the visible object in a determinate way depends upon the characteristics possessed by the visible object. Likewise, how small the displacement from the visual axis must be for the visible object to be perceived in a determinate way depends upon the characteristics possessed by the visible object, for a visible object that has

no subtle characteristics is perceived in a determinate way by sight, even when it lies a small distance from the visual axis. So, too, it is perceived in a determinate way when it is [only] slightly oblique with respect to the radial lines. On the other hand, a visible object with subtle characteristics will not be perceived in a determinate way when it lies outside the visual axis and its distance from the visual axis is the same as the distance at which the form of an [equivalent] visible object with no subtle characteristics is perceived in a determinate way. Likewise, its form will not be perceived in a determinate way when the object has the same obliquity with respect to the radial lines as an [equivalent] object without subtle characteristics does when it is perceived in a determinate way.

[3.8] Moreover, a visible object that is slightly luminous or poorly illuminated will not be perceived by sight correctly, especially if there are subtle features in it. So, too, a visible object that is intensely luminous or shining or a polished body upon which intense light shines will not be correctly perceived by sight. But between faint and brilliant light there are numerous [gradations of] light according to which sight correctly perceives a visible object. But the light according to which sight correctly perceives the form of a visible object will depend on the attributes possessed by the object as well as on its size. For a visible object that possesses no subtle characteristics is perceived by sight in light that is [so] weak that the form of a visible object possessing subtle characteristics may disappear from sight in it.⁴² By the same token, a visible object of large bulk is perceived by sight in light that is [so] weak that a tiny visible object may disappear from sight in it.

[3.9] Furthermore, if the visible object is extremely small and there are subtle features or small individual parts in it, it will not be correctly perceived by sight, e.g., animals whose members are distinct, and the shape of their members, as well as the members themselves, are so small that sight cannot perceive [them]. In fact, if such animals are perceived by sight, they are not perceived in a determinate way. When, however, the animal has a large body, its members will be proportionate[ly large], and sight will then perceive each of those individual members. Thus, sight will perceive its form as it actually exists. Similarly, no visible object that possesses extremely small features will be properly perceived by sight. But if those features are proportionate[ly large] in large visible objects, then sight will perceive those visible objects correctly if those features are proportionate to [the size of] the visible objects.

[3.10] Furthermore, if the visible object is transparent but there is just a bit of opacity in it, it will not be correctly perceived by sight. However, if it is not transparent, or if it only has a bit of transparency in it, and its opacity is obvious, it will be correctly perceived by sight. And the fainter the color-

ing of the transparent object is, the more opacity it will require [to be properly seen], whereas the more intense the color, the more [readily] it can be perceived by sight when its opacity is so slight that a faintly colored visible object [with the same opacity] could not be correctly perceived. Moreover, when the air between the eye and a visible object is hazy or foggy, as [happens when] clouds, smoke, and the like are [present], things in such air will be invisible. Moreover, if those visible objects are subtle or there are subtle features in them, they will not be correctly perceived by sight. Likewise, when a transparent body with some opacity is placed in the air between the eye and a visible object, that visible object will not be correctly perceived by sight. If, however, the air is transparent and clear and of sheer and uniform transparency, and if there is no opaque body placed in it [between eye and objects], then sight will perceive the visible objects in that air correctly. Likewise, if the air is slightly hazy and there are visible objects in it that are not too small and that lack subtle features, sight will correctly perceive those visible objects, and it will not be hindered by the air, even if it is somewhat hazy. However, the amount of haziness in the air according to which a visible object is correctly perceived depends on the features possessed by the visible object, for a visible object that possesses no subtle features will be correctly perceived by sight in air that is hazy enough that another visible object possessing subtle features will not be perceived through it in a determinate way.

[3.11] In addition, when a visible object is moved quite swiftly, and it traverses a space in which it will be perceived by sight in a minimal amount of time, it will not be correctly perceived by sight. For instance, when someone looks through a window outside of which some visible object moves [by] extremely swiftly, if sight perceives that visible object through that window, it will not perceive what kind of thing it is, nor will it determine its form properly. On the other hand, if the object moves in a plane facing the eye along a space that is not too great during a perceptible amount of time, it will be perceived by sight in a determinate way.

[3.12] Also, extremely swift rotary motion, such as the motion of a top, will not be perceived by sight, even though the top is perceived, so it will perceive the top, or a body moving with the top's motion, as if it were immobile. In the same vein, a motion that is extremely slow will not be perceived by sight in a short amount of time, so in a perceptible amount of time it will be perceived as if it were at rest and immobile.⁴³

[3.13] The health [of the eye] has a range. For in the case of certain infirmities the minute features of a body that is seen are invisible, whereas in the case of a less [infirm eye] they are perceived.

[3.14] Generally speaking, any spatial disposition according to which

the form of a visible object is not defined [according to the object] as it actually exists is a spatial disposition that falls outside the [range of] moderation that is proportionate to that object. In terms of distance,⁴⁴ the spatial disposition of a visible object falls outside [the range of] moderation either according to a maximum increase or a maximum decrease in extent. In terms of distance away from the [visual] axis, spatial disposition falls outside [the range of] moderation by exceeding a maximum, whereas in terms of orientation with respect to both eyes, an object falls outside the range of moderation by slanting too much. In the case of light, too great an intensity or excessive faintness causes it to fall outside [the range of] moderation; in the case of magnitude, an [excessive] diminution in the size of a visible object [causes it to fall outside the range of moderation]; in the case of opacity, [too great an] increase in transparency [causes it to fall outside the range of moderation]; in the case of [the transparency of] air, an excess of opacity in it [causes it to fall outside the range of moderation]; in the case of time, an excessive [brevity] in its duration [causes it to fall outside the range of moderation]; and in the case of ocular health, a substantial weakening of the eye or a change produced in it by disease [causes it to fall outside the range of moderation].

[3.15] Now what it means to fall within the range of moderation will be explained as follows. If some object is seen as it actually exists and is moved somewhat farther away from or somewhat nearer to the eye, as long as the difference between appearance and reality is imperceptible, the range is moderate, and it continues to be until the difference is appreciable and there is a perceptible change in appearance. Furthermore, the range of moderation for each condition varies proportionately to the other seven, and according to color as well as to the smallness of the parts of the body. Thus, the range of moderation for distance depends not only on color, but also on the tiny features that are in the body, as well as on the light and the six other conditions that have been mentioned.

[3.16] [The range of moderation for distance] depends on the type of color, for a body that has an intense and bright color is perceived at a greater distance than [one whose color is] dull and faint, so the range of moderation for distance is proportionately greater for an intense color than for a faint one.

[3.17] Similarly, when the distinguishing features of the body of a visible object are noticeable, they are perceived at a greater distance than [they would be] if they were tiny, so [the range of] moderation for distance is greater with respect to the noticeable parts of the body than with respect to the tiny [parts].

[3.18] In the same vein, [the range of] moderation for distance will be proportionately greater for a body that faces the eye directly than for one

inclined to it. So, too, it will be greater when the body is closer to the [visual] axis than when the body is farther [from it].

[3.19] Likewise, the range of moderation for distance is greater in intense light than in faint light.

[3.20] And [the range of moderation for distance is] greater if the body that is seen is large than if [it is] small.

[3.21] So, too, a body that is absolutely opaque is perceived at a greater distance than one that is less opaque, so the opacity of the body is proportionate to [the range of] moderation for distance.

[3.22] [The range of] moderation for distance is proportionate to the quality of the air [through which an object is seen], for hazy air can mask bodies from sight at a given distance, whereas at the same or at a greater distance it reveals them when it is clear.

[3.23] [The range of] moderation for distance is proportionate to time, for in a certain amount of time the motion of a body is perceived at a given distance, whereas it will [only] be perceived at a greater distance in a greater amount of time.

[3.24] Likewise, when the eye enjoys a certain modicum of health, a body will be seen at a greater distance than [when the eye is] less [healthy].

[3.26] By the same token, [the range of] moderation for spatial disposition is measured proportionately to distance, as well as to color, to the small features of the body [that is being looked at], to light, and to the other conditions we enumerated.

[3.33] But you [must] examine and adjust each one [to its counterparts], and you will be able to see quite easily [how the range varies for each]. In the same way you will relate the [range of] moderation for each of them to all the rest, and you will see that what has been said applies to every one of them.

[3.34] Thus, when each of the conditions that have been listed falls within its proper range of moderation, the true form of the visible object will appear as it actually exists. However, when the form does not appear as the [object] actually exists, one or more of the aforementioned conditions has fallen outside [the range] of moderation. Thus, the only reason sight errs in perceiving forms is because one or more of the aforementioned conditions has fallen outside [the range of] moderation, and these are the points that were to be established in this section.

[CHAPTER 4]

[4.1] It is evident from the second book that the perception of things is accomplished through [brute] sensation, recognition, or deduction. Now

when an error occurs in the case of things that are perceived through brute sensation, we know that this involves an error of sensation alone. When someone errs in the case of things he perceives through recognition, the error will involve recognition alone. Finally, if someone errs in the things that are perceived through deduction, the error will involve deduction alone. Sensation apprehends light and color only, as has been pointed out.

[4.2] Recognition, however, includes everything that has been seen before and that is retained by the sense;⁴⁵ for instance, the light of the sun is recognized because it is seen so frequently, and the light of the sun and the light of the moon are differentiated [through such recognition]. And even though the perception of light [itself] occurs through brute sensation, the differentiation of [types of] light still occurs through recognition. Likewise, a grasp of shapes, such as the shape of a triangle, of a square, of a circle, or of the like, occurs through recognition. The same holds for our grasp of roughness, smoothness, shadow, beauty, and the like; these are perceived through deduction, as we explained above, even if the sense [of sight] has not apprehended them frequently.

[4.4] Every perception of objects falls under one of these three heads, and when an error arises in the perception of forms, it occurs in one of these ways alone.

[4.5] An error of [brute] sensation occurs when a body that has many different colors is presented to sight in extremely faint light; for instance, certain clothing of various colors with fine designs will appear to be of a single color. And this error will occur in sensation because the light [falls] outside its [range of] moderation, whereas the remaining conditions will not have fallen outside their [range of] moderation.

[4.6] An error of recognition occurs at times when a person known [to the viewer] is seen at a great distance and is judged to be someone else who is similarly known, so someone seeing his brother at a certain distance thinks he is seeing his father or something of the sort. And this error in recognition is due solely to the fact that the distance has fallen outside [the range of] moderation.

[4.7] An error of deduction occurs, for example, if the moon is judged to be in motion when it is the clouds that are moving. And this error occurs because of inordinate distance, for where the distance is moderate this does not happen, so that, for instance, when a stick is lodged under water, and we see the water moving above it, rather than [seeing] the stick [moving] we perceive the motion of the water as it flows by.⁴⁶

[4.8] The aforementioned error occurs in the case of the moon's motion when there are many clouds in continuous succession, and the reason for this error, as was shown above, is that motion is perceived only when something is seen to approach something else or to recede from something else.⁴⁷

Thus, when there are few clouds, we can discern their motion according to the way each of them approaches or passes beyond some star that is seen. When the sky is covered with clouds, then, we do not perceive their motion because of their close succession; rather, we glimpse the moon [through them, appearing to be] somewhere at one time and elsewhere at another, so we conclude that it is moving very swiftly. In a similar manner, an error will arise when the spatial disposition [of a given object] falls outside [the range of] moderation.

[4.9] And it is according to the eight previously mentioned conditions that perception occurs through [brute] sensation, or through recognition, or through deduction.⁴⁸

[CHAPTER 5]

The fifth part [deals with] the kinds of visual errors that are due to brute sensation according to each of the causes that produce an error of sensation.

[5.1] From what has been said before it is clear that only light and color are perceived through [brute] sensation. Thus, an error of [brute] sensation occurs only in the case of light and color, and an error involving light or color occurs only because of their inordinate weakness or intensity, or according to a difference among tenuous or weak colors. But in faint light this variation in color will reach the eye as a sort of darkness or shadow, and [this happens] even in intense light when the colors are exceedingly tenuous.

[5.4] Distance causes an error in [brute] sensation. When the distance⁴⁹ of a body from the eye is moderate, but there are small parts of various colors in the body, and the size of those parts is not proportionate to the distance [of the body from the eye], that body will appear to be of one color only, for the distance falls outside [the range of] moderation in relation to the particular features, even though all of the other conditions fall within [the range of] moderation. So this error is due to sensation since [it is] the sense [of sight that] apprehends color.

[5.7] Spatial disposition causes [brute] sensation to err. When the inclination of a body that is seen is excessive, its small parts will be invisible to sight. Moreover, if the small parts are of different colors, the colors will appear to be blended throughout the whole object. And this error is due solely to spatial disposition, for when a body faces the eye directly with the other [preconditions] unchanged, just as they are, the parts of the body and of the color will be perceived [so the error arises] only if the spatial disposi-

tion falls outside [the range of] moderation. The same error occurs on account of an inordinate[ly skewed] spatial disposition when the distance of the small parts away from the [visual] axis is considerable.

[5.8] Extremely faint light causes an error. For the tiny parts of a body are invisible to sight [in such light], and it produces a blending of shadowy colors. But if the light is brought back within [the range of] moderation, the difference in colors or the smallness of the parts will not be obscured [so this error arises]⁵⁰ when the light alone falls outside [the range of] moderation.

[5.9] Magnitude brings about error. When the smallest parts of a body differ in color from the whole, those parts will disappear from sight on account of their smallness, and the same for their colors. So the color will appear blended in the body when the magnitude alone falls outside [the range of] moderation, but this blending would not appear if the smallness of the parts did not pass beyond moderation.

[5.10] Opacity is a cause of an error in sensation if the opacity is scant, as [it is] in the case of glass, so when a colored body is placed behind it, the glass seems to take on that [body's] color because its opacity is so attenuated as to fall outside [the range of] moderation, but this would not happen if the glass were more opaque.

[5.11] An error of sensation arises from the transparency of the air. When a flame is interposed between the eye and a facing body, even when the color of the body that is seen is intense, that body will appear shadowy, but [it is] only the transparency of the air [that] has fallen outside [the range of] moderation.

[5.12] Time is the cause of error. For, if sight is abruptly directed toward a body of different colors, the body will appear to be of a single color until the glance is prolonged, provided, I [should] add, that the light in which the body is perceived is not intense.

[5.13] Indeed, in faint light sight is not immediately affected by any individual color, as it would be in intense light.

[5.14] Sight [itself] sometimes presents an error. For if an intense light strikes the eye, it disrupts sight; so, as soon as the eye is directed toward the color of any body, it receives that color in a shadowy way until it rests a bit and the disruption fades. By the same token, when the eye suffers an infirmity, the true colors [of objects] will be obscured from sight, so an error arises solely from the fact that the condition of the eye falls short of moderation.

[5.15] It is therefore evident that errors arise in sight according to each of the aforementioned cases under consideration, and they occur in sensation only, because the perception of colors takes place through [brute] sensation.

[CHAPTER 6]

The sixth part [deals with] the kinds of visual errors that occur through recognition according to each of the causes of error in sight.

[6.1] It was claimed in the second book that it is only through recognition that [sight] apprehends what an object is.⁵¹ For [the perception of] what a thing is arises from the similarity or dissimilarity of one object to another in [terms of] a common form.

[6.2] And it is in the nature of recognition to assimilate an object that is currently in view to an object that has been seen before according to an acquired form, and from this assimilation sight apprehends what any thing is. Moreover, recognition is differentiated according to recognition of the individual, or [recognition] of the universal, or [recognition] of both, so every error in recognition will occur in either or both of these categories.

[6.3] Therefore, when some object appears other than it actually is or of another kind than it actually is, there will be an error in ascribing [the proper] definition [to it],⁵² and this [type of] error does not occur unless one of the aforementioned conditions falls outside [the range of] moderation.

[6.4-5] For instance, there will be an error of recognition in the case of distance. If a known person is seen from a great distance, he may appear to be another person known to the viewer so that when he sees Peter the viewer sometimes assumes he has seen Martin, since it is unquestionable that both are known to him.

[6.6] There will be error in terms of the common form. If someone sees a horse from some distance and assumes that he sees an ass, there is an error in both forms—i.e., individual and common—as [happens] for instance, when someone sees a horse that is known to him at a considerable distance and assumes he sees an ass that he knows. Similarly, a threefold error occurs in the case of trees: according to individuals, according to common forms, and according to both. Hence, one almond tree is sometimes judged to be another one; or from a great distance a large pear tree sometimes appears to be an almond tree; or at times Peter's pear tree appears to be Martin's almond tree. The same threefold error according to distance often happens in the case of clothing, stones, and other things.

[6.7] Sometimes an unfamiliar thing is seen and an error in recognition arises, as [happens] when someone sees a fire far off in the air and judges that he sees a star. It is, moreover, clear that each of the previously discussed errors occurs in recognition when a definition that does not actually

pertain to it is ascribed to the visible object. It is also clear that the aforesaid error occurs because the distance falls outside [the range of] moderation. For if that distance is restored to moderation while other errors and causes, such as they are, persist, the aforementioned error in recognition does not occur.

[6.8] Spatial disposition produces an error in recognition. When some body lies extremely far from the [visual] axis, there will not be a determinate perception of its form. Accordingly, in such a situation Peter may be judged to be Martin; or a horse may be judged to be an ass, as happens with trees and clothing; or a horse that is known will sometimes be assumed to be [the ass] Brunellus.⁵³ In the case of this indistinct sort of perception, a correct [ascription] may be chosen, or a false one may be. Indeed, if the judgment is indeterminate in this situation, the choice will be fortuitous.

[6.9] This error arises from an immoderate spatial disposition, for if it is restored to moderation, the judgment based on recognition will not be erroneous.

[6.10] By the same token, when a body is slanted to an extreme extent, its tiny parts are not [perceived] distinctly, so in this situation there arises an error [in the judgment] of shape, or color, or size; [in such a situation] in fact, a square may appear circular, and similar errors may arise in the case of size and color.

[6.11] An error in recognition arises from light's falling outside [the range] of moderation. For excessively faint light causes an error [in perception] of the form, so during twilight an error occurs in [the perception of] animals, clothing, or trees—and this error is threefold: according to individual [nature], according to kind, or according to both—and it would not occur in moderate light.

[6.12] Furthermore, when light falls outside the range of moderation that is proportionate to a visible object that faces the eye, the aforementioned error occurs, even when the light is not immoderate in and of itself, as happens in the case of a certain flying creature called "aluerach" in Arabic.⁵⁴ For it can be seen only at night. But just as a fire is not clearly discerned when [it is viewed] in daylight, [that creature] may be taken [in daylight] for a moth, which it resembles. And so an error occurs in the definition of the object on account of immoderate light.

[6.14] Size that falls outside its [range of] moderation causes recognition to err, so sometimes, because of its smallness, an ant is judged to be a fly perched on wheat, and sometimes, for the same reason, a mustard seed is taken for a [seed of] water cress.

[6.16-17] Opacity that falls outside the range of moderation causes error. When a red body is placed against [one side of] a [piece of] glass, and the other side of the glass faces the eye, the viewer will judge the color of

the glass to be red, so there is an error in recognition because [there is an error] in the definition of [what is] colored.

[6.18] An inordinate decrease in the transparency of the air is a cause of error, so an error in [judging] what a thing is occurs when the air is hazy. Likewise, if an object is placed between the eye and some object that is seen, and if the transparency of that body is immoderate with respect to the moderate transparency of the air, as is glass, the color of the facing body will be judged as a mixture of its own color and the color of the glass. And so there is an error in the definition of [what is] colored. By the same token, if a sheer cloth is placed in front of the eye and a body is seen behind that cloth, the color of the body will appear mixed [with that of the cloth].

[6.20] But there arises the question of how the color of a body facing the eye from behind the cloth appears mixed [with that of the cloth] since the colored spots on the body only reach the eye through the interstices in the cloth, whereas the color of the cloth reaches the eye only from the threads, through which the color of the body does not pass.

[6.21] The truth of the matter is that, even though the spots of color on the body reach [the eye] discretely and fall on their [separate] places [on the eye] so as not [actually] to mingle with the colors of the threads, and even though the colors of these threads are separate from those [other] colors both in and outside the eye so that there is no [actual] commingling of them, nonetheless, since the spots upon which the color of the body's surface and the color of the thread strike [the surface of the eye] are extremely close to one another, there being no perceptible separation between them, the [neighboring spots] appear to coalesce, so their colors appear as a perfect blend.

[6.22] If, however, the interstices in the cloth are large, the actual color of the cloth and of the body will be discerned without mingling, but the narrower these interstices become, the more evident the mingling will be. Accordingly, when a body is viewed through wool cloth, the blend of colors will frequently appear to conform to the color of the threads, for the interstices of wool cloth are narrow in and of themselves, and since the threads are covered with hair, the interstices are made even narrower.

[6.23-24] Another example of an error caused by transparency [is encountered] when an entertainer moves wooden silhouettes while their shadows are viewed through cloth, which is usually woven of fine linen, [in which case] birds or animals will appear in conformance with the forms of the silhouettes, but this error in the ascription of what the thing [that is seen] is derives solely from the decrease in the transparency of the air.⁵⁵

[6.25] An interval of time that falls outside [the range] of moderation is a cause of error in recognition. If someone looks through a window at a body that passes by swiftly, he will not apprehend the form of that body clearly, so an error in [perceiving] its individual [nature], its kind, or both

will occur, as [happens] in the case of horses, human beings, and trees. The same thing also happens when there is no window; if someone glimpses something that immediately disappears from sight, he will err in the perception of its form, so there may be an error in [the perception of its] kind, or [of its] individual [nature], or [of] both.⁵⁶ But this error will be due solely to time.

[6.27] Sight by itself causes error. If intense sunlight shines on a bright-green or deep-red color, and sight is turned toward it, it will be disrupted. Then, if the eye looks at something else, the object will appear to be something other than it actually is, or of another color than it actually is, because of the continuing disruption. And several errors occur in a similar way.

[6.29-30] Likewise, in the case of disease in the eyes, a horse may look like an ass, and the aforementioned threefold error occurs in many cases. So it is obvious that the error in recognition is due solely to the fact that the eye is in a disturbed state.

[6.31] Hence, it is clear that there are errors of sight that occur in recognition according to the particular causes of visual error.

[CHAPTER 7]

*The seventh section [deals with] the kinds of visual errors
that occur in deduction according to the particular
causes of visual error.*

[7.1] Many of the things perceived by sight are apprehended through deduction, as was shown in the preceding book, and what [sorts] of things are perceived through deduction have been explained, and [it has been explained] that, on the basis of these things, a composite of particular forms reaches the sense [of sight]. Thus, when an error occurs in any of those things, there will be an error in perception that is based on deduction. Now deductive error is of two kinds, for it will occur either in the premises [of the deduction] or in the way those premises are arranged together. In the case of premises there are three [types of error]: a false premise is taken for a true one; a particular [premise] is taken for a universal one; or there is an error in the correlation of premises. For instance, if there are parts on a visible object that are apparent and parts that are not apparent but still perceptible to sight, when the form of that object is impressed on the eye and those parts [that are not apparent] are not seen, then the final perception [of the object] is based exclusively on those parts of the visible object that are [actually] apprehended. Moreover, when it examines the final perceptions arising from that object, [the visual faculty] bases its conclusions on the

parts that are apparent, for it can only take them into account. However, when a close inspection of that thing reveals the parts that were not apparent before, the visual faculty perceives and recognizes its error. Accordingly, in order to make them clear, I shall list the errors [that pertain to] those things that are perceived through deduction, those things being twenty-two in number. And this listing will be [presented] according to each of the eight previously discussed causes.

[Section 1]

*First [we shall deal with errors that occur]
on account of distance.*

[7.2] Accordingly, I say that when the distance falls outside [the range of] moderation it can cause the viewer to err about distance, as happens when someone looks at trees that are very distant. Even if they are quite far apart from one another, he will see them contiguous to one another or will at any rate judge them to be near one another.⁵⁷

[7.3] For the same reason, it happens that certain stars are assumed to cluster together even though they are very far apart. Accordingly, the planets will be judged by everyone to lie on the same surface as the fixed stars, even though they lie quite far from them. There is thus an error in [the perception of] distance because the distance falls outside [the range of] moderation, and this is an error in deduction since the perception of distance occurs only through deduction.

[7.4] A distance that falls outside [the range of] moderation causes an error in [the perception of] spatial disposition, for from such [an inordinate] distance an inclined body will appear to face the eye directly, and so a square body that is slanted will appear oblong at that distance. By the same token, a circular form will appear oval at that distance if it is inclined, and this error will arise only because the inclination is hidden from sight at such a distance, for if the inclination were apparent, there would be nothing to obscure the actual form of the body. Hence, there is an error in [the perception of] spatial disposition only because of the inordinate distance.

[7.5] The reason that the spatial disposition will not be [properly] apprehended is as follows: The difference in length between [any] one of the rays falling on the side of the square and [any] other [ray] is disproportionate[ly small with respect] to the whole distance of the body from the eye, in terms, that is, of a perceptible ratio; so, on account of the imperceptibility of the difference, no one ray will be judged longer than any other.

[7.6] Thus, the form of the square is deemed to be oblong because the side of the square that is not inclined with respect to the viewer falls on one

area of the eye whereas the form of the side that is inclined falls on a smaller area, because it subtends a smaller angle. But the perception of its smallness will depend on the inclination of the square, and since the inclination is unnoticed, one side will be judged longer than the other because [it is seen] under a smaller angle, which is why the form will appear oblong. For the same reason, in the case of a circular form, one diameter appears longer than the other, so it is deemed to be oval. And this error is the result of inordinate distance and would not arise if the distance were moderate.

[7.7] However, if the distance, though immoderate, is not too great, and the inclination of the body is substantial, then the viewer may take the inclination into account, but not the actual inclination; instead, he will judge it to be less [sharp] than it is. And he will analyze the inclination of the side by the angle under which it is perceived, so the side will appear smaller than it is, and he will thus suppose that the form of the square is oblong, but less oblong than [it appeared] before [when the distance was inordinate].⁵⁸

[7.8] An excessive distance produces an error in [the perception] of corporeity, for [the perception of] corporeity is based on the curvature of the surface, so the notion of corporeity is grasped from the notion of this sort of curvature. Thus, when an error arises in regard to corporeity, it will be in regard to the disposition of the surface or surfaces [of an object], for instance, when the curved surface of a body appears flat at a certain distance, or when a flat [surface] is judged to be curved. And this appearance will involve shape, for shape is the arrangement of the surfaces of a body. The arrangement of surfaces also has to do with spatial disposition, so corporeity is a matter of both shape and spatial disposition. Hence, an error in [regard to] corporeity carries with it an error in [regard to] shape and spatial disposition. But, on the basis of inordinate distance, an error in [regard to] shape [can] happen without an [accompanying] error in [regard to] spatial disposition.

[7.9] For instance, a figure with many equal sides facing the eye directly at an inordinate distance appears circular for no other reason than that the corners of the figure are manifold and [thus] imperceptible to sight. For at that distance the [corner segments, while] nonetheless proportional to the whole figure, are invisible to sight, even though the whole figure is not.

[7.10] The very same type of error [occurs] when a curved line is assumed to be straight at this distance, for the [relative] closeness to the eye of one part of the curved line in comparison to the [relative] remoteness of the other is imperceptible, so the curvature of the parts is not apparent, even though no error may arise in [regard to] the spatial disposition of that line.

[7.11-12] Similarly, when a sphere is seen from such a distance, its surface will be adjudged flat, because its outward bulge is nearer [the eye] than its outer edges by an imperceptible amount at this distance, so the nearness

of [all] portions [of the sphere] is assumed to be equal—hence the [apparent] flatness of its surface, which is how the solar and lunar surfaces are judged by viewers, an erroneous judgment of shape that would be precluded if the distance were moderate.

[7.13] There will be an error in [the perception of] the size of a body on account of inordinate distance, for it will appear much smaller than it actually is.

[7.14] The reason for this, as we said, is that a distance is inordinate if the parts that are sensibly proportionate to the whole are invisible to sight, and when the perceptible parts [of an object] cannot be sensed, the [visual] angles they subtend are not sensed, even if they are proportionate to the whole [visual] angle.

[7.15] Hence, when the [visual] axis scans the visible object, many of its lines and many of its parts are not apparent to it, so the whole is made to appear smaller [than it actually is].

[7.16] Furthermore, the size of any part of a body is gauged only according to the size of the angle it subtends, and the size of the angle depends on the [size of] the area demarcated on the eye [by the visual cone]. But the size of the area that is demarcated [by the visual cone] is judged exclusively on the basis of the two terminal spots [defining] that area, and those spots are sensible and proportionate [in size] to the area that is demarcated [by the visual cone], because from such a distance the visible object is judged according to limits that are proportionate to the whole of the visible object. Otherwise, in fact, those limits would not be sensible. Now the limits of the area demarcated [by the visual cone on the eye] lie in a direct line with the limits of the areas on the visible object that are proportionate to them. Hence, the terminal spots of the area that is demarcated [by the visual cone on the eye] block out sensible areas on the visible object [that are in line with them]. Therefore, as the axis touches on specific parts among the individual portions of the object, it fails to sense [some] parts that are [proportionately] sensible, and so the whole visible object appears smaller [than it actually is]. But when a body is seen at a moderate distance, the terminal spots of the area that is cut off [by the visual cone on the eye] are tiny and imperceptible relative to that area [as a whole]. Indeed, the judgment of the viewer culls out the imperceptible limits in the visible object [when it is seen] at a moderate distance, so no areas that are proportionate to the whole are invisible, which is why the body does not appear to be smaller than it actually is.⁵⁹ Furthermore, as has been said above, size is apprehended in a body only by collating distance and [visual] angle.⁶⁰ And it has already been said that, at an inordinate distance, the angle appears smaller because it actually is smaller, but there is no discernment of distance.

[7.17] In fact, it was shown above that a moderate distance is perceived

on the basis of intervening bodies, whereas at an inordinate distance [this basis for judgment] does not apply at all.⁶¹ Therefore, when the distance of the visible object is undetermined, it may be assimilated [by the faculty of discrimination] to a determinate distance. And the viewer will judge the object to be smaller [than it actually is] because he will suppose the [visual] angle and the distance to be smaller than they actually are, so [there will be] an error [in the perception of] the size of the body. And as the distance increases, the error is reinforced until the distance can become so great that a body will be judged to be the size of a point, and if the distance is further increased, that body will disappear from view.

[7.19] Likewise, a body can become invisible at a moderate distance, not because of the distance itself but because of the faintness of the body's color. And it is clear that visibility is lost in the case of faint coloring, for if the body [that cannot be seen because of its faint color] is replaced at the same distance by an intensely colored body of the same size, this [latter body] will not be invisible to sight as [was] the faintly colored body, so sometimes it is not distance or smallness but, rather, weak color by itself that causes a body to become invisible.

[7.20] Furthermore, a body may happen to lose visibility because of the similarity between its color and the color of bodies that lie between it and the eye, and this [can happen] at a moderate distance. Accordingly, when snow blankets the intervening ground, a white body lying at a distance will not be discerned, but the distant snow is perceived. And it is obvious that the body will be lost to sight because of the sameness of color, for if the [white] body is replaced at the same distance by an equivalent body of a different color, this [latter body] will not be invisible.

[7.21] Hence, when any object facing the eye fails to be perceived, the reason for its invisibility may be that the distance over which the form is radiated is inordinate [so that the form is projected] upon an imperceptible spot on the eye, or upon a spot that amounts to a point. If, however, the form is projected upon a perceptible spot on the eye, it may escape notice because of a weak color or because the colors of the visible object and the colors of intervening objects are similar.

[7.22] Furthermore, an error [in perceiving] the size of a visible object can occur at a moderate distance. For if some body is seen at a moderate distance, tiny parts of it will disappear from sight, but those parts would be seen at a shorter distance, although perhaps not clearly, and if the distance is increased somewhat, they will be seen even less clearly. And as the distance increases, the clarity of perception decreases until the parts disappear from sight, even though the distance may not fall outside [the range] of moderation.

[7.23] Likewise, at an inordinate distance a certain portion [of the ob-

ject] is perceived clearly while certain of its tiny parts are invisible, for the distance of the object has fallen outside [the range of] moderation in relation to those parts, even though it has not done so with respect to the whole body or the portion of it that is perceived. Moreover, even though the distance may be known to the viewer, the error in perceiving the size of the parts still occurs because the size of the [visual] angle under which a [given] part is perceived is judged to be less extensive than it actually is. And the reason the angle appears smaller is that the terminal spots of the area that [the forms of] the parts demarcated on the [surface of the] eye are invisible, so the extent of the angle is shrunk [by that much].⁶² Therefore, when the [size of] the visible object is inordinate[ly small] with respect to the given [moderate] distance, an error in [the perception of] its size will arise on the basis of two things: the smallness of the [visual] angle and the indeterminate [measure of its] distance. At an inordinate distance, however, the error in [the perception of] the size of the tiny parts will be due to an error [in the perception of the size] of the angle only. These, then, are the reasons why a body is judged to be smaller than it is at a moderate distance.

[7.24] An inordinate distance sometimes causes an error [that leads to an exaggerated perception] of size, so that at an inordinate distance (i.e., one that is too small), when the body that is seen lies very near the eye, the body will appear larger than it does at a moderate distance and larger than it actually is.

[7.25] And this happens for two reasons, for, as has been said, the intellect gauges both the distance and the [visual] angle, and on that basis it deduces the size of the body, but at this [very close] distance the [visual] angle is quite large.⁶³ Meanwhile, the distance of the body is gauged exclusively from the surface of the eye to the surface of the body, for the distance extending from the visible body to the interior of the eye cannot be taken into account in the judgment of sight, because the interior part of the eye is not affected by the rays, nor does sight try to measure it. Thus, sight carries out its deduction on the basis of the extent of the angle and the determination of distance. Now the actual distance of the body is measured by the line extending from the center of the eye to the body, since the [visual] angle is gauged from the center [of the eye]. And when the body lies at a moderate distance, the radius of the eye, which is the amount by which the actual distance of the body exceeds its apparent distance, is imperceptible in relation to the overall distance of the body, so it does not produce an error in the judgment of distance. But when the body is near the eye, the radius will have a sensible size in relation to the body's distance. Accordingly, it may be greater than, equal to, or less than [the distance between the object and the eye's surface], but it will be proportionate to some extent, e.g., half as large or some such; hence, when the visible object lies near the eye, the

increase in the angle of the visual cone along with the perceptible discrepancy between estimated and actual distance leads to the perception that the object is larger [than it actually is].

[7.26] An inordinate distance produces an error [in the perception] of disjunction. Accordingly, if a wall is looked at from afar, and there is some dark color on a portion of it, the viewer will be convinced that this color represents a division between segments, so, on the basis of this error, something that is continuous is taken to be disjoined. Likewise, if tall plants are growing near that wall, the [visible] portions [of the wall] interspersed between the parts [of the wall] occluded by the facing plants will appear to be separated, so the wall will not be judged as continuous.

[7.27] By the same token, when sunlight that is not particularly intense shines on a wall, if some object casts a shadow upon the wall, the same error occurs in [the judgment] that there is a disjunction of segments that [actually] have no intermediate [gaps].

[7.28] It is therefore clear that the error [in perceiving] disjunction is an error of deduction caused by inordinate distance.

[7.29] A distance that falls outside [the range of] moderation is the cause of an error [in perceiving] continuity. For bodies of a similar color that abut one another and are seen from afar are taken to be continuous. Hence, the planks of a wall or bench may happen to appear continuous, even though they are slightly separated, i.e., by disjunction. And this happens when the visible object lies at a moderate distance that is nonetheless inordinate as far as the perception of such a tiny separation is concerned.

[7.30] Thus, on the basis of this error [which stems] from [inordinate] distance, something that is disjoined is taken to be continuous.

[7.31] Moreover, since the perception of number entails a consideration of continuity and discontinuity, an error in [the perception of] number occurs when discrete objects appear as a unity or a single object presents the appearance of being [divided up into] more than one object.

[7.32] Inordinate distance creates an error [in the perception] of motion. For if someone looks toward the moon, or the sun, or some star while he moves briskly [toward it], he notices that the moon gets no closer to him than [it was] at the beginning of his motion. He concludes that it is moving in the same direction [as he] and [therefore] it is [continually] receding from him, and from this [he concludes] that it maintains a constant distance [from him]. And this happens as the moon also hastens in the same direction. The reason for such an error is that the viewer knows that down here, when two bodies are set up so that one moves in a given direction, if each maintains the same spatial disposition with respect to the other, it follows necessarily that the other one [appears] to move in the opposite direction at an equal velocity.⁶⁴

[7.33] Thus, since in the case of celestial bodies the change of the moving viewer's spatial disposition with respect to the moving star is not perceived, the motion [of the star] is unconsciously deduced on the basis of premises that are already known by the soul. So the change in his spatial disposition with respect to the star is imperceptible to the moving viewer, because the path he follows in the course of moving is disproportionate in size to the star itself, [which makes it] all the more [evident that] the difference between his distance from the star at the beginning [of his motion] and his distance from the star at the end [of his motion] is imperceptible with respect to his overall distance [from the star]. The same error occurs in the case of the movement of clouds, for it is the moon that is believed to be moving swiftly, even though it is not, but we have explained this above.⁶⁵

[7.34] A distance that falls outside [the range of] moderation produces an error [in the perception] of rest. If someone who is seen from afar does not move swiftly, he will be judged to be at rest, which is why we take the planets to be immobile, even though they move quickly.

[7.35] And this judgment that the planets are immobile is due to the fact that the paths they follow, even during a substantial time-period, are not perceptible to sight at such a [great] distance, so, since they continue to maintain the same spatial disposition with respect to the observer, they are judged to be immobile.

[7.36] In the same way, if some body [seen] from afar moves along the line-of-sight, either approaching or receding from the eye, it will be judged to be at rest unless its motion is extremely swift. And, as was shown above, this error arises because the motion of a body is not perceived unless at one moment it is seen [in conjunction] with one body and at another moment [in conjunction] with another body.⁶⁶ In this case, however, such a perception is precluded, because the path that the moving object follows along the line-of-sight is imperceptible at such an [inordinate] distance.

[7.39] An excessive distance produces an error [in the perception of] roughness. Accordingly, the hair of someone who is depicted in a painting that is viewed at an inordinate distance is judged to have texture because that texture is represented by the painting. Since it is known that real hair has texture, the soul concludes by resemblance that there is texture in the painted hairs according to the way their form is represented. The same error occurs in the case of clothing with designs and with the hair of animals that are represented in paintings.⁶⁷

[7.42] In all these cases, however, instead of actual texture there is utter smoothness; and even though light is reflected from smooth bodies rather than from rough ones, still, [the fact that] light may be seen to reflect from [the surfaces of] paintings does not obviate the conclusion that [the depicted hair has] texture. For to whoever reaches that conclusion it is unquestion-

able that roughness and reflectivity can coexist in the same body, as happens in the case of human hair that is pitch-black and luxuriant, for it reflects light even though it has texture.

[7.43] Hence, on the basis of this similarity there arises an error in the judgment of texture in the painting because of the inordinate distance in relation to the object that is painted. For the smoothness of a painting cannot be perceived unless it is quite distinct; hence, a moderate distance with respect to other things is inordinate with respect to the apprehension of smoothness.

[7.44] On the basis of inordinate distance an error occurs in [the perception of] smoothness. For if a body that is somewhat rough faces the eye from a considerable distance, it will be judged as smooth, for the roughness of a body is apprehended only through variations in the relative spatial disposition of the [object's] parts or the light of prominent portions and the shadow of depressed portions, as was explained above.⁶⁸ But from such a distance variations in the [relative] spatial disposition of the [object's] parts or the casting of shadows upon depressed portions by prominent ones is not apprehended, so the object is judged as smooth.

[7.46] Because of inordinate distance, an error [in the perception] of transparency arises. When a needle or something very thin is stood right in front of the eye, although that needle may appear larger than it [actually] is to sight, it still does not occlude any portion of a wall or other object beyond it. Since the perception of transparency in a body is based on the fact that we can see something behind it, then, transparency will be imputed to a needle, or to anything like it, that is stood [right in front of the eye], because the entire wall can be seen behind it. The reason that the needle appears larger [than it actually is] when placed near the eye has been explained above.⁶⁹ The reason it blocks none of the wall beyond it from view at such a close position is that, as far as the needle's [capacity] to block vision is concerned, such a tiny distance is inordinate. For if the needle is brought a little farther away from the eye, a portion of the wall that is larger than the needle itself will be blocked from view.

[7.47] But the reason for this phenomenon will be explained more fully later.⁷⁰

[7.48] An error in [the perception of] opacity occurs on the basis of excessive distance. If someone looks at a transparent body from afar, and a colored body or something dark is placed behind it, that body will not be judged as transparent, but as opaque. And this error stems from the fact that [sight] perceives no other body behind that body. Since it is in the nature of a transparent object that an opaque object can be seen behind it, it will be concluded that the body is not transparent but opaque.

[7.50] On the basis of excessive distance an error in [the perception] of

shadow arises. If a white body with a dark area faces the eye at such an [inordinate] distance, and if sunlight shines upon that body, there will seem to be a shadow on the dark area of the object.

[7.51] Moreover, if another body is seen near that one, it will be concluded on the basis of longstanding habit that the apparent shadow is cast by the other body. And it is obvious that this error is due to an excessive distance.

[7.52] An error [in the perception] of darkness is induced by excessive distance. If a white body with a pitch-black section is seen from afar, that section may be judged to consist of darkness, so it will be concluded that right where that section lies there is a hole in the body through which the darkness behind [the surface of] that body seems to show.

[7.54] A distance that exceeds the limits of moderation causes an error [in the perception] of beauty or ugliness. If something is looked at from afar, and if there are small blemishes in it that deform it, it is judged beautiful because those blemishes are rendered invisible by the distance. For the final perception [of beauty] is reached on the basis of appearances alone, and since the blemishes are invisible, the parts really do appear beautiful.

[7.56] Similarly, if an object with designs on it that render it beautiful is seen from afar, and if those designs are tiny with respect to the object as a whole, then, since the features that confer beauty on the object are invisible to sight, that object will be judged ugly, because the [viewer] who is judging [the object] bases his judgment exclusively on appearances.

[7.58] An error in [the perception of] similarity or dissimilarity among objects arises from an excessive distance. If the eyes are directed toward bodies of a similar color that lie far away, and if there are tiny marks or lines drawn on them that are dissimilar and varied, then, if sight fails to notice [those features], the bodies will be judged to be similar overall.

[7.60] On the other hand, if the colors of the bodies are altogether different, but there are identical tiny marks on them, then they will be judged to be dissimilar overall. And this error will arise because the conclusion will be drawn on the basis of appearances only.

[Section 2]

When spatial disposition falls outside the range of moderation it produces an error in [the perception of] any of the things perceived through deduction.

[7.63] In [regard to] distance, if two bodies are seen, one of them being directly behind the other so that the one occludes part of the other, and part of the rear body juts out, and if the distance is moderate but not quite deter-

minate, and if there are no other bodies between them, then the measure of the distance of one from the other will not be gauged clearly, and the observer may judge them to be very near one another.⁷¹

[7.64] This error involves deduction, because distance is deductively perceived on the basis of spatial disposition alone, for, if part of one of the bodies were not occluded by the other, but, rather, both were completely exposed to view so that the gap between them fell not on the same ray but on different rays, then the distance of one from the other would be discerned. And this error is due entirely to an inordinate spatial disposition, for if the spatial disposition is restored to moderation while everything else remains the same, the error does not arise.

[7.65] An inordinate spatial disposition causes an error in the visual perception of spatial disposition. When the visual axis meets a body that faces the eye at a moderate distance, if another body that is far removed from the axis and somewhat inclined to the imaginary line to which the [visual] axis falls orthogonally is taken, then the viewer does not perceive the inclination of that body because its spatial disposition has fallen outside [the range of] moderation. For bodies that lie far away from the [visual] axis are not clearly perceived, so in the case of this error something that is inclined will be judged to face the eye directly.

[7.67] In [regard to] shape, an error occurs on account of [an inordinate] spatial disposition. If a round body, such as a goblet or bowl, is situated far away from the [visual] axis and somewhat inclined to the imaginary line we [just] mentioned, then, because its inclination is imperceptible, and because one of its diameters is perceived under a greater [visual] angle than the other diameter, for whatever is seen from a facing disposition subtends a larger [visual] angle than it does when it is inclined, and because there is a marked difference in size between the angles, the facing diameter is judged to be longer than the inclined one, so the round body will be judged to have an oval shape.

[7.68] Through the same error a square figure will be judged to be rectangular, since the side of it facing the eye directly appears longer than the side that is inclined.

[7.70] And this is an error in deduction, for it depends on premises that are false—i.e., that neither of the sides is inclined; that, if they subtend unequal [visual] angles, things seen at the same distance according to the same spatial disposition are [invariably] unequal in size; and that when one side is unequal to the other, the form of the object is [invariably] oblong—so the shape is interpreted incorrectly, not as it actually is. For the same reason it is clear that there is an error in [the perception of] size if one diameter of a circular body appears longer than another diameter of the same body, since they are actually equal.

[7.71] Another way, moreover, in which an error in [the perception of] size arises exclusively from an inordinate spatial disposition comes about when someone who is high up looks down on objects of equal size that are placed in a row, one after the other [away from the viewer, for in that case] the ray that falls on the first of these objects will certainly be lower [with respect to the center of sight] than the ray falling on the second. And the height of the rays falling on any of those objects will depend on how far that object lies from the first in line, so the ray falling on the last object in line will be higher than a ray falling on any other of those objects. Accordingly, the last object will be judged by the observer to be taller than all the rest, provided, that is, that the ground lying between any of the two objects is invisible to sight so that the altitude of the person [who is observing from on high] cannot be measured relative to the ground that appears.

[7.72] And this will be an error in deduction, because the observer errs according to the presupposition that whatever appears higher is taller, which applies in most, but not all, cases.

[7.73] And this error is due to an inordinate spatial disposition in regard to the perception of the size of an object set up in this way, for if the ray falling on the first object were parallel to the ground, and if the same ray were to fall on something else as it continued outward, there would be no basis for this error.

[7.75] An error regarding disjunction arises from an inordinate spatial disposition. If the inclination of some body with respect to the rays is great, and there are perceptible black or very dark areas on it, they may be taken to be interstices, and so it will be assumed that there is a disjunction between the parts bounded by [any] such darkened area, even though there is continuity at this point. Moreover, if dark lines are perceptible on this body, the parts on each side will be judged to be disjoined when they are continuous, and so an error arises on the basis of the body's inclination.

[7.77] There will be an error in [the perception of] continuity on the basis of [an inordinate] spatial disposition. If several walls are positioned facing the eye so that one lines up behind another at a slight distance from it, and if all of them lie along the same line-of-sight, the interval between them may be hidden from the viewer.⁷²

[7.78] In that case they will be judged to be continuous when they are disjoined, an error that would not arise if the spatial disposition of the walls were changed so that they were not perceived by the same ray.

[7.79] An error in [the perception of] number is prompted by an inordinate spatial disposition when some object is seen double, and this occurs when there is a difference in the body's spatial disposition with respect to the two eyes. So, too, as was explained above, a single body will be judged double when that body falls between the two [visual] axes.⁷³

[7.80] And this is an error in deduction, for the viewer supposes that he has seen different bodies outside. When the form reaches to different locations inside the eyes, the viewer concludes on this basis that what is actually identical is different.

[7.81] An error in [the perception of] motion arises from [an inordinate] spatial disposition, as [happens] when someone looks out from a boat floating with the current on a river, [for in that case] if there are trees on the riverbank that lie far to the side of the [visual] axis, they will be judged to be moving.⁷⁴

[7.82] But if the [visual] axes are focused directly upon those trees, they will appear immobile.

[7.83] An error in [the perception of] rest arises from [an inordinate] spatial disposition. If some object is seen far to the side of the [visual] axis, and if that entire object revolves swiftly, it will appear motionless.

[7.84] So it is obvious that this error involves spatial disposition, for, if the spatial disposition were restored [to moderation], the body's motion would be perceived, so the error is due solely to an inordinate spatial disposition.

[7.85] [An inordinate] spatial disposition causes an error in [the perception of] roughness. If light reflects from a painting that represents hair, but the eye does not lie where the reflection occurs, there will be a perception of roughness in the painted hair when there is only smoothness there.

[7.86] And this error is due solely to an inordinate spatial disposition, for when the eye is placed in line with the reflected light, no roughness is perceived in the body that is seen.

[7.87] An error in [the perception of] smoothness will be due to [an inordinate] spatial disposition. If something that lies far to the side of the [visual] axis is slightly rough, it will appear smooth.

[7.88] If the spatial disposition were returned to moderation, the viewer would be able to perceive its roughness.

[7.89] In [the perception] of transparency or opacity an error will occur on the basis of an inordinate spatial disposition. If light shines at a slant on a glass that is full of wine, and if sight fails to see the light pass through the glass, then, if the inclination of the glass with respect to the rays is extreme, and the observer fails to see that there is wine in the glass, the wine will be judged by the observer to be an opaque body that is continuous with the glass. But this error does not occur when the passage of light through the glass is evident, so this error in regard to transparency and opacity is due to [an inordinate] spatial disposition.

[7.92] In [regard to] shadow and darkness: if some object lies far to the side of the [visual] axis, and if it has a dark section on it, that section may be taken for shadow, and if there is some body nearby, it will be assumed that

the shadow is cast by it.

[7.94-95] However, if there is an intensely black area on that body, that black area may be taken for a hole through which the darkness [inside the body] shows through, but this will not occur if the body is placed according to a moderate spatial disposition.

[7.96] Furthermore, in [the perception of] beauty and ugliness an error occurs on the basis of [an inordinate] spatial disposition. When some body lies far to the side of the [visual] axis, and there are tiny blemishes in it that disfigure it, they will be invisible, and the body will be judged to possess beauty, so in this situation a freckled face appears beautiful. Likewise, in this situation the shadow inherent in the moon is invisible, so when it is viewed in such a way [perfect] beauty is attributed to the moon.⁷⁵

[7.98] On the other hand, if there are designs on the object that render it beautiful, and if the object is beautiful only when these designs are apparent, then, since they are invisible in this situation, the object will be judged to be ugly.

[7.99] And this error involves deduction, because the conclusion that something is ugly or beautiful depends entirely on appearance.

[7.100] In [the perception of] similarity and dissimilarity an error arises on the basis of [an inordinate] spatial disposition. If two objects are set up far to the side of the [visual] axis [and if they are] of the same kind, color, and shape but possess some small features that are dissimilar, they will be judged to be perfectly identical since those features have escaped the viewer's notice.

[7.102] On the other hand, if those objects are not of the same kind, color, or figure but possess some identical features, they will be judged to be wholly dissimilar, since there is some dissimilarity between them. Accordingly, the error in [perceiving] similarity and dissimilarity is due to the fact that the final judgment [of similarity or dissimilarity] is based solely on appearances.

[7.103] In all of the foregoing cases the error arises exclusively from an inordinate spatial disposition, for if the spatial disposition falls within [the range of] moderation, all other things remaining as they are, the erroneous judgment will not occur.

[Section 3]

*Light exceeds the limits of moderation, and on this basis
alone an error is produced in [the perception of]
everything that is apprehended through
deduction.*

[7.104] In [the perception of] distance [an error arises] from a deficiency

of light. If people are arranged in a line, one after another, at a moderate distance and not too near one another, then, if sight is directed toward them at night while they are so disposed, they will appear to coalesce because the separation between them is imperceptible on account of the deficiency of light, although that separation would be evident in strong light. And if these people move in the same direction at the same velocity, they will invariably be judged to move as one.

[7.106] In [regard to] spatial disposition: If something faces the eye at a slight inclination at night, when it is not too dark, the object will be judged to face the eye directly because of the inordinate weakness of the light.

[7.107] Likewise, a figure with several equal sides will appear circular when viewed at night, for the excessive weakness of the light hides the corners [from sight].

[7.108] By the same token, a sphere viewed under these circumstances is taken to have a flat surface, because its outward bulge is hidden from sight.

[7.110-111] In [regard to] size: If a person is viewed at night, and a grove of trees or a wall that is far away from him is seen, the person will appear to be near the grove or the wall, since sight fails to perceive their distance from each other, even though it is considerable. Moreover, the same ray may pass over the head of the person to the top of the grove according to how far away the grove is, and in this case they will appear to be of the same height, or else the person may appear taller. This would not happen if the light were moderately intense, for the distance between the person and the grove would be discerned, and the height of each would be gauged according to the [intervening] ground that is perceived.

[7.112] An error in [the perception of] disjunction, number, and continuity will arise from an insufficiency of light. If a plank with dark lines drawn on it along its full length is seen at night, an observer may assume that these lines represent junctures or gaps; and so there will be an error in [perceiving] disjunction, because something that is continuous appears disjoined, and [there will also be an error] in [perceiving] number, because something that is single will be taken to be multiple.

[7.114] Likewise, when the eye is placed where strong light is reflected, if it looks at bodies that are somewhat distant, they will appear continuous; so there is an error in [the perception of] continuity on account of light that exceeds limits, whether of intensity or of weakness.

[7.116] In [regard to] motion or rest an error occurs in light [that falls outside the range of moderation]. If a person and a grove of trees that is far away from him are perceived at night, the distance between the person and the grove will be imperceptible. But if the observer moves toward the person, the closer he gets to him the more determinate that distance will ap-

pear, so, as before, the person who is seen will appear conjoined with the grove. But the closer the viewer gets to that person, the farther away from the grove the person appears to get, and since the viewer is certain that the grove remains immobile, he will deduce that the person who is seen is moving away from the grove, even though he is actually immobile, but this error would not occur in moderate light.

[7.117] In [regard to] rest: A person who is seen at night is not clearly perceived, so if he moves slowly, his motion will not be discerned, and he will be judged to be immobile.

[7.118] In [regard to] roughness or smoothness an error will occur [on the basis of light that falls out of the range of moderation]. For a rough object that is seen at night may be judged to be smooth, or vice versa, depending on the nature of the visible object.

[7.119] In [regard to] transparency or opacity: At night the transparency of a body that is highly transparent will be judged to have decreased, for, since an opaque object cannot be clearly perceived behind it, the viewer will judge that its lessened transparency prevents sight from seeing through it. An object that is [only] somewhat transparent will in fact be judged to be opaque.

[7.121] In [regard to] shadow or darkness: If there are dark areas on a white wall, and candlelight shines on that wall, an observer may judge such dark areas to be shadows, and it may appear to him that the shadow he sees is projected by a neighboring wall; and so [there is] an error in the judgment of shadow.

[7.122] Likewise, if there is a pitch-black area on the wall, it may be judged as the space of an opening through which the [inner] darkness [of the wall] shows forth. And if the entire surface of the wall is tinged with a pitch-black color, the entire wall may be taken for darkness, as happens in the case of a wall that is covered with soot when it is seen in faint light.

[7.124] In [regard to] beauty and ugliness: It is clear that a face appears beautiful at night, even if there are blemishes, such as freckles, in it.

[7.125] And if there are subtle designs in the visible object that are entirely responsible for its beauty, then, since they are invisible to sight at night, the object will appear ugly.

[7.127] In [regard] to similarity and dissimilarity: In the case of objects of the same kind, color, and shape, when differences among certain of their features are rendered invisible in faint light, those objects will be judged altogether alike.

[7.128] If, however, the objects are different in kind, color, and shape but share certain features, then, since those features are imperceptible because of the decreased light, the objects will be judged to be altogether dissimilar.

[7.130] So it is clear in all the foregoing cases that the error arises from

the weakness of light alone, for if the light fell within the limits of moderation, the error would not occur, assuming that everything else remained the same.

[Section 4]

Size falls outside the range of moderation, and when it does it produces an error in [the perception] of everything that deduction leads us to conclude.

[7.131] An error in [the perception of] distance will arise for the reason just given. If two people are seen from a moderate distance, but that distance extends to the limit of moderation, and if one of the people stands a little in front of the other, the gap between them will not be discerned, so one will appear to be right next to the other. And the error arises from the fact that, since the distance between them is quite small, it is not proportional to their overall distance from the eye, even though that [overall] distance is moderate.

[7.133] Furthermore, it constitutes an error in [the perception of] distance because those people will be judged by sight to be equidistant [from the eye], and thus one distance [is judged] greater than it actually is, so there is an error in [the perception of] distance.

[7.134-135] There is an error in [the perception of] spatial disposition on the basis of smallness. For if a mustard seed is inclined with respect to the eye, it will still appear to face it directly, because the slant of this seed with respect to the imaginary line to which the common axis falls orthogonally cannot be grasped on account of the seed's inordinate smallness. The reason is that the [difference in] distance between this line and the endpoints of the seed is not discerned, because it is miniscule, but it is according to this [difference in] distance that its inclination with respect to that [imaginary] line is gauged. And it is according to this line that the inclination of a visible object is always gauged in relation to the two eyes, so there is an error in [the perception of] spatial disposition on the basis of an inordinate[ly small] size.

[7.137] In [regard to] shape: When the visible object is extremely small, and there are corners on it, those corners will be invisible to sight, so that, even though it is not actually [round], its form may be judged to be round or oblong.

[7.138] And if there is some slight curvature to it, that curvature will be imperceptible to sight, so its surface will be judged to be flat; hence, there is clearly an error in [the perception of] shape.

[7.140] In [regard to the perception of] size, [an inordinate] size induces an error. If two objects are set before the eyes, one slightly larger than the

other in length alone or in breadth, they may be judged to be identical in every dimension. And this error arises because the excess of one dimension over the other has passed the limits of moderation with respect to sight since that excess is imperceptible to sight by virtue of its inordinate smallness. Thus, in order for the sizes of objects to be correctly determined, these measurements are necessary, because size cannot be apprehended with certainty by sight [under such conditions].

[7.142] In [the perception of] disjunction an error occurs [if the size is inordinate]. If a hair is stuck on a glass, there will appear to be a disjunction or crack in the glass when, in reality, there is absolute continuity in it. And this error arises from the thinness of the hair, for, if something thick[er] were to adhere to it, the glass would not be judged to be cracked.

[7.143] In [regard to] continuity: If thin sheets of parchment that are of equal length are stacked tightly together, and if the viewer does not know that it is a stack of sheets, he will assume that it forms a single, continuous body. And the reason for this error is that the size of the gaps between the sheets is not perceived by the viewer because of their smallness. Moreover, the same thing that causes an error in [the perception of] continuity will cause an error in [the perception of] number.

[7.145] In [regard to] motion: If two things move, and one of them moves a bit more quickly than the other, an observer will judge their speeds to be equal, because the excess of one over the other is imperceptible to the observer.

[7.146] Similarly, the difference in size between the path that one follows and the path that the other follows is imperceptible to sight, so both the paths and the speeds are judged to be equal.

[7.147] In [regard to] rest: When a very small animal is presented to sight, one of its members may move, but the animal will be judged to be motionless, because the member's movement is invisible to sight.

[7.149] In [regard to] roughness and smoothness: Indeed, when a very small object is seen, it may be judged to be smooth where it is rough, and vice-versa. For, as has been said, roughness is perceived in an object only through the shadow cast by certain parts on others, or the protrusion of such parts and the depression of others,⁷⁶ all of which escapes the viewer's scrutiny on account of the inordinate smallness of the body.

[7.151] In [regard to] transparency and opacity: If someone looks at a very small, polished object, like a pearl, from which light can reflect, he will judge it to be transparent when it is not.

[7.152] By the same token, when a very small, transparent object is seen, it may seem to be opaque because no opaque body is perceived behind it.

[7.154] In [regard to] shadow and darkness: If there are separate spots of a pitch-black color on a white wall facing the eye, and if it is exposed to

sunlight that falls directly on the wall, or nearly so, then the individual spots will be judged by the viewer to be individual holes behind which darkness shows forth, so there is an error with regard to the judgment of darkness on account solely of the smallness of the spots, and that error would not occur if the blackness, no matter how intense, were to be painted on a sizeable portion of the wall.

[7.155] On the other hand, if the blackness in these spots is not so intense, those spots will be judged to be openings filled with shadow, since light will not penetrate into them, as often happens when light shines on a surface with many openings in it, so there is an error in [the perception of] shadow on the basis solely of the smallness of the spots.

[7.156-157] In [regard to] beauty and ugliness: When blemishes that disfigure an object are invisible to sight because of their smallness, an erroneous judgment of beauty occurs, for it is based on appearances only, as is an error in the perception of ugliness, [which arises] if the designs that render a visible object beautiful are invisible.

[7.159-160] In [regard to] similarity and dissimilarity: When tiny features are the cause of the similarity or dissimilarity between any objects, because those features are unseen on account of their smallness, the bodies will be judged similar or dissimilar in all respects. And this judgment will be based on appearances alone.

[7.162] In all the foregoing cases the error in deduction is based on the smallness of the body; if the size is moderate, all other things being equal, the error does not occur.

[Section 5]

*Opacity sometimes falls outside [the range] of moderation
and induces an error in [the perception of] any of the
things that are perceived through deduction.*

[7.163] In [regard to] distance: If the opacity of a body is minimal so that it is exquisitely transparent, like pure crystal, and if some intensely luminous body lies behind it, the crystal is not clearly perceived; rather, the [other] body will be perceived through it as if there were no intermediate body [between it and the eye]. Therefore, since the transparent body is apprehended as if it did not exist, there will not be a clear perception of its distance on that basis, so there is an error [in the perception of] distance, whereby, if the transparent body is disposed at a slant, its inclination will be invisible to the viewer, and it may be judged to face the eye directly, so there is an error in [the perception of] spatial disposition as well as in [the perception of] distance, for one of its extremities will be judged to lie the same distance [from the eye] as the other, although they lie at different distances.⁷⁷

[7.164-165] Moreover, since the size of the object is perceived on the basis of distance and the extent of the angle under which it is seen, when the distance is unknown, an error in [the perception of] size occurs. In a similar way, an error in [the perception of] shape arises, for if a body has corners, they will be invisible to the viewer, so a six-cornered figure⁷⁸ will be taken for a sphere. And if there is a slight curvature in the body, that curvature will be unseen, and the body will be judged to be flat.

[7.166-169] In [regard to] disjunction: If a black line is drawn the length of a body, the body will indeed appear to be divided where the line is, so it is judged to be more than one [body]. If, on the other hand, there are two such bodies slightly separated from one another, they will be judged to be continuous, so there is an error in [the perception of] continuity. And it is evident that on this basis there will be an error in the perception of number, since one thing appears to be several, and several appear to be one.

[7.170] There will be an error in [the perception of] motion on the basis of inordinate transparency. If an exquisitely transparent body, such as crystal, is placed before an opening, and if the edges of this body are invisible to sight, then, if some other object moves behind this body, an observer will judge the transparent body to be moving when it is actually motionless, but this would not happen if the body were moderately opaque.⁷⁹

[7.171] An error in [the perception of] rest will occur on the basis of the same inordinate [transparency]. If an exquisitely transparent object is held snugly in the hand, and if it recedes from the hand or is rotated inside it⁸⁰ while the hand remains immobile, provided that it appears distinct from the hand, the body will be judged to be motionless. For its motion cannot be perceived unless each of its parts changes its spatial disposition with respect to the hand or with respect to part of it, but since its parts are completely identical or seem to be according to its transparency, the spatial disposition of none of its parts can be discerned, nor on that account can its motion.

[7.173] In [regard to] roughness: If a highly transparent body has some roughness, but not too much, it may be judged to be smooth. On the other hand, if it is smooth, but a rough object or an object of various colors is placed behind it, the transparent body will be judged to be rough, so there will be an error in [the perception of] smoothness.

[7.175] In [regard to] transparency: If a body that is not very transparent but intensely colored lies behind an exquisitely transparent body, the body in front will not appear very transparent; instead, its transparency will be judged according to the transparency of the body placed behind it, so a glass placed behind another glass does not appear as transparent as it does when it is exposed to sight on its own, so there is an error in [the perception of] transparency.

[7.176] If an opaque object is placed behind the first transparent body, though, the first body will be judged to be opaque, so there will be an error in [the perception of] opacity. By the same token, when a highly transparent glass contains wine, if neither light nor some other body is perceived behind it, the glass may be judged to form an opaque body along with the wine.

[7.178-179] In [regard to] shadow an error will arise on the basis of [inordinate] transparency. If sunlight streams into a room through some opening and shines on a glass window [that opens into a second, interior room], and if that [interior] room is still shadowy, that shadow will appear [to lie] on the window, even though light actually shines on it, but this light would certainly be perceived if the window were opaque, because it would not pass through, and it would thus be seen [to shine] on a solid body, so there will be an error in [the perception of] shadow.

[7.180] In [regard to] darkness: If sunlight does not shine on the water of a river, or on the sea, as happens in [the early] morning or evening, and if the water is clear, it will appear dark. And the clearer the water is, the darker it will be judged to be.

[7.182] And this happens because the upper stratum of the water casts shadow on the stratum just below, and that stratum casts shadow on the one just below it, and so on in order to the bottom.

[7.183] And even though the shadow in any of the individual strata is minimal, taken as a whole they form an intense shadow, as clearly happens in the color of wine. For the color in a tiny amount of wine is faint, but when such amounts are multiplied, even though they are the same in kind, the color deepens. Moreover, the reason there seems to be darkness in a clear sea when shadow is cast upon it is that extreme clarity produces transparency, so it can be seen through to a considerable depth. Accordingly, many of the strata that cast shadows can be seen, and in the aggregate these shadows, when perceived, lead to the conclusion that there is darkness [in the water].

[7.184] On the other hand, if the sea is roiled [and muddy], then sight will penetrate only a little because of the water's diminished transparency, and it will perceive [only] a narrow stratum of the water. And even though it casts shadow, since that shadow is attenuated, the color of that stratum overcomes the shadow, for in muddy water the color is apparent, whereas in clear water there is none. Hence, according to both the color that is seen in the muddy water and the attenuated shadow that is seen in the [narrow] stratum [through which sight penetrates], darkness is not perceived in the water, so roiled water will appear clear, whereas clear water will appear dark. Moreover, when a ray of sunshine strikes the surface of the sea, since the ray's passage [into the water] is evident because of the water's trans-

parency, every appearance of darkness or shadow will vanish.

[7.185-187] In [regard to] beauty and ugliness: If tiny features or etchings render a highly transparent glass beautiful, and if cloudy, unappealing wine is poured into that glass, the reason for its beauty will be hidden, and the glass will be judged to be ugly, as sometimes happens in the case of a glass goblet. On the other hand, if some of its tiny features disfigure such a glass, and clear, bright wine of a beautiful color is poured into it, what disfigures the glass will be hidden, and the glass will be judged beautiful when it is ugly.

[7.189] In [regard to] similarity and dissimilarity: If two highly transparent glasses are identical in form, kind, and transparency, but if they differ in the arrangement of certain of their features, then, when they are filled with wine of the same color and clarity, what causes them to differ will be invisible, and they will be judged to be perfectly identical.

[7.190] On the other hand, if they differ in kind and form but are identical in certain [other] features, then, when they are filled with the same kind of wine, they will be judged to be entirely different, so there is an error in [the perception of] similarity and dissimilarity because such a judgment is based on appearances alone.

[7.192] In all of the preceding cases the error arises solely from an inordinate opacity, for, if everything else remains the same, the error does not arise when the opacity is restored to moderation.

[Section 6]

The transparency of the air intervening between the eye and the visible object falls outside its own limits of moderation and produces an error in [the perception of] everything that sight is led to conclude from deduction.

[7.193-194] In [regard to] distance: If the air is misty or dusky, as usually happens in the morning, and if there is a tower facing the eye at a moderate distance, it will be judged by sight to lie farther away than it actually is, so there is an error in [the perception of] distance, for the distance along the [intervening] ground according to which the distance of the tower is gauged is not perceived, and the ground is hidden because of the lessened transparency of the air, so [insufficient] transparency is the source of error.

[7.195] Moreover, if a body that is under scrutiny is somewhat inclined with respect to the eye in this kind of air, the inclination, which would be evident in clear air, will be hidden, so there will be an error in [the perception of] spatial disposition.

[7.196] In addition, if there is a slight bulge in the object, that object will appear flat in such air, and if the object has corners, they will be invisible, so

there will be an erroneous judgment of shape.

[7.197] An error in [the perception of] size will arise in such air, for a visible object will appear larger than it would in moderate[ly transparent] air, as happens in the case of bodies that are perceived through transparent water.⁸¹

[7.198] If, moreover, there is a black line in an object, that line will be judged to represent a split between segments, so there is an error in [the perception of] disjunction.

[7.199] But if two bodies are barely separated, they will appear continuous in such air, so there will be an error in [the perception of] continuity. And it is clear from these [two] cases that there is an error in [the perception of] number.

[7.202] In [regard to] motion: If two things are seen in such air, and if one of them moves a bit faster than the other, they may be judged to move at equal speeds, whereas in moderate[ly transparent] air the difference in speed between them could be discerned. And this error occurs because the difference between the length of the path one follows and the length of the path the other follows is imperceptible.⁸²

[7.204] In [regard to] rest: If someone looks at flowing water through such air from a distance that is moderate but not short, either he will judge it to be motionless, or, if it flows swiftly, he will judge it to move less vigorously than it actually does.

[7.206] In [regard to] roughness and smoothness: [It follows] that in this kind of air a rough object will appear smooth because the reason for its roughness will be invisible, whereas if the visible object is polished, since there is no reflection discerned in it, it will be judged to be rough.

[7.207-209] In [regard to] shadow: If a white object with round, black spots on it is seen through such air, and if firelight shines on that object while the same sort of air lies between [the eye and the object], there will seem to be shadow where those spots are, or else they may be taken for holes through which the darkness [inside the object] is allowed to show forth, so there will be an error in [the perception of] darkness, which is why a transparent object will appear less transparent [than it really is] through such air, or it may be judged to be opaque, and so there is an error in [the judgment of] opacity and transparency.

[7.211] In [regard to] beauty and ugliness [an error in perception will arise] because the specific things that render the object beautiful or ugly are invisible in such air.

[7.213] In [regard to] similarity and dissimilarity [an error in perception will arise] because the features that cause two bodies to differ or to be identical are not apparent [in such air].

[7.216] In all these cases the error is due to solely to the inordinate trans-

parency of the air, for, if everything else remained the same, that error would not occur in moderate[ly transparent] air.

[Section 7]

*A time-interval that falls outside the limits of moderation
can cause an error [in the perception of] each of the
things that sight is led to conclude from deduction.*

[7.217] [In [regard to] distance: If, from a tower, someone glimpses a distant object that is immediately snatched away from view, he will not be able to determine its distance from the tower properly, so he may judge it to be nearer or farther away from the tower than it actually is. And this happens because, in that brief period of time, the ground between the tower and the visible object according to which the distance is measured is not [properly] perceived by the observer, or else it happens because in such a brief time-span the [visual] axis could not scan the intermediate ground, so it could not apprehend it properly, and there will thus be an error in [the perception of] distance.

[7.218] In [regard to] spatial disposition: When something is glimpsed and then immediately removed, it may be judged to face the eye directly when it is inclined, or vice versa.

[7.221] In [regard to] shape: if there is a slight bulge in an object that is [merely] glimpsed, that bulge will go unseen, so the object will be judged to be flat, or the corners it possesses will be invisible [to sight].

[7.222] In [regard to] size: If someone waves a flaming torch quickly over a short distance so that it oscillates back and forth many times [during a brief time-interval], the path of its motion will appear fiery, because the movement of the torch from one side to the other is almost instantaneous.

[7.223] Accordingly, neither the size nor the motion of the torch can be [properly] discerned because of the brevity of the time, so in this case there will also be an error in [the perception of] motion.

[7.226] In [regard to] disjunction: If something that is glimpsed by sight is [immediately] taken away, and if there is a black line on it, that black [line] will be taken to mark a split between segments [of the object].

[7.227-228] Moreover, if contiguous objects or ones right next to each other are [merely] glimpsed, they will be judged to be continuous, as happens in the case of the planks of a bench that is [merely] glimpsed, so there will be an error in [the perception] of continuity.

[7.230] In [regard to] motion: When one of two objects moves a bit faster than the other, their motions will be judged to be equal when they are perceived over a brief time-span, because the difference [in speed] is not perceptible in such a short amount of time.

[7.232] In [regard to] rest: If a slowly moving object is [merely] glimpsed, it will not appear to move, for the path it follows during the time it is perceived is imperceptible to sight because of its brevity. But it was explained above that the motion of a body is perceived only during a perceptible time-span.⁸³

[7.233] The same sort of error happens in the case of a small disk. When it revolves swiftly, it appears motionless because its revolution cannot be perceived in the small amount of time during which it makes a single revolution.

[7.234] The same error occurs in the case of a top, so there will be an error in [the perception of] rest, since the change in spatial disposition of the parts of the top cannot be discerned, which is why its motion cannot be discerned either. Now if the top is of one color only, it is clear that its motion is not perceived. If it consists of several different colors, its motion will still not be seen, because the difference among the colors is invisible, and they are presented as a sort of uniform blend of the colors on account of the inordinate speed [of rotation].⁸⁴

[7.237] In [regard to] roughness: When something rough is [merely] glimpsed, it may be judged to be smooth. Moreover, if something smooth is glimpsed the same way, neither smoothness nor roughness can be discerned in it, so there will be uncertainty and error [in such perception].

[7.239] In [regard to] transparency: If light shines on a transparent object at a slant, and that object is [merely] glimpsed, since the inclination of the light is not perceived, the transparency of the object as it appears may be judged absolute. But if the object is exposed to view a bit longer, the [light's] inclination will be perceived as the cause of the apparent decrease in transparency.⁸⁵

[7.240] In [regard to] opacity: If someone sees a transparent object very briefly and does not discern light passing through it from behind, the object will be judged to be opaque.

[7.241-242] In [regard to] shadow: If portions of a white wall are black, but not pitch-black, and if firelight shines upon that wall, and it is [merely] glimpsed, [those dark portions] will be judged to be shadows. If, however, the black is very deep, they will be judged to be holes that are full of darkness.

[7.244-246] In [regard to] beauty and ugliness: For the minute features conferring beauty or ugliness [on a given object] are not perceptible in such a short time-period, as is the case when someone glances at a face through a window while passing by, [for under those conditions] he may judge it to be ugly [when it is] beautiful, or vice versa. And the same error occurs when the visible object moves while the eye remains immobile.

[7.247] In [regard to] similarity and dissimilarity: For the particular fea-

tures that cause similarity or dissimilarity are invisible to sight.

[7.249] In all these cases an error occurs on the basis solely of an inordinate[ly short amount of] time, since none of those errors would occur if the time-interval were restored to moderation.

[Section 8]

A weakness or aberration of the eye produces an error in [the perception of] everything that is perceived in sight through deduction.

[7.250] In [regard to] distance: If two objects face the eye, one being of an intense color and lying farther from the eye, the other being of a faint color and nearer the eye, since the perception of their distance [from the eye] depends entirely on comparing the two, weak sight will produce an inconclusive comparison.

[7.251] But since it is certain to everyone that sight has a clearer apprehension of nearer things than it does of farther things, the viewer concludes that, between these two objects, the one that is seen more distinctly is the nearer. And it is obvious that weak sight has a clearer apprehension of an intense color than it does of a weak one, even though [the intensely colored object] lies somewhat farther away.

[7.252] The same error arises when the visual power lies within [the range of] moderation, for at a great distance a body that is more intensely colored is judged to be nearer than one that is faintly colored, provided that it does not lie much farther away.⁸⁶

[7.254] Weak sight errs in [the perception of] spatial disposition. If an object at some moderate distance is slightly inclined, the inclination will not be apprehended [even] when the distance [of the object] is properly perceived.

[7.255] Moreover, an indistinct perception of distance and spatial disposition produces an error in [the perception of] size.

[7.256] In [regard to] shape: For a slight bulge or a multiplicity of corners in a body is invisible to weak sight.

[7.257] Moreover, if there is a black line on an object, it will be judged as a juncture or crack, whereas contiguous bodies will be judged to form a single continuum, so there will be an error in [the perception of] disjunction, continuity, and number.

[7.258] For the same reason someone who suffers from a squint judges a single object to be double if there is a deformity in one eye only, for the visible object will occupy noncorresponding places with respect to his two eyes.

[7.259] Moreover, if the deformity extends to both of his eyes, then, when

he chances to move them, they may happen to be oriented differently with respect to the visible object, and so one thing [will be taken as] more than one thing.

[7.261] In [regard to] motion: If someone spins around several times, when he stops he supposes that the walls are moving. And this happens because, when the viewer is moving, the visual spirit within him moves [too]. So even though the viewer has stopped, his visual spirit will not come to rest immediately, but its motion will continue in the motionless viewer, and on this basis a judgment that the [surrounding] visible objects are moving arises.⁸⁷ We see an example of this sort of motion in the case of a top, for the top revolves for awhile after the hand that moves it stops. There is also a disease according to which everything seems to the sufferer to revolve [about him].

[7.264] In [regard to] rest: When a body with identical parts revolves slowly, weak sight does not perceive its motion, whereas moderately strong sight will perceive it.

[7.265] On the other hand, if its rotation is swift, its motion is not even perceived by moderately strong sight. If, however, the moving body consists of dissimilar parts, e.g., in the case of a wheel,⁸⁸ weak sight will perceive its motion. But if the rotation is swift, the motion will be hidden to weak sight. Since the parts of the wheel are not completely dissimilar, their dissimilarity will not be properly perceived in swift motion, but it is by a dissimilarity of parts that their motion is perceived.

[7.267-268] In [regard to] roughness and smoothness: For something that is [only] moderately smooth will be judged to be rough, or vice versa if there is a difference between the forms of the rough and smooth objects.

[7.269] In [regard to] transparency: When there is a bit of opacity in a transparent body, it will be judged by weak sight to be more opaque than it actually is.

[7.270] In [regard to] opacity: When a transparent body is intensely colored, or when an intensely colored body lies behind it, if its transparency is not too great, [weak] sight will judge it to be opaque.

[7.272] In [regard to] shadow: When light shines on a white wall with small marks that are black, but not intensely so, those marks appear to weak sight as shadows.

[7.273] If, however, those marks are intensely black, they will look like holes through which darkness appears.

[7.275-276] In [regard to] beauty, ugliness, similarity, and dissimilarity [an error arises] because the specific features that render objects beautiful, or ugly, or similar are hidden to [weak] sight.

[7.278] So there is an error in [the perception of] all of the things we discussed on account, solely, of weak sight.

[7.279] We have now explained how an error of [visual] deduction arises according to each of the causes of visual errors in each of the things that are apprehended through deduction. We have now dealt with each kind of error and have adduced an example of each. And even though there is a plethora of visual errors, they have nonetheless all been distilled down to the kinds that have been described and arranged according to the examples adduced. And we have presented each of these errors according to a single cause that produces it.

[7.280] Now [visual] error sometimes arises not from a single cause, but from two or more causes. For instance, if something that is [merely] glimpsed from afar moves slowly, it will appear to be motionless, whereas its motion could be perceived at a moderate distance in the same brief time-span. So too, the motion would not be imperceptible at a moderate distance if the time during which it was viewed were moderate.

[7.281] This error thus arises on the basis of two inordinate conditions, neither one of which suffices by itself [to produce the error].

[7.282] A convergence of three [inordinate conditions] produces [visual] error. If a body of various colors that rotates, but not very fast, is seen in faint light from afar for a brief moment, the body will be judged to be at rest.

[7.283] Yet if [the same body] is looked at from the same distance in the same light, but during a moderate amount of time, the motion will be perceived, and by the same token it will not be imperceptible [if seen] in the same light for a brief moment, but at a moderate distance. And it could also be perceived at that same distance [for a brief moment but] in strong light.

[7.286] In general, then, among all the errors that occur in sight, whether singly or in conjunction, every one is subject to the causes that we described. Moreover, every form of a visible object is a composite of the [visible] attributes we have listed, and since sight apprehends nothing about visible objects except these specific attributes, no error will occur in sight that does not involve one of them. And every error that occurs in recognition occurs because the intellect either assimilates things it perceives [at the moment] with things it somehow perceived [earlier] or distinguishes between them.

[7.287] And every error concerning individuals will occur either in [brute] sensation, in recognition, or in deduction, and error can occur in no other way than according to one, two, or three of these. Moreover, whatever error occurs in any of these three ways will occur only by means of an error of sight concerning particular aspects.

[7.288] So now it has been shown that an error of sight concerning particular aspects will be due only to the causes we have listed, either from one of them alone or from several of them.

NOTES TO BOOK THREE

¹Objects are perceived “directly” (*recte*) when the radial links between eye and object are uninterrupted and, thus, unbroken by either reflection or refraction.

²6.33, pp. 365-366 above.

³6.72, p. 377 above.

⁴6.77, p. 378 above.

⁵Figure 3.1, taken from ms *P3* (f 114v), shows how the visual axes from the two eyes, **A** and **G**, intersect at point **D** on the circle to the right, labeled *basis pyramidis*

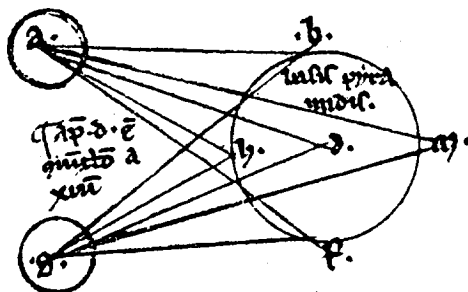


figure 3.1

(“base of the [visual] cone”); indeed, the text between the two eyes reads: *Apud D est coniunctio axium* (“The intersection of the axes is at **D**”). Ray-couples **AB**, **GB**; **AH**, **GH**; **AF**, **GF**; and **AM**, **GM** constitute corresponding rays within their respective visual cones.

⁶I, 6.28, p. 364 above.

⁷Evidently, Alhacen followed Ptolemy in assuming that the horopter—i.e., the plane of the visual field—is flat rather than curved, as visual theorists have acknowledged it to be since the establishment of the Vieth-Müller Circle in the first quarter of the nineteenth century; see Ptolemy, *Optics* II, 61, in Smith, *Ptolemy's Theory*, p. 152. The assumption of a flat horopter raises certain problems: For instance, it makes it extraordinarily difficult to explain how we get a unified visual impression of a sphere when each visual cone comprehends a different segment of that sphere—a point that Galen acknowledges, at least implicitly, in his discussion of binocular vision in *De usu partium*; see “Introduction,” pp. xlii-xliii above.

⁸As figure 3.2 on the following page shows, any two rays meeting to the side of the point where the visual axes intersect will be unequal in length, the relative inequality increasing the farther to the side they intersect; on the other hand, rays meeting directly above or below the point of axial intersection will be equal. Let the ellipse with center **C** represent the circular base of the two visual cones whose

vertices lie at centers of sight **A** and **B**. Let **XC** be normal to that circle, and let the plane containing points **X**, **C**, and **E** be perpendicular to the plane containing **X**, **C**, and **F**. Finally, let visual axes **AB** and **BC** lie in plane **XCE**, and let them intersect at point **C** so that they are equal. Obviously, then, rays **AE** and **BE** meeting at point **E** to the side of point **C** within plane **XCE**, will be unequal, **AE** being longer than **BE**. On the other hand, rays **AF** and **BF** meeting point **F** within plane **XCF** will be equal. If corresponding rays for each cone are brought to intersection at all the points equidistant from the point of axial intersection (i.e., along the circle's circumference), then, as long as the relative inequality in length between the corresponding rays that intersect to the side of the point of axial intersection is negligible (i.e., insensible), then the entire portion of the object enclosed by those points will appear single and, moreover, relatively distinct.

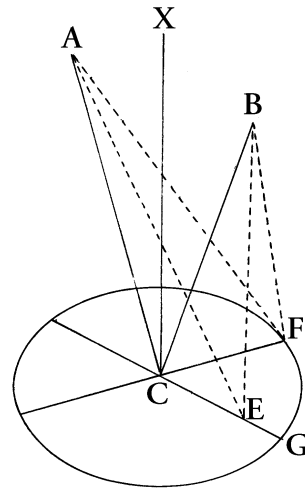


figure 3.2

⁹In other words, if points **C** and **E** in figure 3.2 are right next to one another, angles **AEC** and **BEG** will be so close in size that the difference between them will be undetectable to the visual faculty.

¹⁰This, of course, is the case when the point lies directly above or below the point of axial intersection along line **CF** as represented in figure 3.2.

¹¹Figure 3.3, which is taken from ms *P3* (f 115v), is apparently meant to illustrate this point. Thus, anywhere along line **HM** the axial rays, whether **AH** and **GH**, **AD**

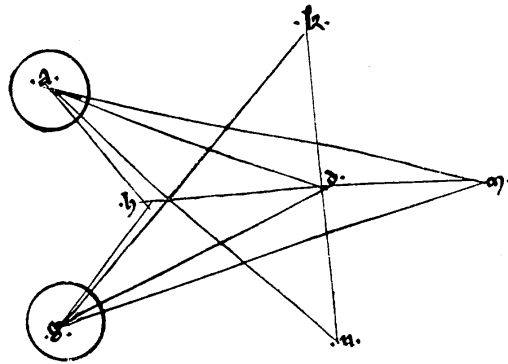


figure 3.3

and **DG**, or **AM** and **GM**, will be equal. On the other hand, if the intersection-point is far off to the side, then the corresponding axes **GK** and **AK** (this latter left undrawn), or **AN** and **GN**, (this latter also left undrawn), will be discernibly unequal.

¹²See 2.22, pp. 572-573 above, for elaboration on this example. Figure 3.4 is provided by ms *P3* (f 116v) to illustrate this point. The two axes, each labeled *axis*,

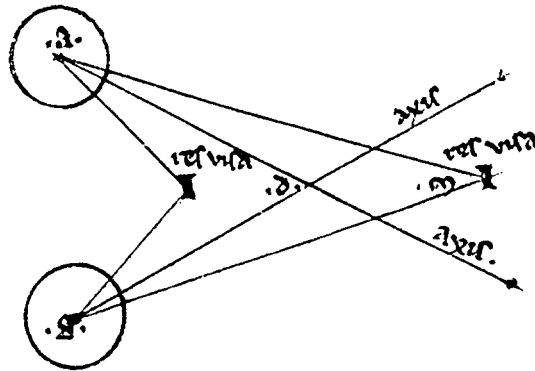


figure 3.4

come to intersection at point **D**. Meantime, the two visible objects (*res visa*) to the left and right of that intersection-point are seen along rays that strike their respective eyes at noncorresponding points. Thus, for instance, ray **AM** extending from the eye at **A** to the visible object at the right intersects that eye's surface to the left of the visual axis, whereas ray **GM** extending from the eye at **G** to the same visible object intersects that eye's surface to the right of the visual axis.

¹³II, 2.2, pp. 417-418 above.

¹⁴Idem.

¹⁵I, 5.37, p. 355 above.

¹⁶See figure 3.5. In this diagram the two visual axes meet at point **B** on the object represented by line **ABC**. To that same point, extending from point **H** at the top of the figure, where the center of the common nerve lies, is a line perpendicular to the line passing through the rear of the eyes and parallel to **ABC**. The center of that line is **X**, so, in passing through it from the center of the common nerve to **B**, **HB** defines the common axis. This description of the common axis and its generation represents an elaboration on Ptolemy's account in *Optics*, III, 35, in Smith, *Ptolemy's Theory*, pp. 144-145; see also "Introduction," pp. xxxiii-xxxiv above.

¹⁷Taken from ms P3 (f 117r), figure 3.6 on the following page illustrates the points just made. The explanation, which is provided in the accompanying text, is as follows: *Hec forma C venit ad Z per duas vias: scilicet per OP et SY in alio oculo. Eodem modo A venit ad V per duas vias* ("This form [of] **C** reaches **Z** [in the common nerve] by two routes: i.e., along **OP** [in the eye to the right] and [along **SY** [in the eye to the left]. Likewise, **A** reaches **V** by two routes"). The ulterior purpose of this diagram is, of course, to show that the

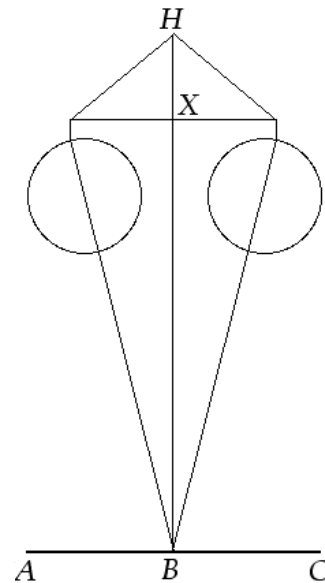


figure 3.5

images from both eyes can be perfectly fused in the common nerve.

¹⁸Thus, just as the clearest, most definite monocular visual impression occurs along the visual axis, the clearest, most definite binocular visual impression occurs along the common axis when the two visual axes intersect it on the surface of the object. By extension, then, an object is seen most clearly and most definitely when it is in a perfectly facing position vis-à-vis the viewer; see II, 3.106, pp. 462-463 above.

¹⁹Thus, the increasing indefiniteness or indistinctness of things seen toward the edge of the visual field is due to the imperfect superposition of their forms as they pass from noncorresponding spots on the two eyes to noncorresponding spots in the common nerve.

²⁰In short, if it is not inordinate, the doubling of forms conduces to a blurring, rather than a complete fragmentation, of the composite image in the common nerve.

²¹This is, in essence, a recapitulation of Ptolemy's explanation in *Optics*, II, 35-37,

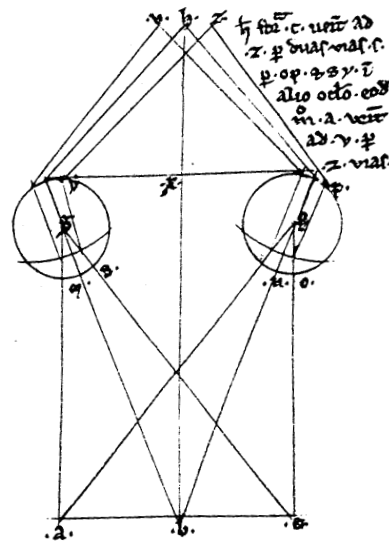


figure 3.6

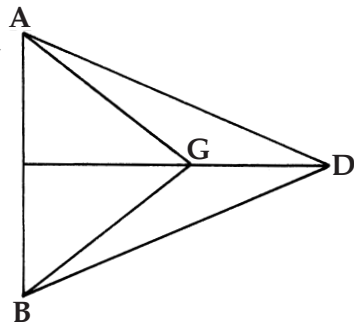


figure 3.7a

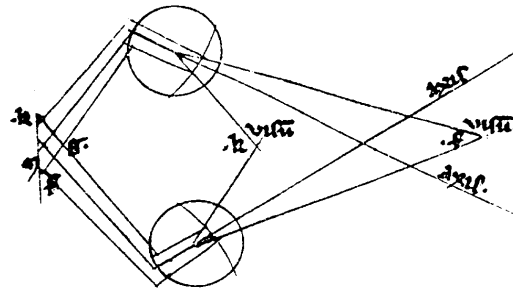


figure 3.7b

in Smith, *Ptolemy's Theory*, pp. 84-85. The gist of the argument is as follows from figure 3.7a (Figure II.1 in *Ptolemy's Theory*, p. 84). If the two centers of sight are A and B, and if the two visual axes AG and BG come to focus on G, then D, which lies beyond G, will be seen to the left of G by the left eye A along ray AD and to the right of G by the right eye B along ray BD. If, on the other hand, the visual axes AD and BD come to focus on D, then G will be seen to the right of D by the left eye A along ray AG and to the left of D by the right eye B along ray BD. To account for the doubling of such images in the common nerve, P3 offers figure 3.7b on f 120v. If F (labeled *visum* = "visible object") is the object in question, and if it lies beyond the

intersection of the two visual axes, then the form of **F** will be projected through the left-hand eye to point **K** in the common nerve. That same form projected through the right-hand eye will be end up at point **F** in the common nerve. Thus, **F** will be seen at two locations flanking the center of the common nerve, its respective forms having crossed paths at **G** in front of the center of the common nerve.

²²This is just a special case of the situation in 2.22 above, the object now lying on one of the visual axes rather than between them; the essential result (i.e., image-doubling) is the same, however, and for essentially the same reasons

²³The apparatus described in this paragraph is clearly modeled after the one described by Ptolemy in *Optics* III, 43, in Smith, *Ptolemy's Theory*, p. 147. A "digit" is approximately 3/4" (1.9 cm), and a cubit is approximately 1.5' (45.7 cm).

²⁴2.12, p. 567 above.

²⁵That is, the experimenter should take notice of everything on the plaque, not shift his gaze around to everything on it.

²⁶The doubling of the images described here both for line **HZ** and for the visual axes **BC** and **AD** can be explained as follows on the basis of figure 3.9, which is taken from *P3* (f 121v). From the perspective of the eye at **B**, segment **HQ** of line **HZ** is seen along rays that lie to the right of axis **BQC**, so that segment will appear displaced to the right of point **Q**, the points toward **H** appearing more displaced than the points toward **Q**. Point **Q**, however, will appear at its actual location (see the discussion of Ptolemy's analysis of displacement in "Introduction," pp. xxxiv-xxxv above). On the other hand, according to the same eye at **B**, segment **QZ** will be seen along rays that lie to the left of axis **BQC**, so that segment will appear displaced to the left of **Q**, the points toward **Z** appearing more displaced than the points toward **Q**. Thus, **HZ** will appear at a slant along a line rotated counterclockwise toward **AD** on pivot-point **Q**. For the eye at **A** the situation will be reversed, so **HZ** will appear along a line rotated clockwise toward **BC** on pivot-point **Q**; see 2.44, pp. 576-577 above. Diagonal **BQC** will be seen from point **B** along visual axis **BC**, but from point **A** its lower segment **BQ** will be seen along rays to the left of **Q**, whereas its upper segment **QC** will be seen along rays to the right of **Q**. Hence, according to the eye at **A**, diagonal **BC** will appear along a line rotated counterclockwise toward **HZ**. Accordingly, from point **B** two images of **BC** will be seen, one right in line with **BC** itself, the other aslant to it and intersecting it at **Q**. So, too, diagonal **AD** will be seen double, one image appearing right in line with **AD** itself, the other aslant to it and intersecting it at **Q**; see 2.46, p. 577 above; cf. also Ptolemy, *Optics* III, 43-44, in Smith, *Ptolemy's Theory*, p. 147.

²⁷From **B** the peg at **L** will be seen to the right of **Q** along a ray that lies to the rightward of visual axis **BC**, whereas the peg at **S** will appear to the left of **Q** along

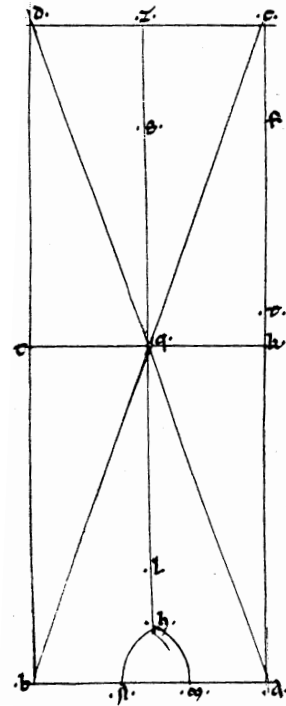


figure 3.9

a ray that lies to the leftward of visual axis **BC**. Both pegs, however, will be seen rightward of visual axis **BC**, whereas the peg at **S** will appear to the left of **Q** along a ray that lies to the leftward of visual axis **BC**. Both pegs, however, will be seen along a single line that appears slanted in the same general direction as diagonal **AD** (as in 2.29 above). By the same token, from **A** the peg at **L** will be seen to the left of **Q**, the peg at **S** to the right of it, and both will be seen on a single line that appears slanted in the same general direction as diagonal **BC**.

²⁸In figure 3.10, if one peg is placed at **L** and the other at **S** on visual axis **BC**, then, from point **B** both pegs will appear to coalesce at point **Q**. However, from

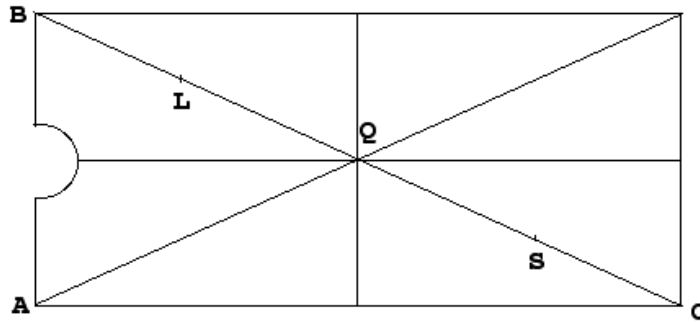


figure 3.10

point **A**, the peg at **S** will appear to the right of **Q** and the peg at **L** to its left. Thus, there will be four images, two of them coalescing at the center and two of them flanking that centerpoint.

²⁹In figure 3.11, if **L** is placed on visual axis **BC** between **B** and **Q**, and if **S** is placed on visual axis **AD** between **A** and **Q**, then the peg at **L** will be seen by the eye at **B** in line with **Q**, and the peg at **S** will be seen by the eye at **B** to the right of **Q**.

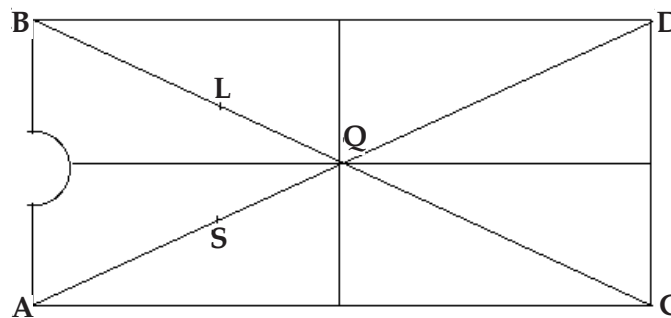


figure 3.11

From the eye at **A**, however, the peg at **S** will appear to lie in line with **Q**, whereas from the eye at **A** the peg at **L** will appear to lie to the left of **Q**. Hence, altogether there will be four images, two of them coalescing at the center and two of them flanking. According to Sabra's version, Alhacen goes on to include the third case,

with the pegs placed on the two visual axes beyond point **Q** toward **D** and **C**, respectively, but this case is missing from the Latin version.

³⁰That is, the two rays virtually coincide with the lines drawn on the plaque, so those lines, as represented in figure 3.8, can be taken as the rays themselves.

³¹See note 26, p. 633 above.

³²Clearly, in this discussion Alhacen is not referring to the visual axes in their entirety, but only those segments between the eyes and centerpoint **Q**.

³³The point here is that neither the diagonals nor the pegs placed on them will coalesce perfectly at the center (see notes 25 and 26, p. 633 above). Instead, they will overlap somewhat while still maintaining some slight lateral separation because they are seen not only along the axial rays, but also along neighboring noncorresponding rays. Hence, they come close to, but do not achieve, true convergence; for elaboration, see Sabra, *Optics*, vol. 2, pp. 124-127.

³⁴7.24-25, pp. 605-606 above.

³⁵The point here seems to be that there will be no apparent displacement through image-doubling.

³⁶P3 offers figure 3.12 on f 128r to illustrate this point. The text within the triangle reads: *Per hanc poterit explanari quod dicitur hic* ("On the basis of this [figure] what is said here can be explained"). On the right side of the figure (not shown here) there is an explanatory text in two parts. The first part refers to the top line, **CZ**, and reads as follows: *Hec linea ita est longa ut eius extremitas ita sit remota a medio ut lateat visibile apud C, quoniam consideratio est apud extremum tabule: id est cum aspicitur Z* ("This line is long [enough] that its endpoint lies far [enough] from the center that the visible object at point **C** loses visibility, for the focus is on the edge of the table: that is, when **Z** is being looked at"). The second part refers to the middle line, **QK**, and reads as follows: *Hec linea est remota a medio ut lateat visibile apud K quando consideratio est apud medium tabule. Remotiones autem radiorum exeuntium ab axe ad extrema sunt lineae HK [et] HC, et est proportio ZC ad QK secundum proportionem CH ad KH* ("This line is far [enough] from the center that the visible object at **K** loses visibility when the focus is upon the middle of the table. Moreover, the lengths of the rays passing from the axis to the edges are lines **HK** [and] **HC**, and $ZC : QK :: CH : KH$ "). We are thus left to infer that no matter how far away the object may lie (within reason) from **H** along **HZ**, as it moves laterally away from the center, its loss of visibility is a function of the angle **ZBC** rather than of the actual linear distance it moves along **QK** or **ZC**.

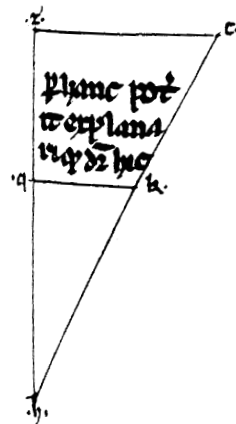


figure 3.12

³⁷Here, and once more in this paragraph, the Latin term used is *imprimere* ("to impress" or "to imprint") rather than the usual *figere*; see note 95 to book 1, pp. 409-410 above.

³⁸I, 2.21, in Sabra, *Optics*, vol. 1, p. 11.

³⁹II, 3.57-59 and 4.20, pp. 444-445 and 521 above.

⁴⁰III, 2.79, p. 586 above.

⁴¹III, 2.81, pp. 586-587 above.

⁴²In this case it is not the object itself, but its defining form that goes unperceived. Without a clear apprehension of such defining forms, the visual faculty is unable to determine what the objects they represent actually are.

⁴³This demarcation between 3.12 and 3.13 marks the shift discussed in "Manuscripts and Editing," p. clxviii above, between Latin version 1 (fairly literal) to Latin version 2 (paraphrase). For the sake of textual flow, I have remanded the transitional section from 3.13 (version 1) through 3.12 (version 2) to Appendix 1, pp. 642-651 above.

⁴⁴The use here of *longitudo* instead of the previously used term *remotio* for "distance" seems to reflect the change in translators suggested in "Manuscripts and Editing," pp. clxviii-clxix above. Cf., however, II, 3.156, pp. 484-485 above. Note also the use of *elongatio* for "distance" in 5.4 et passim, as opposed to its previous usage as "distancing" or "drawing away" (see, e.g., II, 3.126, 3.143 and 3.180, pp. 471, 477-478, and 497 above).

⁴⁵"Sense" is taken here broadly to include the entire perceptual apparatus—including the imagination, which serves as a mnemonic storehouse—involved in the visual process.

⁴⁶Cf. Ptolemy, *Optics* II, 131, in Smith, *Ptolemy's Theory*, pp. 123-124, where the problem of distinguishing what is in motion is cast in terms of a boat anchored in a flowing river.

⁴⁷II, 3.178-181, pp. 496-498 above.

⁴⁸Ptolemy, too, subdivides visual illusion under three heads in his analysis of visual illusions in *Optics* II, 83-142, in Smith, *Ptolemy's Theory*, pp. 106-128. By his account, the first kind of illusion is due to physical circumstance (e.g., too much light or too much distance). The second kind, which is due to the visual faculty itself (i.e., the visual flux), includes diplopia and the oculogyral illusion. The third kind is subdivided into illusions that are essentially perceptual in origin (e.g., judging brighter objects to be closer than duller ones that subtend the same visual angle) and illusions that involve intellectual intervention (e.g., interpreting image-reversal in mirrors). Alhacen's subdivisions are somewhat different, in part because his theory of vision is not based upon the emission of visual flux by the eye. As a result, his overall explanation of visual perception entails considerably more psychological/intellectual intervention on the viewer's part than does Ptolemy's. Hence, the vast majority of visual illusions discussed by Alhacen involve the third subtype: illusions that arise during the process of deduction (*syllogismus*).

⁴⁹The Latin term for "distance" here is *elongatio*; see note 44 above.

⁵⁰I assume that there is an ellipsis at this point in the Latin text, and I have taken it upon myself to fill it with the phrase "so this error arises" in order to resolve the obvious contradiction that occurs without it.

⁵¹II, 3.19, p. 431 above.

⁵²To "ascribe definition" in this context simply means to specify what something is; hence, to misascribe such definition is to err in such specification.

⁵³Brunellus (or "Brownie") the ass is a stock figure, along with Socrates (*Sortes*), in the construction of various premises for the teaching of logic in the Latin Middle Ages; see, e.g., Norman Kretzmann, Anthony Kenney, and Jan Pinborg, eds., *The Cambridge History of Later Medieval Philosophy* (Cambridge: Cambridge University

Press, 1982), pp. 265 and 433.

⁵⁴*Aluerach* is a Latin transliteration of the Arabic term for “firefly.” See note 12 to book 1, p. 396 above.

⁵⁵By “air” here and elsewhere in the text is meant the entire space between eye and object, so any disruption in it—by sheer cloth, intervening flames, vapors, or the like—that affects its ability to be seen through is imputed to the air, even though, strictly speaking, the disruption is due to an outside agent rather than to the air itself, whose inherent transparency remains unchanged.

⁵⁶Cf. Ptolemy, *Optics* II, 130, in Smith, *Ptolemy’s Theory*, p. 122.

⁵⁷Although the point is not specified, the separation among trees referred to in this passage is along the line-of-sight, not lateral.

⁵⁸Figure 3.13 is provided in ms *P3* (f 138r) by way, presumably, of illustrating the points made in 7.6 and 7.7.

⁵⁹The explanation offered above is based on the fact that light- and color-radiation originates at individual spots, not points, on the object-surface under scrutiny. Those spots and the forms they generate thus have some breadth, and so do the lines of radiation along which they reach the surface of the eye. The visual angle under which any object is perceived is measured according to the rays bracketing the cross-section of that object, and those rays touch on the terminal spots at each end of that cross-section. Under normal circumstances, when the overall form of the object impressed on the *glacialis* occupies some perceptible area on it, the terminal spot-forms of that overall form are so small as to be negligible in the account of its size. When that overall form is tiny to begin with, however, those spots are relatively sizeable. Thus, when they are ignored, as they are under normal circumstances, a sizeable portion of the overall form is thrown out of the account. The resulting perception of size is thereby deficient by that amount, so the area on the *glacialis* occupied by the overall form will be adjudged smaller than it actually is; see 7.23, pp. 604-605 above.

⁶⁰II, 3.141-146, pp. 476-479 above.

⁶¹II, 3.76-77, pp. 451-452 above.

⁶²See note 59 above.

⁶³Figure 3.14, taken from *P3* (f 140r), illustrates an inordinately large visual angle with respect to the distance of the object at the ends of the rays extending out from

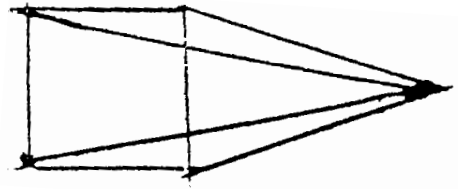


figure 3.13

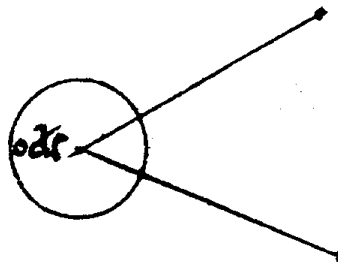


figure 3.14

the eye (*oculus*).

⁶⁴For Ptolemy's roughly equivalent account of this illusion, see *Optics* II, 99, in Smith, *Ptolemy's Theory*, p. 111.

⁶⁵III, 4.7-8, pp. 594-595 above. Ms P3 offers figure 3.15 on f 140v to illustrate the example of the moon (*luna*) appearing to move through the clouds (*nubes*).

⁶⁶II, 3.178, p. 496 above

⁶⁷Here, at last, Alhacen explicitly mentions illusionism in painting but offers no account of how it is in fact achieved by artists nor pursues its implications. This is surprising for three reasons. First and foremost is that even the most rudimentary knowledge of the principles of chiaroscuro makes it evident that the interplay between light and shadow provides invaluable clues about such surface-shapes as concavity and convexity as well as about slant and the like. Second, Ptolemy actually discusses such illusionism and explains in a general way how it is achieved; see, e.g., *Optics* II, 127-128, in Smith, *Ptolemy's Theory*, pp. 121-122. Finally, it is clear that Alhacen understood the basic principles of color-perspective insofar as he was aware that a given object appears brighter and more vividly colored at a close distance than it does at a farther one; see, e.g., II, 3.159, p. 486 above and III, 7.250-251, p. 625 above; cf. Ptolemy, *Optics* II, 124., in Smith, *Ptolemy's Theory*, p. 120. Despite his knowledge of these principles, Alhacen was no more forward than Ptolemy in applying them to his account of spatial perception.

⁶⁸II, 3.189-191, pp. 500-501 above.

⁶⁹7.24-25, pp. 605-606 above.

⁷⁰In chapter 6 of the seventh book of the *De aspectibus* (see Risner, *Opticae thesaurus*, pp. 269-270). Alhacen's explanation there is based on the supposition that point-forms from the occluded portion of the wall reach the surface of the eye along rays that are slightly inclined to that surface yet close enough to the orthogonal to make a sensible impression on it. Thus, the needle is seen according to the orthogonal rays emanating from it while, at the same time, the wall behind it is seen according to the almost imperceptibly inclined rays emanating from it.

⁷¹See II, 3.80, p. 453 above.

⁷²Idem.

⁷³2.21 and 2.31, pp. 572 and 575 above.

⁷⁴See Ptolemy, *Optics* II, 132, in Smith, *Ptolemy's Theory*, p. 124, for this same example of misattributed motion.

⁷⁵As Alhacen observes in II, 3.202, p. 504 above, even with its distinguishing marks, the moon is still beautiful, though presumably less so than it would be without them.

⁷⁶II, 3.189-191, pp. 500-501 above.

⁷⁷Two quite distinct (indeed, contradictory) things seem to be confused in this passage: being unable to see an exquisitely transparent body at all and being able to see a transparent body but unable to perceive its slant.

⁷⁸Presumably a hexagon (which has six vertices or "corners") is intended here, although, judging by Sabra's version of this passage, the Latin translator confected this example on his own.

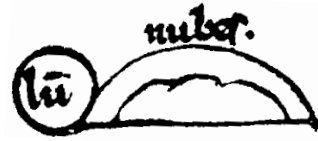


figure 3.15

⁷⁹According to Sabra's version (see *Optics*, vol. 1, p. 334), the reason the crystal body appears to move is that, being exquisitely transparent, it cannot actually be seen, so it will not be distinguished from the moving object behind it; cf. II, 3.195, pp. 502-503 above.

⁸⁰The phrase *ab ea recedat* makes no sense in this context. According to Sabra's version (see *Optics*, vol. 1, p.p. 334-335), the transparent object in question is spherical. Hence, when it is rotated within the hand, its rotation will be undetected because of the homogeneity of its structure and transparency.

⁸¹In the seventh chapter of book 7 of the *De aspectibus*, Alhacen discusses the magnification of images that is caused by refraction when the object is placed in an optically denser medium than the viewer; see esp. Risner, *Opticae thesaurus*, pp. 271-272. Under the circumstances described in this passage, the viewer would have to stand in a portion of air that is less hazy (and thus less optically dense) than the portion of air occupied by the object that supposedly appears larger.

⁸²On its face, the rationale offered here for the perceiver's inability to distinguish the difference in velocity has nothing to do with the air's lack of transparency; after all, why should air make distance imperceptible? In Sabra's version (*Optics*, vol. 2, pp. 342-343), the situation Ibn al-Haytham describes involves two objects moving toward the eye at slightly different speeds, Ibn al-Haytham offering as an example one horseman overtaking another in a chase. Accordingly, if the air is foggy or dusty, he continues, the difference in their speeds will be undetectable because the intervening ground, which provides the natural reference-frame for judging distance and its change, cannot be seen. The failure of the Latin text to capture the proper sense of Ibn al-Haytham's account is due to the extraordinarily abbreviated nature of the Latin translation, a problem that recurs throughout this chapter of the book.

⁸³II, 3.185, p. 499 above.

⁸⁴Cf. Ptolemy, *Optics* II, 96 and 98, in Smith, *Ptolemy's Theory*, pp. 109-111.

⁸⁵The sense of this rather confused passage seems to be that, when the light that is seen behind a transparent body strikes that body at a slant, the body will look less transparent than it actually is because, as Alhacen establishes at the very beginning of chapter 7 of the seventh book, refraction weakens light and color. Presumably, then, since the slanted light will be refracted, and thus weakened, before it reaches the eye, the medium through which it passes will seem less transparent than it would if the light were to pass through along orthogonal rays, which are the most dynamically effective; see note 64 to book 1, pp. 404-405 above.

⁸⁶Here, again, is a clear indication that Alhacen was aware of color-perspective; see note 67, p. 638 above.

⁸⁷This explanation of the oculogyral illusion on the basis of inertial swirl is essentially the same as that provided by Ptolemy in *Optics*, II, 121, in Smith, *Ptolemy's Theory*, pp. 119-120.

⁸⁸The dissimilarity of parts in this case is presumably a function of the disparity among spokes as well as between spokes (discontinuous) and rim (continuous). Accordingly, as Alhacen points out later in the passage, such disparities will keep the spinning wheel from looking perfectly homogeneous and motionless, although the individual elements (i.e., spokes and rim) of the wheel will not be properly perceived as such.

APPENDICES

APPENDIX ONE

[3.13] Et etiam visus, cum fuerit lesus, aut accidet ei aliquid accidens transmutans

. . . . et ex hoc quodcumque sumatur viso punctum **K**.

[2.53] Non per axem comprehendatur, sed per radium
5 videtur axi communi fixo propinquius loco vero. Cum enim
appareat continuitas puncti visi ad punctum super quem cadit
axis et discernatur quantitas spatii interiacentis, punctum au-
tem in quo cadit axis videatur propinquior axi fixo quam sit,
videbitur punctum sumptum propinquius eidem quam sit.

10 [2.54] Et quoniam modicum est illius propinquitatis aug-
mentum, et non sentitur in omnibus visis corporibus, non mu-
tatur propter hoc insensibile situs corporum respectu visus.

[2.55-259] Amplius sumantur tria folia pargameni modica,
et ponat unum in loco **Q**, et aliud in loco **K**, tertium in loco **T**,
15 et in unoquoque eorum sit aliquid scriptum. Certior erit siqui-
dem comprehensio scripture folii **Q** quam folii **T** vel **K**, et si
folium **T** vel **K** accedit ad **Q**, quanto plus accesserit scriptura
eius certior apparebit. Si autem folium **T** vel **K** elongatur a **Q**
super lineam **TQK** extra tabulam, minor erit scripture verifi-
20 catio.

[2.60] Clauso enim uno oculo, quecumque dicta sunt in
globis cereis patebunt in foliorum scripturis.

[2.61] Palam ergo propter hoc in uno visu sive in duplici
inspiciatur manifestissimum est illud cui occurret axis, nec erit
25 verificatio forme corporis nisi super ipsum axis incedat.

[2.62] Amplius, si sumatur folium latitudinis quattuor di-
gitorum, et in eo aliquid scribatur latitudinem folii tenens, et

1 aut: ad *S*; *om.* *FP1VatV2* 3 *post et add.* est *O/post* sumatur *add.* in corpore *O*
5 communi fixo: confixo *O* 6 continuitas: concavitas *FP1VatV2* 8 sit *corr.* ex
si *O* 10 propinquitatis *corr.* ex propinquitas *F/augmentum* (11): *corr.* ex augmen-
ta *SVat* 11 non *om.* *O/visis corr.* ex visibus *P1* 12 insensibile: insensibilia *O/post*
respectu *scr. et del.* sit *Vat* 14 ponat: ponatur *O/K: E O* 15 erit siquidem (16)
transp. *FVatV2/siquidem* (16) *om.* *P1* 16 *post folii scr. et del.* quinque *F/Q: quasi V2/*
K: E O/et . . . K (17) *om.* *VatV2* 17 *K: E O/accedit: accidit FOP1VatV2/accesserit:*
accessit O 18 *post folium add.* (??) *O/K: E O/elongatur: elongetur O* 19 *TQK:*
TQE O/verificatio (20): *certificatio FP1VatV2* 23 *post hoc add.* quod sive *O*
24 *inspiciatur . . . cui: inficiatur quod O/nec . . . axis* (25) *om.* *VatV2* 27 *aliquid:*
aliquod P1/aliquid scribatur transp. *OP1VatV2/latitudinem corr.* ex latitudine *O*

[3.13] Moreover, when the eye is injured, or something happens to it that changes. . .

¹. . . and on this visible object let some point **K** be taken.

[2.53] It should not be perceived along the axis, but it is seen by a ray nearer to the actual location [of the object] than the fixed common axis. For if the point that is seen appears continuous with the point to which the axis falls, and if the size of the gap between them is discerned, but the point to which the axis falls appears to lie closer to the fixed [common] axis than it is, then the chosen point [**K**] will appear to lie closer to that axis than it actually does.

[2.54] But since the increase in its closeness is very slight, and since it is not sensed in the case of every visible body, the spatial disposition of the bodies with respect to the eyes is not changed by this imperceptible [amount].

[2.55-259] Furthermore, let three small sheets of parchment be taken, and let one of them be placed at **Q**, another at **K**, and the third at **T**, and let something be written on each of them. The writing on sheet **Q** will certainly be clearer than that on sheet **T** or [sheet] **K**, but if sheet **T** or [sheet] **K** approaches **Q**, then the closer it gets, the clearer the writing on it will appear. On the other hand, if sheet **T** or [sheet] **K** is moved away from **Q** and beyond the plaque along line **TQK**, its writing will become less definite.

[2.60] In fact, if one eye is closed, everything that was described in the case of the balls of wax will also be revealed in the case of the writing on the [parchment] sheets.

[2.61] From this it is therefore evident that, whether it is viewed through one eye or through both, an object upon which the [visual] axis falls is [seen] most clearly, and the form of a body will not be distinct[ly perceived] unless the visual axis falls upon it.

[2.62] Furthermore, if a sheet [of parchment] four inches wide is taken, and something is written along its width, and if it is applied

¹This marks the start of version 2 (paraphrase) of the Latin text. The fact that it starts in *medias res* with a recapitulation of chapter 2 from 2.53 on seems to indicate that, for at least awhile, translator 2 worked in parallel with translator 1 before taking over on his own. If so, then perhaps he was practicing here. Whatever the case, when this portion of version 2, from 2.52 through 3.12, is compared to its counterpart in version 1 (pp. 271-290 above), several things become evident. First and most obvious is how abbreviated version 2 is both by ellipsis within given passages and by the omission of entire swatches of text. Thus, 2.67-2.79 and 2.84-2.86 of version 1, pp. 278-282 and 284-285 above, are missing entirely from version 2.

linee **TQK** directe amplectetur, certior apparebit scriptura que circa **Q** erit quam si remota fuerit.

30 [2.64] Si autem paululum declinetur folium super lineam **AQD**, minor erit scripture eius cuiusque verificatio, et secundum maioritatem declinationis erit minoritas verificationis. Et semper hec minoritas augmentabitur donec folium linee **AQD** applicatur.

35 [2.65] Idem penitus videbit si oculum clausuris unum. Si vero applicetur folium linee **TQ**, tantum inspecto **Q**, cadent axes super folii terminum, et eo declinato in hoc situ, minor erit scripture certitudo; similiter si fiat visus tantum cum uno oculo. Pari modo, si non recedat folium a linea **TQK** sed super
40 ipsam declinata incumbat, erit certitudinis debilitatio. Idem accidet si folium linee **DZC** applicetur aut propinquiori aut remotiori tamen linee **TQK** equidistanti et super eam declinetur.

[2.66] Per hoc planum quod, sive in uno visu sive in duplici, certior comprehendetur forma corporis quod occurrerit visui erectum quam concursus axium.

[2.80] Quare autem in corpore multum declinato non accidit forme verificatio que quidem accideret si corpus erectum occurreret, sed in longitudine temperata comprehendatur magnitudo ipsius declinati sicut et recti, hec est ratio. Forma declinati in strictorem cadit oculi partem quam erecti propter
50 angulum visus minorem.

[2.81] Unde partes minute illius forme incidunt in minutissimas oculi partes que propter sui parvitatem sensui imperceptibiles abscondunt sensui et se ipsas et partes forme receptas. Partes vero corporis quod rectum occurrerit visui cadunt in partes sensibiles oculi propter magnitudinem anguli, unde fit earum certitudo sensui.

28 **TQK**: **TQE O/post** directe *scr. et del. am Vat/amplectetur: amplicetur O; corr. ex amplectebatur P1* 29 *si: in S* 30 *paululum: paulatim FP1VatV2* 31 **AQD**: **AQZ O** 33 **AQD**: **TQZ O** 35 *idem: item P1VatV2/si oculum rep. V2* 36 **TQ**: **EQ O/Q**: quasi *V2* 37 *post axes scr. et del. super F/folii corr. ex folium Vat* 38 *certitudo corr. ex certificatio Vat* 39 *post recedat scr. et del. super Vat/TQK: TQE O/super mg. F* 40 *certitudinis corr. ex certudinis S* 41 *accidet: accidit V1/linee inter. O/DZC: DZQ O; DZS P1* 42 **TQK**: **TQE O** 45 *occurrerit: occurrerit O; occurrerint SVatV2; corr. ex occurrerint F* 46 *erectum corr. ex rectum O/post quam add. quod occurrit declinatum sive in ipsum cadat sive non O/concursus corr. ex cursus P1* 47 *quare corr. ex quando F/post declinato scr. et del. capite S* 48 *post forme scr. et del. multum P1/erectum: rectum OS* 49 *sed: licet OS/temperata: separata FP1SVatV2* 50 *recti: erecti V1/post hec add. autem P1/est om. P1* 51 *post quam scr. et del. eius O/erecti corr. ex recti O* 54 *partes: partem V2* 55 *abscondunt: absconderunt Vat*

directly along line **TQK**, the writing at **Q** will appear more definite than it would if it were farther [from it].

[2.64] Moreover, if the sheet is slightly inclined on line **AQD**,² any of the writing on it will appear less distinct, and the decreasing distinctness [of the writing] will be a function of the increasing inclination [of the sheet]. This decrease [in distinctness] will invariably intensify until the sheet coincides with line **AQD**.

[2.65] Precisely the same thing will be seen if you close one eye. If, however, the sheet is applied along line **TQ** while only **Q** is looked at, the [visual] axes will fall on the edge of this sheet, and if it is inclined at that spot, the writing [on it] will appear less definite; and the same holds if sight occurs with one eye only. By the same token, if the sheet is not drawn away from line **TQK** but is placed at a slant to it, there will be a decrease in the definiteness [with which the lettering is seen]. The same thing will happen if the sheet is placed on line **DZC**, or on a line nearer to it or farther from it and parallel to line **TQK**, and if it is inclined to that line.

[2.66] From this it is obvious that, whether [it is viewed] with one or with two eyes, the form of a body that stands directly facing the eye and that has the [visual] axes intersecting upon it will be perceived more clearly [than one that does not meet these criteria].

[2.80] The following explains why the form of a body that is sharply slanted does not appear definite, whereas it would if the body faced the eye directly, and why the magnitude of that same slanted body is perceived correctly, as it [would be if it] faced [the viewer] directly, at a moderate distance. The form of an inclined body is projected on a narrower area of the eye than [the form of] a body that faces the eye directly because the [visual] angle [under which it is seen] is smaller.

[2.81] Hence, the small parts of that form are projected on infinitesimal parts of the eye, and since they are imperceptible to sense because of their smallness, these parts, in and of themselves, as well as the parts of the form impressed on them, are invisible to the sense [of sight]. On the other hand, the parts of a body that faces the eye directly are projected on perceptible areas of the eye because of the size of the [visual] angle [under which they are seen], so they are

Second is the relative ineptitude of translator 2, whose Latin is less felicitous (and commensurately harder to follow) than that of translator 1. Third is the apparent failure of translator 2 to understand the point of certain passages and, therefore, to misinterpret, or at least misrepresent, the basic intent of those passages.

²Or, more properly, line **TQK**; see figure 3.8, p. 264 above.

[2.83] Magnitudo autem corporis declinati non tantum
 60 secundum capacitatem anguli percipitur et consideratur sed,
 sicut dictum est, per angulum et longitudinis radii et etiam
 situs estimationem.

[CAPITULUM 3A]

De modis quibus error accidit visui

[3.1] Declaratum est in libro primo quod, ad hoc ut formas
 corporis visi directe visus comprehendat, necessaria est quo-
 rumdam aggregatio que sunt: longitudo; oppositio; lux non
 5 multum debilis; soliditas corporis; magnitudo eiusdem; rari-
 tas intermedii aeris. Si enim assuerit alicuius horum defectus,
 non erit visus.

[3.2] Planum est etiam ex libro secundo quod nichil penitus
 potest visus comprehendere ex corporibus nisi in tempore.
 10 Tempus igitur est unum eorum que necessaria sunt ad hoc ut
 fiat visus.

[3.3] Similiter infirmitas oculi impedit visum, quare sanitas
 est unum necessariorum.

[3.4] Amplius iam explanatum est in parte precedenti
 15 quod corpus multum elongatum ab axe occultatur visui, et si
 multum tunc fuerit declinatum, non plene comprehendetur.
 Necessarius est ergo situs ad complementum visus cum non
 plena fiat comprehensio nisi in situ determinato.

[3.5] Sunt igitur octo necessaria scilicet ad operationem
 20 visus, velut: situs, remotio, lux, magnitudo corporis, soliditas,
 raritas aeris, tempus, sanitas visus.

[3.6] Et quodlibet istorum latitudinem habet proportiona-
 tam ad rem visam. Verbi gratia, corpus aliquod ab aliqua dis-
 tantia plene comprehenditur, ab alia non plene. Inter illas est
 25 via lata in qua erit plena comprehensio corporis illius que via

59 corporis *mg.* O/tantum: tamen VatV2 60 percipitur *inter.* O/et *om.* O
 61 sicut *om.* FP1VatV2/post angulum *add.* (??) O 1 ante de *add.* pars tertia S
 2 ut: quod EP3 3 necessaria: necessarie P3/quorumdam (4): quarumdam Er
 4 post longitudo *add.* lux P1S (*scr.* et *del.* S) 8 etiam: et P3/penitus *om.* C1EErL3P3R
 10 unum *corr.* ex unus P3 12 ante similiter *add.* et C1L3/infirmitas *corr.* ex inut Er/
 quare . . . unum (13) *inter.* a. m. S 13 est: erit C1EErL3P3R 14 iam: autem
 C1EL3P3/precedenti: praecedente R 15 occultatur: occultabatur S 17 est ergo
transp. R/ad *inter.* L3/cum *corr.* ex tunc P1 18 ante nisi *scr.* et *del.* fiat Er/nisi *inter.* L3;
corr. ex visi a. m. C1 19 igitur: ergo R/post octo *scr.* et *del.* n Er/scilicet *om.* ErP1RS

made clear to the sense [of sight].

[2.83] The size of the inclined body, however, is not perceived and evaluated according to the size of the [visual] angle alone but, as has been said, according to the angle along with the length of the ray as well as the judgment of spatial disposition.

[CHAPTER 3A]

Concerning the ways in which sight happens to err

[3.1] It has been shown in the first book that, in order for the forms of a visible body that is directly seen by sight to be perceived, certain conditions must be met as a whole, i.e.: [there must be] spatial separation [between eye and object]; [the object must] face [the eye]; [there must be] light that is not too weak; the body [must possess some] opacity; the body [must possess some] size; and the intermediate air [must] be transparent. For if any of these is lacking, sight will not occur.

[3.2] In addition, it is obvious from the second book that sight can perceive no body whatever except over time. Thus time is one of those conditions that must be met in order for sight to take place.

[3.3] Likewise, a disease of the eye hinders sight, so a healthy eye is one of those requisite conditions.

[3.4] Furthermore, it has already been explained in the preceding section that a body that lies extremely far from the [visual] axis is hidden from sight, and if it is sharply inclined, it will not be perceived clearly. Thus, a [proper] spatial disposition is needed for perfect sight, since perception is not clear except according to a particular spatial disposition.

[3.5] Eight things are thus specifically needed for sight to operate [properly], i.e.: [a proper] spatial disposition, distance, light, bulk, opacity, transparency in the air, time, and a healthy eye.

[3.6] Moreover, each of these has a range that is proportionate to the visible object. For instance, a given body at a certain distance is clearly perceived, whereas at another it is not. There is a wide range between these [limits] within which that body will be clearly perceived, and this is the range of distances suited to [the perception

20 velut: longitudo C1EErL3P3R/remotio om. C1EErL3P3R 24 ante plene scr. et del. distantia
L3/post illas add. distantias R 25 via lata: latitudo magna R/erit: fit R/plena om. S/
corporis illius transp. R/via² om. R

est latitudo longitudinis respectu tanti corporis, et secundum quod maius fuerit corpus, maior erit latitudo distantie eius.

[3.7] Pari modo, cum magna fuerit corporis alicuius declinatione, non comprehenduntur note vel particule que sunt in eo. Si
 30 autem in eadem declinatione videatur corpus in quo maioris quantitatis note vel partes minus minute fuerint comprehenduntur. In minori autem declinatione corporis primi videbuntur eius minutie. Inter has declinationes sunt multe in quibus apparebunt note. Similiter corpus parvum circa axem situm vi-
 35 detur, multum elongatum occultatur, et in eadem elongatione corpus maius videbitur. Palam ergo quod situs habet latitudinem proportionatam ad corporis magnitudinem et minutias eiusdem.

[3.8] Lucem planum est habere latitudinem. Fortitudo enim
 40 lucis, cum magna fuerit, obfuscatur apparentiam corporis, et similiter fortis eiusdem debilitas. Sed erit corporum apparentia in lucibus intermediis. Preterea in luce aliqua quedam partes corporis comprehenduntur, et in eadem luce alie minutissime absconduntur que in luce maiori viderentur. Est igitur latitudo
 45 lucis proportionata ad magnitudinem corporis.

[3.9] Magnitudo corporis habet latitudinem. Si enim partes rei vise non fuerint proportionales totali, occultabuntur visui. Si vero sint proportionales, et corpus totale fuerit modicum, abscondentur; unde in avibus minutis particulas aliquas non
 50 percipimus etiam proportionales eis. Si autem magnum fuerit corpus visum et partes eius proportionales, non latebunt in tantum. Est igitur latitudo magnitudinis rei vise proportionata ad totale corpus cuius pars fuerit.

[3.10] Soliditas habet latitudinem proportionatam ad rem
 55 visam. Si enim in corpore aliquo color acutus fuerit, licet pauce soliditatis, videri poterit, quod eadem soliditate manente non

26 *post longitudinis add. in C1L3* 27 *maius corr. ex magis P1* 28 *corporis corr. ex corpus S* 29 *comprehenduntur: comprehendetur P1* 30 *quo: qua P1S*
 31 *vel: in Er/post partes add. et P1/post minute add. et S/comprehenduntur (32): comprehenduntur EP3R* 32 *videbuntur om. Er* 33 *minutie: minute L3/post minutie add. et est R/declinationes: declarationes Er/sunt . . . note (34): latitudo R/post multe add. declinationes C1L3 (inter. L3)* 34 *note om. EP3/parvum: unum P3*
 35 *elongatum corr. ex elongantum P1/elongatum occultatur transp. EP3* 36 *corpus maius transp. P1S/ergo: igitur P1* 37 *proportionatam corr. ex proportionata P3/corporis: corpus S* 38 *eiusdem: eius C1EL3P3R* 40 *lucis: lucium EL3P3*
 41 *fortis: etiam R/sed: et C1L3* 42 *post in¹ add. pluribus C1L3/lucibus: lucidis P3; corr. ex lucidis a. m. E/partes: particule C1* 43 *comprehenduntur: comprehenduntur C1EL3P3* 44 *igitur: ergo R* 45 *lucis: lucem Er* 47 *ante rei scr. et del. ita C1/rei a. m. C1* 48 *sint: fuerint C1R; sunt P1S/et corr. ex ad. C1*

of] such a body, so the larger the body is, the wider the range of distances [within which it will be properly perceived].

[3.7] By the same token, when a body is sharply inclined, its distinguishing marks or small parts will not be perceived. However, at the same inclination one may see a body whose distinguishing marks are larger or whose small parts are not so small, [and so those marks or parts] are perceived. Moreover, if the first body's inclination is not so sharp, its small features will be seen. Between these inclinations there are many according to which the distinguishing marks will be seen. Likewise, a small body lying at the [visual] axis is seen, [whereas] when it lies far away [from the visual axis] it becomes invisible, but at the same distance [from the axis] a larger body will be seen. It is therefore evident that spatial disposition has a range that is proportionate to the size of the body and its small features.

[3.8] It is obvious that light has a range. For the intensity of light, when it is great, renders a body obscure, and, like intensity, feebleness of light [also renders a body invisible]. But bodies will be visible in light of intermediate gradations. Moreover, in a given light certain [small] parts of a body are perceived, whereas in the same light other tiny features that would be seen in brighter light are invisible. For light, then, there is a range that is proportionate to the size of the body.

[3.9] The size of a body has a range. For if the parts of a visible object are not proportionate to the whole, they will be invisible to sight. Moreover, if they are proportionate [to the whole], but the whole body is small, they will be invisible; accordingly, in small birds we do not perceive certain minute parts, even though they are proportionate to the birds [as a whole]. If, however, the body that is seen is large, and its parts are proportionate, they will not be invisible to such an extent. There is thus a range of sizes for the [part of a] visible object that is proportionate to the whole body of which it is a part.

[3.10] Opacity has a range that is proportionate to the visible object. For if the color in some body is bright, even though the body may be [only] slightly opaque, the body can be seen, whereas if the body retained the same opacity, this would not happen if its

49 *ante abscondentur add. adhuc R / abscondentur: abscondetur P1R / in inter. a. m. Er / avibus corr. ex navibus L3 / post avibus add. et animalibus P1RS (et: vel S)* 50 *etiam: et P3; licet sint R / eis: eius EErL3P3; corr. ex eius C1* 51 *eius: ei Er; om. P1 / in tantum (52): usque ad eo R* 52 *latitudo corr. ex latitudin P1* 53 *totale corpus transp. P1S / fuerit: fuit C1* 54 *post soliditas add. autem P3R* 55 *acutus fuerit transp. P3*

accideret si color esset obtusus. Raritas aeris habet latitudinem.
 Si enim visui et scripture interponatur aer parum solidus, ut
 flamma vel fumus, scriptura non discernetur; pargamentum
 60 tamen videbitur. Et sic in huiusmodi est igitur proportionata
 hec latitudo secundum visa.

[3.11] Tempus habet latitudinem. Si quis enim per fora-
 men inspiciet corpus quod statim transeat, non percipietur.

[3.12] Similiter motus troci, quia velocissimus in tempore
 65 multum parvo, non attenditur. Similiter in motis accidit mul-
 tum parvo motu.

58 et: in *P1* 59 flamma *corr. ex* flammis *S* 60 videbitur: videtur *C1L3*/huius-
 modi *corr. ex* huius *a. m. S/post* huiusmodi *add. alijs R/igitur: ergo R* 63 inspiciet:
 inspiciat *P1R/quod om. S/transeat om. Er* 64 quia *om. P1S* 65 in . . . accidit:
 accidit in motis *C1ErL3P3R/motis: motu EP3R; moto Er; alter. ex motu in moto L3*
 66 *post* parvo *scr. et del. non attenditur P3/motu om. EEerL3P3R*

color were dull. The transparency of air has a range. For if air that is not particularly opaque, such as flame or smoke, is interposed between the eye and writing, the writing will not be perceived; yet the parchment [on which it is written] will still be seen. In such a case, therefore, the range [of transparency of the air] is proportionate to what is seen.

[3.11] Time has a range. For if someone looks through a window at a body that passes by in a flash, the body will not be [properly] perceived.

[3.12] The same holds for the motion of a top, which, being extremely swift and occurring in a small amount of time, is not noticed. The same happens in the case of moving objects that move quite slowly.

APPENDIX 2

This appendix consists of a complete listing of divisions, by chapters and subchapters, for all seventeen manuscripts as well as for the Risner edition (*R*). The incipits for all of the chapter-heads or subheads to be found in these eighteen exemplars are listed at the top of each table. For books 1-3, the location of each incipit is given by paragraph number in the critical Latin text. For books 4-7 that location is given by page-number in the Risner edition. Below each listing is a tabulation for every exemplar, chapter-by-chapter, or subdivision-by-subdivision. An “x” indicates the presence of that chapter in that particular exemplar. Parentheses around the “x” indicate a weak demarcation in the given text. Table 8, finally, groups the manuscripts according to the divisions and subdivisions they have in common.

TABLE 1
BOOK I: Chapter Divisions

| | | |
|----|--|--------|
| 1 | Invenimus visum quando inspexerit | (4.1) |
| 1a | Et invenimus etiam inspicientem | (4.6) |
| 2 | Et etiam videmus stellas in nocte | (4.8) |
| 2a | Et iterum quando aspiciens aspexerit | (4.11) |
| 3 | Et iterum visui multotiens latent | (4.18) |
| 4 | Et iterum invenimus multa corpora | (4.20) |
| 5 | Et cum luces fortes visibilium occultent | (4.27) |
| 6 | Oculus autem est compositus ex telis | (5.1) |
| 7 | Iam declaratum est superius quod | (6.1) |
| 8 | Tunice quas diximus in declaratione | (7.1) |
| 9 | Iam ergo declaratum est superius quod | (8.1) |

| | CH1 | CH1a | CH2 | CH2a | CH3 | CH4 | CH5 | CH6 | CH7 | CH8 | CH9 |
|------------|---------------------------|------|-----|------|-----|-----|-----|-----|-----|-----|-----|
| S | x | . | x | . | x | x | x | x | x | x | x |
| P1 | x | . | x | . | x | x | x | x | x | x | x |
| LE3 | -----section missing----- | | | | | | | | | x | x |
| PE | x | . | x | . | . | x | x | x | x | x | x |
| Er | x | . | x | . | x | . | x | x | x | x | x |
| C1 | x | . | x | . | x | . | x | x | x | x | x |
| E | x | . | x | . | . | x | x | x | x | x | x |
| R | x | . | x | . | . | x | . | x | x | x | x |
| O | x | . | x | . | x | . | x | x | x | x | x |

| | | | | | | | | | | | |
|-----|-----------------------------|---|---|---|---|---|---|---|---|---|---|
| L1 | x | . | x | . | x | . | x | x | x | x | . |
| L2 | x | x | x | x | . | x | x | x | x | x | x |
| C2 | x | . | x | . | x | x | x | x | . | x | x |
| P2 | x | . | x | . | . | x | x | x | . | x | x |
| M | x | . | x | . | x | . | x | x | . | x | x |
| F | ----- section missing ----- | | | | | | | | | | x |
| V1 | x | . | x | . | . | x | . | x | x | x | x |
| V2 | x | . | x | . | x | x | x | x | x | x | x |
| Vat | x | . | x | . | x | x | x | x | x | x | x |

TABLE 2A
BOOK II: Chapter Divisions

- | | | |
|----|---|--------|
| 1 | Declaratum est qualiter fiat visio | (1.1) |
| 2 | Iam declaratum est in primo tractatu | (2.1) |
| 3 | Sensus quidem visus nichil comprehendit | (3.1) |
| 3a | Et cum declarata sint omnia ista | (3.43) |
| 4 | Iam declaratum est quomodo visus | (4.1) |

| | CH 1 | CH 2 | CH 3 | CH 3A | CH 4 | |
|-----|-----------|-----------|---------------------|-----------|-----------|---|
| S | x | x | x | . | x | |
| P1 | x | x | x | . | x | |
| L3 | x | x | x | . | x | |
| P3 | x | x | x | x | x | |
| Er | x | x | x | . | x | |
| C1 | x | x | x | . | x | |
| E | x | x | x | x | x | |
| R | x (prol.) | x (ch. 1) | . | x (ch. 2) | x (ch. 3) | |
| O | x | x | x | . | x | |
| L1 | x | x | x | . | . | |
| L2 | x | x | x | x | x | |
| C2 | x | x | x | . | . | |
| P2 | x | x | x | x | x | |
| M | . | x | x | . | x | |
| F | x | x | ----- missing ----- | | | x |
| V1 | x | (x) | x | . | x | |
| V2 | x | x | x | . | x | |
| Vat | x | x | x | . | x | |

TABLE 2B

BOOK II: Subdivisions in Chapter 3

| | | |
|----|---|---------|
| 1 | Et cum declarata sint omnia ista | (3.43) |
| 2 | Sed remotio rei vise a visu non | (3.67) |
| 3 | Situs vero quem visus comprehendit | (3.94) |
| 4 | Corporeitas vero, que est extensio | (3.121) |
| 5 | Figura autem rei vise dividitur in duo | (3.127) |
| 6 | Magnitudo vero et quantitas rei vise | (3.135) |
| 7 | Distinctio vero que est inter visibilia | (3.172) |
| 8 | Continuatio autem comprehenditur | (3.175) |
| 9 | Numerus vero comprehenditur a visu | (3.177) |
| 10 | Motus autem comprehenditur a visu | (3.178) |
| 11 | Quies autem comprehenditur a visu | (3.188) |
| 12 | Asperitas vero comprehenditur a visu | (3.189) |
| 13 | Planities autem est equalitas superficiei | (3.192) |
| 14 | Diafonitas autem comprehenditur | (3.195) |
| 15 | Spissitudo comprehenditur a visu | (3.197) |
| 16 | Umbra vero comprehenditur a visu | (3.198) |
| 17 | Obscuritas vero comprehenditur | (3.199) |
| 18 | Pulcritudo comprehenditur a visu | (3.200) |
| 19 | Turpitudine vero est forma carens | (3.232) |
| 20 | Consimilitudo autem est equalitas | (3.233) |
| 21 | Diversitas autem comprehenditur | (3.234) |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|-----|----------------------------|-----|---|-----|-----|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
| S | . | . | . | . | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| P1 | . | . | . | x | x | x | . | . | . | x | . | . | . | x | . | . | . | . | . | . | . |
| L3 | . | x | . | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| P3 | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Er | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| C1 | . | . | . | . | . | . | . | x | x | x | . | . | . | . | . | . | . | . | . | . | . |
| E | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| R | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| O | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| L1 | . | x | . | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| L2 | x | x | x | x | . | x | x | x | x | x | x | x | x | x | x | x | x | x | . | x | x |
| C2 | . | x | . | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| P2 | x | x | x | x | x | x | x | . | . | x | x | x | x | x | x | x | x | x | x | x | x |
| M | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| F | -----missing section ----- | | | | | | | | | | | | | | | | | | | | |
| V1 | . | (x) | . | (x) | (x) | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| V2 | . | . | . | x | x | x | . | . | . | x | . | . | . | x | . | . | . | . | . | . | . |
| Vat | . | . | . | x | x | x | . | . | . | x | . | . | . | x | . | . | . | . | . | . | . |

TABLE 3A
BOOK III: Chapter Divisions

| | | |
|----|---------------------------------------|--------------|
| 1 | Declaratum est in primo tractatu | (1.1) |
| 2 | Declaratum est in primo tractatu | (2.1) |
| 3 | Declaratum est in ipso primo tractatu | (3.1) |
| 3a | Declaratum est in libro primo quod | (Appendix 1) |
| 4 | Planum est ex libro secundo quod | (4.1) |
| 5 | Ex predictis palam quod non est | (5.1) |
| 6 | Dictum est in libro secundo quod | (6.1) |
| 7 | Plurima eorum quorum in visu sit | (7.1) |

| | CH1 | CH2 | CH3 | CH3A | CH4 | CH5 | CH6 | CH7 |
|-----|-----|-----|-----|------|-----|-----|-----|-----|
| S | x | x | x | x | x | x | x | x |
| P1 | x | x | x | x | x | x | x | x |
| L3 | x | x | . | x | x | x | x | x |
| P3 | x | x | . | x | x | x | x | x |
| Er | x | x | . | x | x | x | x | x |
| C1 | x | x | . | x | x | x | x | x |
| E | x | x | . | x | x | x | x | x |
| R | x | x | . | x | x | x | x | x |
| O | x | x | x | x | x | x | x | x |
| L1 | x | . | . | x | x | x | x | x |
| L2 | x | x | . | x | x | x | x | x |
| C2 | x | . | . | x | x | x | x | x |
| P2 | x | x | . | x | x | x | x | x |
| M | x | x | . | x | x | x | x | x |
| F | x | x | x | x | x | x | x | x |
| V1 | x | x | . | x | x | x | x | x |
| V2 | x | x | x | x | x | x | x | x |
| Vat | x | x | x | x | x | x | x | x |

TABLE 3B
BOOK III: Subdivisions in Chapter 7

| | | |
|---|---|---------|
| 1 | In longitudine, si videantur | (7.63) |
| 2 | In longitudine ex lucis parvitate | (7.104) |
| 3 | Error erit in longitudine ex causa | (7.131) |
| 4 | In longitudine: Si minima fuerit | (7.163) |
| 5 | In longitudine: Si fuerit aer pruinosis | (7.193) |
| 6 | In longitudine: Si subito intueatur | (3.217) |
| 7 | In longitudine: Si opponantur visui | (7.250) |
| 8 | Iam diximus quomodo accidit error | (7.279) |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----|---|---|---|---|---|---|---|---|
| S | . | . | . | x | x | x | x | . |
| P1 | . | . | x | . | . | x | x | . |
| L3 | . | . | x | x | x | x | x | . |
| P3 | . | . | . | . | . | . | . | . |
| Er | . | . | x | x | x | x | x | . |
| C1 | . | . | x | x | x | x | x | . |
| E | . | . | . | . | . | . | . | . |
| R | x | x | x | x | x | x | x | x |
| O | . | x | x | x | x | x | x | . |
| L1 | . | . | x | x | x | x | x | . |
| L2 | x | x | x | x | x | x | x | x |
| C2 | . | . | x | x | x | . | x | . |
| P2 | . | . | . | . | . | . | . | . |
| M | . | . | x | x | x | x | x | . |
| F | . | . | x | . | . | x | x | . |
| V1 | . | . | . | . | . | . | . | . |
| V2 | . | . | x | . | . | x | x | . |
| Vat | . | . | x | . | . | x | x | . |

TABLE 4
BOOK IV: Chapter Divisions

| | | |
|----|-----------------------------------|-------|
| 1 | Iam explanavimus in libris tribus | (102) |
| 2 | Planum est ex libro primo quod | (102) |
| 3 | Politum est laeve multum | (104) |
| 4 | Super modum comprehensionis | (113) |
| 5 | Iam patuit in parte superiori | (114) |
| 5a | In speculis autem columnaribus | (116) |

| | CH 1 | CH 2 | CH 3 | CH 4 | CH 5 | CH 5A |
|-----|------|------|------|------|------|-------|
| S | x | x | x | x | x | . |
| P1 | x | x | x | x | x | . |
| L3 | x | x | x | x | x | x |
| P3 | x | x | x | x | x | . |
| Er | x | x | x | x | x | x |
| C1 | x | x | x | x | x | (x) |
| E | x | x | x | x | x | . |
| R | x | x | x | x | x | . |
| O | x | x | x | x | x | . |
| L1 | x | x | x | x | x | x |
| L2 | x | x | x | x | x | . |
| C2 | x | x | x | x | x | x |
| P2 | x | x | x | x | x | x |
| M | x | x | x | x | x | x |
| F | x | x | x | x | x | . |
| V1 | x | x | x | x | x | . |
| V2 | x | x | x | x | x | . |
| Vat | x | x | x | x | x | . |

TABLE 5
BOOK V: Chapter Divisions

| | | |
|----|--|-------|
| 1 | Liquet ex quarto libro quod formae rerum | (125) |
| 2 | Imaginis cuiuscunque puncti locus est | (125) |
| 2a | In speculis sphaericis extra politis patebit | (134) |
| 2b | Restat iam ut loca imaginum certius | (137) |
| 2c | In speculis exterioribus pyramidalibus | (156) |
| 2d | In speculis sphaericis concavis aliquando | (162) |
| 2e | In speculis columnaribus concavis | (182) |
| 2f | In speculis pyramidalibus concavis | (185) |

| | CH 1 | CH 2 | CH 2a | CH 2b | CH 2c | CH 2d | CH 2e | CH 2f |
|-----|------|------|-------|-------|-------|-------|-------|-------|
| S | x | x | . | . | . | x | . | . |
| P1 | x | x | . | . | . | x | x | . |
| L3 | x | x | . | . | . | x | x | . |
| P3 | x | x | . | . | . | . | . | . |
| Er | x | . | . | . | . | x | . | . |
| C1 | x | x | . | x | . | . | . | (x) |
| E | x | x | . | . | . | . | . | . |
| R | x | x | . | . | . | . | . | . |
| O | x | x | . | . | x | . | x | . |
| L1 | x | x | . | . | . | . | x | . |
| L2 | x | x | . | . | . | (x) | . | . |
| C2 | x | x | . | . | . | x | x | . |
| P2 | x | x | . | . | . | x | . | . |
| M | x | . | . | x | . | x | . | x |
| F | x | x | . | . | . | x | x | . |
| V1 | x | x | . | . | . | (x) | . | . |
| V2 | x | x | x | . | . | x | x | . |
| Vat | x | x | . | . | . | x | x | . |

TABLE 6
BOOK VI: Chapter Divisions

| | | |
|----|---|-----------------|
| 1 | Patuit ex superioribus libris modus | (188) |
| 2 | Comprehensionem formarum in visu | (188) |
| 3 | In singulis speculis erronea formarum | (189) |
| 4 | Universitas errorum in speculis planis | (189) |
| 5 | Amplius in speculis columnaribus | (205) |
| 6 | Amplius in speculis pyramidalibus | (209) |
| 6a | Capitulum sextum de fallaciis que | (not in Risner) |
| 6b | Hoc declarato dicamus cum visus | (211) |
| 7 | In hiis vero plures errores accidunt | (214) |
| 7a | Et si habuerit alias imagines forte erunt | (225) |
| 8 | In his autem accidunt similes eis qui | (225) |
| 9 | In his autem accidunt illae fallaciae | (229) |

| | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH6a | CH6b | CH7 | CH7a | CH8 | CH9 |
|-----|-----|-----|-----|-----|-----|-----|------|------|-----|------|-----|-----|
| S | x | (x) | (x) | x | . | . | . | x | x | . | x | x |
| P1 | x | x | x | x | x | x | . | . | x | . | x | x |
| L3 | x | x | x | x | x | x | x | . | x | . | x | x |
| P3 | x | x | x | x | x | x | . | . | . | . | x | x |
| Er | x | (x) | (x) | x | x | . | . | x | x | . | x | x |
| C1 | x | (x) | (x) | x | . | . | . | . | x | . | x | x |
| E | x | x | (x) | x | x | x | . | . | (x) | . | x | x |
| R | x | x | x | x | x | x | . | . | x | . | x | x |
| O | x | (x) | (x) | x | x | x | x | . | (x) | . | x | x |
| L1 | x | x | . | x | x | x | . | . | (x) | . | x | x |
| L2 | x | x | (x) | x | . | . | . | . | x | . | x | x |
| C2 | x | x | x | x | x | x | x | . | x | . | x | x |
| P2 | x | x | x | x | x | x | . | . | x | . | x | x |
| M | x | (x) | x | x | . | . | . | . | x | x | x | x |
| F | x | x | x | x | x | . | . | . | x | . | x | x |
| V1 | x | x | x | x | x | x | . | . | x | . | x | x |
| V2 | x | x | (x) | x | x | x | . | . | x | . | x | x |
| Vat | x | x | x | x | x | . | . | . | x | . | x | x |

TABLE 7
BOOK VII: Chapter Divisions

| | | |
|---|--|-------|
| 1 | Praedictum est in prooemio quarti tractatus | (231) |
| 2 | Quod lumen quidem transeat in aerem | (231) |
| 3 | In predicto capitulo declaratum est quod | (242) |
| 4 | Quod quicquid comprehendit ultra | (247) |
| 5 | Imago est forma rei visibilis quam visus | (253) |
| 6 | In praecedentibus iam declaravimus quod | (266) |
| 7 | Fallaciae que accidunt secundum refractionem | (270) |

| | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 |
|-----|-----|-----|-----|-----|-----|-----|-----|
| S | x | x | x | x | x | x | x |
| P1 | x | (x) | x | x | x | x | x |
| L3 | x | (x) | x | x | x | x | x |
| P3 | x | x | x | x | x | x | x |
| Er | x | . | x | x | x | x | x |
| C1 | x | (x) | x | x | x | x | x |
| E | x | x | x | x | x | x | x |
| R | x | x | x | x | x | x | x |
| O | x | (x) | x | x | x | x | x |
| L1 | x | (x) | x | x | x | x | x |
| L2 | x | (x) | x | x | x | x | x |
| C2 | x | (x) | x | x | x | x | x |
| P2 | x | x | x | x | x | x | x |
| M | x | (x) | x | x | x | x | x |
| F | x | (x) | x | x | x | x | x |
| V1 | x | (x) | x | x | x | x | x |
| V2 | x | (x) | x | x | x | x | x |
| Vat | x | x | x | x | x | x | x |

TABLE 8

This table contains all the tabulations from the seven previous tables arranged according to chapter divisions and subdivisions that are common to given sets of manuscripts. Thus, for book 1, *S*, *P1*, *V2*, and *Vat* all have the same divisions, as do *E* and *P3*, etc.

| 8.1: BOOK I | | | | | | | | | | | | 8.2: BOOK II | | | | | | |
|-------------|-------|----|---|----|---|----|---|---|---|---|---|--------------|---------|-------|---------|-------|-------|--|
| | 1 | 1a | 2 | 2a | 3 | 3a | 4 | 5 | 6 | 7 | 8 | | 1 | 2 | 3 | 4 | 5 | |
| S | x | . | x | . | x | x | x | x | x | x | x | P3 | x | x | x | x | x | |
| P1 | x | . | x | . | x | x | x | x | x | x | x | E | x | x | x | x | x | |
| V2 | x | . | x | . | x | x | x | x | x | x | x | L2 | x | x | x | x | x | |
| Vat | x | . | x | . | x | x | x | x | x | x | x | P2 | x | x | x | x | x | |
| | | | | | | | | | | | | | | | | | | |
| P3 | x | . | x | . | . | x | x | x | x | x | x | L1 | x | x | x | . | . | |
| Er | x | . | x | . | . | x | x | x | x | x | x | C2 | x | x | x | . | . | |
| | | | | | | | | | | | | | | | | | | |
| R | x | . | x | . | . | x | . | x | x | x | x | R | x (pr.) | x (1) | . | x (2) | x (3) | |
| V1 | x | . | x | . | . | x | . | x | x | x | x | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| Er | x | . | x | . | x | . | x | x | x | x | x | S | x | x | x | . | x | |
| C1 | x | . | x | . | x | . | x | x | x | x | x | P1 | x | x | x | . | x | |
| O | x | . | x | . | x | . | x | x | x | x | x | L3 | x | x | x | . | x | |
| | | | | | | | | | | | | Er | x | x | x | . | x | |
| L1 | x | . | x | . | x | . | x | x | x | x | . | C1 | x | x | x | . | x | |
| | | | | | | | | | | | | O | x | x | x | . | x | |
| L2 | x | x | x | x | . | x | x | x | x | x | x | V1 | x | (x) | x | . | x | |
| | | | | | | | | | | | | V2 | x | x | x | . | x | |
| C2 | x | . | x | . | x | x | x | x | . | x | x | Vat | x | x | x | . | x | |
| | | | | | | | | | | | | | | | | | | |
| P2 | x | . | x | . | . | x | x | x | . | x | x | | | | | | | |
| | | | | | | | | | | | | M | . | x | x | . | x | |
| M | x | . | x | . | x | . | x | x | . | x | x | | | | | | | |
| | | | | | | | | | | | | F | x | x | ----- x | | | |
| L3 | ----- | | | | | | | | | | x | x | | | | | | |
| F | ----- | | | | | | | | | | x | | | | | | | |

8.3: BK II, CH. 3

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|-----|-------|-----|---|-----|-----|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
| P1 | . | . | . | x | x | x | . | . | . | x | . | . | . | x | . | . | . | . | . | . | . |
| V2 | . | . | . | x | x | x | . | . | . | x | . | . | . | x | . | . | . | . | . | . | . |
| Vat | . | . | . | x | x | x | . | . | . | x | . | . | . | x | . | . | . | . | . | . | . |
| L3 | . | x | . | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| L1 | . | x | . | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| C2 | . | x | . | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| P3 | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| E | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| R | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| L2 | x | x | x | x | . | x | x | x | x | x | x | x | x | x | x | x | x | x | . | x | x |
| P2 | x | x | x | x | x | x | x | . | . | x | x | x | x | x | x | x | x | x | x | x | x |
| S | . | . | . | . | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Er | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| O | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| M | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| C1 | . | . | . | . | . | . | . | x | x | x | . | . | . | . | . | . | . | . | . | . | . |
| V1 | . | (x) | . | (x) | (x) | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| F | ----- | | | | | | | | | | | | | | | | | | | . | . |

8.4: BOOK III

| | 1 | 2 | 3 | 3a | 4 | 5 | 6 | 7 |
|-----|---|---|---|----|---|---|---|---|
| S | x | x | x | x | x | x | x | x |
| P1 | x | x | x | x | x | x | x | x |
| O | x | x | x | x | x | x | x | x |
| F | x | x | x | x | x | x | x | x |
| V2 | x | x | x | x | x | x | x | x |
| Vat | x | x | x | x | x | x | x | x |
| L3 | x | x | . | x | x | x | x | x |
| P3 | x | x | . | x | x | x | x | x |
| Er | x | x | . | x | x | x | x | x |
| C1 | x | x | . | x | x | x | x | x |
| E | x | x | . | x | x | x | x | x |
| L2 | x | x | . | x | x | x | x | x |
| P2 | x | x | . | x | x | x | x | x |
| M | x | x | . | x | x | x | x | x |
| V1 | x | x | . | x | x | x | x | x |
| R | x | x | . | x | x | x | x | x |
| L1 | x | . | . | x | x | x | x | x |
| C2 | x | . | . | x | x | x | x | x |

8.5: BOOK III, CH. 7

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----|---|---|---|---|---|---|---|---|
| S | . | . | . | x | x | x | x | . |
| P1 | . | . | x | . | . | x | x | . |
| F | . | . | x | . | . | x | x | . |
| V2 | . | . | x | . | . | x | x | . |
| Vat | . | . | x | . | . | x | x | . |
| P3 | . | . | . | . | . | . | . | . |
| E | . | . | . | . | . | . | . | . |
| P2 | . | . | . | . | . | . | . | . |
| V1 | . | . | . | . | . | . | . | . |
| L3 | . | . | x | x | x | x | x | . |
| Er | . | . | x | x | x | x | x | . |
| C1 | . | . | x | x | x | x | x | . |
| L1 | . | . | x | x | x | x | x | . |
| M | . | . | x | x | x | x | x | . |
| O | . | . | x | x | x | x | . | . |
| R | x | x | x | x | x | x | x | x |
| L2 | x | x | x | x | x | x | x | x |
| C2 | . | . | x | x | x | . | x | . |

8.6: BOOK IV

| | 1 | 2 | 3 | 4 | 5 | 5a |
|-----|---|---|---|---|---|-----|
| L3 | x | x | x | x | x | x |
| Er | x | x | x | x | x | x |
| C1 | x | x | x | x | x | (x) |
| L1 | x | x | x | x | x | x |
| C2 | x | x | x | x | x | x |
| P2 | x | x | x | x | x | x |
| M | x | x | x | x | x | x |
| S | x | x | x | x | x | . |
| P1 | x | x | x | x | x | . |
| P3 | x | x | x | x | x | . |
| E | x | x | x | x | x | . |
| R | x | x | x | x | x | . |
| O | x | x | x | x | x | . |
| L2 | x | x | x | x | x | . |
| F | x | x | x | x | x | . |
| V1 | x | x | x | x | x | . |
| V2 | x | x | x | x | x | . |
| Vat | x | x | x | x | x | . |

8.7: BOOK V

| | 1 | 2 | 2a | 2b | 2c | 2d | 2e | 2f |
|-----|---|---|----|----|----|-----|----|-----|
| P1 | x | x | . | . | . | x | x | . |
| L3 | x | x | . | . | . | x | x | . |
| F | x | x | . | . | . | x | x | . |
| Vat | x | x | . | . | . | x | x | . |
| C2 | x | x | . | . | . | x | x | . |
| V2 | x | x | x | . | . | x | x | . |
| E | x | x | . | . | . | . | . | . |
| R | x | x | . | . | . | . | . | . |
| P3 | x | x | . | . | . | . | . | . |
| V1 | x | x | . | . | . | (x) | . | . |
| L2 | x | x | . | . | . | (x) | . | . |
| P2 | x | x | . | . | . | x | . | . |
| S | x | x | . | . | . | x | . | . |
| L1 | x | x | . | . | . | . | x | . |
| Er | x | . | . | . | . | x | . | . |
| C1 | x | x | . | x | . | . | . | (x) |
| M | x | . | . | x | . | x | . | x |
| O | x | x | . | . | x | . | x | . |

8.8: BOOK VI

| | 1 | 2 | 3 | 4 | 5 | 6 | 6a | 6b | 7 | 7a | 8 | 9 |
|-----|---|-----|-----|---|---|---|----|----|-----|----|---|---|
| S | x | (x) | (x) | x | . | . | . | x | x | . | x | x |
| P1 | x | x | x | x | x | x | . | . | x | . | x | x |
| E | x | x | (x) | x | x | x | . | . | (x) | . | x | x |
| R | x | x | x | x | x | x | . | . | x | . | x | x |
| V1 | x | x | x | x | x | x | . | . | x | . | x | x |
| V2 | x | x | (x) | x | x | x | . | . | x | . | x | x |
| P2 | x | x | x | x | x | x | . | . | x | . | x | x |
| L1 | x | x | . | x | x | x | . | . | (x) | . | x | x |
| L3 | x | x | x | x | x | x | x | . | x | . | x | x |
| O | x | (x) | (x) | x | x | x | x | . | (x) | . | x | x |
| C2 | x | x | x | x | x | x | x | . | x | . | x | x |
| P3 | x | x | x | x | x | x | . | . | . | . | x | x |
| Er | x | (x) | (x) | x | x | . | . | . | x | x | . | x |
| C1 | x | (x) | (x) | x | . | . | . | . | x | . | x | x |
| L2 | x | x | (x) | x | . | . | . | . | x | . | x | x |
| M | x | (x) | x | x | . | . | . | . | x | x | x | x |
| F | x | x | x | x | x | . | . | . | x | . | x | x |
| Vat | x | x | x | x | x | . | . | . | x | . | x | x |

8.9: BOOK VII

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-----|---|-----|---|---|---|---|---|
| S | x | x | x | x | x | x | x |
| E | x | x | x | x | x | x | x |
| R | x | x | x | x | x | x | x |
| P3 | x | x | x | x | x | x | x |
| P2 | x | x | x | x | x | x | x |
| Vat | x | x | x | x | x | x | x |
| P1 | x | (x) | x | x | x | x | x |
| L3 | x | (x) | x | x | x | x | x |
| C1 | x | (x) | x | x | x | x | x |
| O | x | (x) | x | x | x | x | x |
| L1 | x | (x) | x | x | x | x | x |
| L2 | x | (x) | x | x | x | x | x |
| C2 | x | (x) | x | x | x | x | x |
| M | x | (x) | x | x | x | x | x |
| F | x | (x) | x | x | x | x | x |
| V1 | x | (x) | x | x | x | x | x |
| V2 | x | (x) | x | x | x | x | x |
| Er | x | . | x | x | x | x | x |

APPENDIX 3

This appendix provides a listing of all the idiosyncratic and shared variants for each of the seventeen manuscripts, except P3.

Table 1 on the following page gives a summary of results. Each line-couple provides a comparison of all manuscripts by total score. The manuscript listed to the left in each line-couple constitutes the reference-manuscript, so the number next to it represents its score for idiosyncratic variants. In the first line-couple, for instance, O, the reference-manuscript, has an overall score of 1377 for idiosyncratic variants. The next manuscript in line, Er, has a score of 1423 for variants shared with O, and so on down the line. For each line-couple, the manuscripts are listed in descending order by score, from highest to lowest, for shared variants. Again, in the first line-couple Er has the highest score for shared variants, M the next highest, and so on down the line to L3, which has the lowest. The higher the score, then, the more closely related the given manuscript should be to the reference-manuscript.

Tables 2-17 give a complete breakdown of idiosyncratic and shared variants for each reference-manuscript according to type of variant. The format for these tables is precisely the same as that for Table 1 in "Manuscripts and Editing," p. clxiv

TABLE I

| | | | | | | | | | | | | | | | | |
|-----------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| O | 1377 | Er | M | S | P1 | F | C1 | L2 | V2 | P2 | C2 | Va | V1 | E | L1 | L3 |
| | | 1423 | 1093 | 686 | 582 | 581 | 532 | 469 | 464 | 452 | 445 | 441 | 399 | 395 | 343 | 333 |
| E | 643 | P2 | L1 | C2 | V1 | L3 | V2 | Er | C1 | O | P1 | M | Va | L2 | S | F |
| | | 3061 | 1293 | 1111 | 1007 | 774 | 593 | 506 | 460 | 395 | 374 | 373 | 274 | 251 | 191 | 185 |
| L1 | 3374 | E | C2 | P2 | L3 | V1 | V2 | Er | C1 | M | Va | L2 | O | P1 | S | F |
| | | 1293 | 1171 | 1102 | 1013 | 785 | 687 | 573 | 557 | 438 | 401 | 396 | 343 | 335 | 291 | 207 |
| L2 | 1927 | P1 | Va | F | V2 | S | O | M | L1 | V1 | C2 | C1 | Er | E | P2 | L3 |
| | | 1095 | 1049 | 967 | 851 | 819 | 469 | 397 | 396 | 365 | 308 | 295 | 292 | 251 | 233 | 206 |
| L3 | 1219 | L1 | C2 | E | P2 | C1 | V1 | Er | M | O | V2 | L2 | S | Va | P1 | F |
| | | 1013 | 909 | 774 | 768 | 749 | 677 | 432 | 362 | 333 | 319 | 206 | 195 | 191 | 169 | 130 |
| C1 | 1344 | L3 | Er | C2 | L1 | M | V1 | O | P2 | E | S | L2 | V2 | Va | F | P1 |
| | | 749 | 671 | 587 | 557 | 547 | 536 | 532 | 519 | 460 | 297 | 295 | 276 | 226 | 202 | 179 |
| C2 | 6096 | L1 | E | P2 | L3 | V1 | Er | C1 | M | O | V2 | L2 | Va | S | P1 | F |
| | | 1171 | 1111 | 1005 | 909 | 901 | 626 | 587 | 461 | 445 | 394 | 308 | 281 | 274 | 265 | 163 |
| P1 | 1689 | Va | F | V2 | L2 | S | O | V1 | M | E | L1 | P2 | C2 | Er | C1 | L3 |
| | | 2440 | 2263 | 1809 | 1095 | 879 | 852 | 384 | 376 | 374 | 335 | 330 | 265 | 261 | 179 | 169 |
| P2 | 1439 | E | L1 | V1 | C2 | L3 | V2 | C1 | Er | O | M | Va | P1 | S | L2 | F |
| | | 3061 | 1102 | 1030 | 1005 | 768 | 558 | 519 | 516 | 452 | 403 | 386 | 330 | 274 | 233 | 222 |
| M | 2442 | O | Er | C1 | V1 | C2 | L1 | V2 | S | P2 | L2 | P1 | E | L3 | F | Va |
| | | 1093 | 778 | 547 | 515 | 461 | 438 | 425 | 422 | 402 | 397 | 376 | 373 | 362 | 350 | 338 |
| F | 154 | P1 | Va | V2 | L2 | S | O | M | Er | V1 | P2 | L1 | C1 | E | C2 | L3 |
| | | 2263 | 2159 | 1476 | 967 | 753 | 581 | 350 | 256 | 233 | 222 | 207 | 202 | 185 | 163 | 130 |
| V1 | 2280 | P2 | E | C2 | L1 | L3 | C1 | V2 | M | Er | O | Va | P1 | S | L2 | F |
| | | 1030 | 1007 | 901 | 785 | 677 | 536 | 527 | 515 | 431 | 399 | 394 | 384 | 380 | 365 | 233 |
| V2 | 2038 | Va | P1 | F | S | L2 | L1 | E | P2 | V1 | O | M | C2 | L3 | Er | C1 |
| | | 2467 | 1809 | 1476 | 946 | 851 | 687 | 593 | 558 | 527 | 464 | 425 | 394 | 319 | 284 | 276 |
| Er | 1159 | O | M | C1 | S | C2 | L1 | P2 | E | L3 | V1 | Va | L2 | V2 | P1 | F |
| | | 1423 | 778 | 671 | 628 | 626 | 573 | 516 | 506 | 432 | 431 | 332 | 292 | 284 | 261 | 256 |
| Va | 1261 | V2 | P1 | F | L2 | S | O | L1 | V1 | P2 | M | Er | C2 | E | C1 | L3 |
| | | 2467 | 2440 | 2159 | 1049 | 1029 | 441 | 401 | 394 | 386 | 338 | 332 | 281 | 274 | 226 | 191 |
| S | 1101 | Va | V2 | P1 | L2 | F | O | Er | M | V1 | C1 | L1 | C2 | P2 | L3 | E |
| | | 1028 | 946 | 879 | 819 | 753 | 686 | 628 | 422 | 380 | 297 | 291 | 274 | 274 | 195 | 191 |

TABLE 2

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|------|-------|-------|---|-------|------|-------|------|
| O | 27.0 | 16.0 | 11.0 | 157.5 | 144.0 | | 101.5 | 16.0 | 97.0 | 1377 |
| Er | 20.5 | 10.0 | | 65.0 | 60.5 | | 71.0 | 42.0 | 169.0 | 1423 |
| M | 13.5 | 9.0 | | 43.0 | 46.0 | | 51.0 | 56.0 | 146.0 | 1093 |
| S | 6.0 | 5.0 | | 39.0 | 25.5 | | 39.0 | 13.0 | 87.5 | 686 |
| P1 | 4.0 | 3.0 | | 27.0 | 24.5 | | 47.0 | 7.0 | 82.0 | 582 |
| F | 8.0 | 1.0 | | 23.0 | 20.5 | | 52.0 | 9.0 | 86.5 | 581 |
| C1 | 2.5 | 7.5 | | 21.0 | 27.0 | | 21.0 | 23.0 | 79.0 | 532 |
| L2 | 6.0 | 3.0 | | 25.0 | 9.5 | | 35.0 | 12.0 | 64.5 | 469 |
| V2 | 5.0 | 2.0 | | 27.0 | 12.5 | | 33.5 | 4.0 | 69.5 | 464 |
| P2 | 1.5 | 6.0 | | 23.0 | 13.5 | | 25.0 | 7.0 | 96.0 | 452 |
| C2 | 2.0 | 5.5 | | 21.5 | 15.0 | | 30.0 | 5.0 | 79.0 | 445 |
| Va | 6.5 | 2.0 | | 19.0 | 16.0 | | 38.0 | 4.0 | 50.0 | 441 |
| V1 | 3.0 | 5.5 | | 24.5 | 15.0 | | 10.0 | 5.0 | 66.0 | 399 |
| E | 1.5 | 1.5 | | 26.0 | 14.5 | | 22.5 | 5.0 | 63.0 | 395 |
| L1 | 2.5 | 1.5 | | 22.0 | 11.0 | | 16.5 | 7.0 | 58.0 | 343 |
| L3 | 2.5 | 6.0 | | 17.0 | 10.0 | | 13.5 | 4.0 | 62.0 | 333 |

TABLE 3

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|-------|-------|-----|-------|-------|-------|------|
| E | 5.0 | 13.0 | 1.0 | 22.0 | 25.0 | 2.0 | 34.0 | 28.0 | 64.0 | 643 |
| P2 | 26.0 | 38.0 | 2.0 | 140.5 | 129.0 | | 134.0 | 153.0 | 313.0 | 3061 |
| L1 | 19.0 | 9.5 | 1.0 | 71.5 | 40.5 | | 56.0 | 42.0 | 155.0 | 1293 |
| C2 | 14.0 | 10.0 | 1.0 | 58.5 | 38.0 | | 52.0 | 39.0 | 122.5 | 1111 |
| V1 | 10.5 | 11.0 | | 46.0 | 48.5 | | 46.5 | 26.0 | 114.5 | 1007 |
| L3 | 7.5 | 8.5 | | 37.5 | 27.0 | | 42.0 | 25.0 | 102.0 | 774 |
| V2 | 11.5 | 4.0 | | 19.0 | 30.5 | | 23.0 | 24.0 | 73.5 | 593 |
| Er | 5.0 | 5.0 | | 32.0 | 13.0 | | 23.0 | 12.0 | 71.0 | 506 |
| C1 | 5.0 | 5.5 | | 16.0 | 16.0 | | 30.0 | 19.0 | 66.5 | 460 |
| O | 1.5 | 1.5 | | 26.0 | 14.5 | | 22.5 | 5.0 | 63.0 | 395 |
| P1 | 3.0 | 3.0 | | 15.0 | 28.5 | | 13.0 | 2.0 | 47.5 | 374 |
| M | 1.0 | 4.0 | | 14.0 | 17.5 | | 19.0 | 13.0 | 77.5 | 373 |
| Va | 2.0 | 2.0 | | 11.0 | 16.0 | | 14.0 | 7.0 | 38.0 | 274 |
| L2 | 0.5 | 1.5 | | 11.5 | 10.0 | | 17.0 | 7.0 | 50.0 | 251 |
| S | 3.0 | 0.5 | | 12.0 | 7.0 | | 5.0 | 4.0 | 30.0 | 191 |
| F | 1.5 | 2.0 | | 6.0 | 10.5 | | 10.0 | 3.0 | 31.0 | 185 |

TABLE 4

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|-------|------|-----|-------|------|-------|------|
| L1 | 83.0 | 12.0 | 3.0 | 190.5 | 74.0 | 2.0 | 163.0 | 69.0 | 362.0 | 3374 |
| E | 19.0 | 9.5 | 1.0 | 71.5 | 40.5 | | 56.0 | 42.0 | 155.0 | 1293 |
| C2 | 14.0 | 6.0 | | 69.0 | 35.5 | | 61.0 | 41.0 | 140.5 | 1171 |
| P2 | 12.0 | 9.0 | | 57.5 | 41.5 | | 44.0 | 43.0 | 151.0 | 1102 |
| L3 | 11.5 | 7.5 | | 43.5 | 37.5 | | 61.5 | 32.5 | 151.0 | 1013 |
| V1 | 6.0 | 4.0 | | 38.0 | 30.5 | | 38.5 | 35.0 | 133.0 | 785 |
| V2 | 9.5 | 1.0 | | 47.5 | 19.5 | | 32.0 | 13.0 | 89.0 | 687 |
| Er | 5.0 | 6.0 | 1.0 | 36.0 | 14.0 | | 22.0 | 20.0 | 80.5 | 573 |
| C1 | 4.5 | 3.5 | | 15.5 | 29.0 | | 36.0 | 25.0 | 92.0 | 557 |
| M | 3.0 | 5.0 | | 20.0 | 18.0 | | 20.0 | 12.0 | 76.5 | 438 |
| Va | 6.5 | | | 21.0 | 18.0 | | 18.5 | 2.0 | 66.5 | 401 |
| L2 | 4.5 | | | 26.0 | 14.5 | | 16.0 | 7.0 | 65.0 | 396 |
| O | 2.5 | 1.5 | | 22.0 | 11.0 | | 16.5 | 7.0 | 58.0 | 343 |
| P1 | 3.0 | 0.5 | | 19.0 | 16.5 | | 12.5 | 5.0 | 60.0 | 335 |
| S | 1.0 | 1.0 | | 21.0 | 9.5 | | 11.0 | 3.0 | 61.0 | 291 |
| F | 1.5 | | | 13.0 | 9.0 | | 8.0 | 1.0 | 44.0 | 207 |

TABLE 5

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|-------|------|-----|------|------|-------|------|
| L2 | 28.0 | 11.0 | 3.0 | 142.0 | 53.0 | 9.0 | 55.0 | 74.0 | 102.0 | 1927 |
| P1 | 15.5 | 3.0 | | 56.5 | 46.0 | | 65.5 | 29.0 | 107.5 | 1095 |
| Va | 16.0 | 4.0 | | 53.0 | 34.0 | 1.0 | 70.5 | 28.0 | 113.0 | 1049 |
| F | 14.5 | 3.0 | | 43.5 | 38.0 | | 66.0 | 28.0 | 107.5 | 967 |
| V2 | 12.0 | 4.0 | | 41.5 | 38.5 | | 39.0 | 26.0 | 100.0 | 851 |
| S | 10.5 | 5.0 | | 47.0 | 26.5 | | 45.0 | 19.0 | 97.0 | 819 |
| O | 6.0 | 3.0 | | 25.0 | 9.5 | | 35.0 | 12.0 | 64.5 | 469 |
| M | 3.0 | 4.0 | | 16.5 | 19.5 | | 22.0 | 10.0 | 55.0 | 397 |
| L1 | 4.5 | | | 26.0 | 14.5 | | 16.0 | 7.0 | 65.0 | 396 |
| V1 | 3.0 | 1.0 | | 19.5 | 15.5 | | 19.0 | 9.0 | 60.0 | 365 |
| C2 | 3.0 | 3.0 | | 18.0 | 8.0 | | 15.0 | 5.0 | 54.0 | 308 |
| C1 | 1.0 | 1.0 | | 10.0 | 14.5 | | 24.0 | 11.0 | 51.5 | 295 |
| Er | 4.0 | 1.0 | | 16.0 | 9.5 | | 14.0 | 7.0 | 48.0 | 292 |
| E | 0.5 | 1.5 | | 11.5 | 10.0 | | 17.0 | 7.0 | 50.0 | 251 |
| P2 | | 1.0 | | 14.0 | 10.0 | | 10.5 | 6.0 | 47.0 | 233 |
| L3 | 2.0 | 1.0 | | 12.5 | 8.5 | | 6.5 | 3.0 | 36.5 | 206 |

TABLE 6

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|------|------|-----|------|------|-------|------|
| L3 | 11.0 | 20.0 | 4.0 | 51.0 | 53.0 | 1.0 | 50.0 | 42.0 | 123.0 | 1219 |
| L1 | 11.5 | 7.5 | | 43.5 | 37.5 | | 61.5 | 32.5 | 151.0 | 1013 |
| C2 | 9.5 | 10.0 | 1.0 | 44.5 | 23.5 | | 54.5 | 34.0 | 120.0 | 909 |
| E | 7.5 | 8.5 | | 37.5 | 27.0 | | 42.0 | 25.0 | 102.0 | 774 |
| P2 | 6.0 | 10.0 | | 39.0 | 27.5 | 1.0 | 32.5 | 29.0 | 103.0 | 768 |
| C1 | 3.5 | 11.5 | | 24.0 | 34.5 | 1.0 | 40.0 | 37.0 | 111.0 | 749 |
| V1 | 6.0 | 8.0 | 1.0 | 29.0 | 28.0 | 1.0 | 33.5 | 22.0 | 87.0 | 677 |
| Er | 1.5 | 6.0 | | 26.5 | 12.5 | | 21.0 | 6.0 | 74.0 | 432 |
| M | 2.0 | 7.0 | | 15.5 | 16.5 | | 15.0 | 7.0 | 53.0 | 362 |
| O | 2.5 | 6.0 | | 17.0 | 10.0 | | 13.5 | 4.0 | 62.0 | 333 |
| V2 | 4.0 | 4.0 | | 11.5 | 16.5 | | 10.0 | 6.0 | 57.0 | 319 |
| L2 | 2.0 | 1.0 | | 12.5 | 8.5 | | 6.5 | 3.0 | 36.5 | 206 |
| S | 1.5 | 3.5 | | 10.5 | 6.5 | | 3.0 | | 49.0 | 195 |
| Va | 1.0 | | | 11.5 | 6.5 | | 11.5 | 2.0 | 55.5 | 191 |
| P1 | 1.5 | 1.5 | | 8.0 | 6.5 | | 5.5 | 3.0 | 40.0 | 169 |
| F | 1.0 | 2.0 | | 3.5 | 4.5 | | 5.0 | 3.0 | 40.5 | 130 |

TABLE 7

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|-----|------|-----|------|------|-----|------|------|-------|------|
| C1 | 8.0 | 34.0 | 6.0 | 41.0 | 71.0 | 4.0 | 44.0 | 64.0 | 81.0 | 1344 |
| L3 | 3.5 | 11.5 | | 24.0 | 34.5 | 1.0 | 40.0 | 37.0 | 111.0 | 749 |
| Er | 2.0 | 7.0 | | 29.0 | 26.0 | | 41.0 | 34.0 | 101.5 | 671 |
| C2 | 2.5 | 6.0 | | 24.5 | 25.0 | | 41.0 | 26.0 | 69.5 | 587 |
| L1 | 4.5 | 3.5 | | 15.5 | 29.0 | | 36.0 | 25.0 | 92.0 | 557 |
| M | 3.0 | 8.5 | | 19.5 | 21.5 | | 27.0 | 28.0 | 93.0 | 547 |
| V1 | 4.0 | 8.5 | | 19.5 | 27.0 | 1.0 | 26.0 | 19.0 | 59.5 | 536 |
| O | 2.5 | 7.5 | | 21.0 | 27.0 | | 21.0 | 23.0 | 79.0 | 532 |
| P2 | 4.5 | 7.5 | | 19.5 | 19.0 | 1.0 | 27.0 | 21.0 | 79.0 | 519 |
| E | 5.0 | 5.5 | | 16.0 | 16.0 | | 30.0 | 19.0 | 66.5 | 460 |
| S | 1.0 | 2.5 | | 13.0 | 12.5 | | 23.0 | 3.0 | 52.0 | 297 |
| L2 | 1.0 | 1.0 | | 10.0 | 14.5 | | 24.0 | 11.0 | 51.5 | 295 |
| V2 | 2.5 | 1.0 | | 5.5 | 17.0 | | 19.0 | 6.0 | 58.0 | 276 |
| Va | 2.0 | | | 7.0 | 12.0 | | 18.5 | 4.0 | 42.0 | 226 |
| F | 1.5 | 1.0 | | 5.0 | 9.5 | | 15.0 | 9.0 | 40.0 | 202 |
| P1 | | 1.0 | | 5.0 | 13.5 | | 8.0 | 6.0 | 37.5 | 179 |

TABLE 8

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|-------|------|------|-------|-------|------|-------|-------|-------|------|
| C2 | 142.0 | 56.0 | 19.0 | 338.0 | 168.0 | 20.0 | 210.0 | 165.0 | 329.0 | 6096 |
| L1 | 14.0 | 6.0 | | 69.0 | 35.5 | | 61.0 | 41.0 | 140.5 | 1171 |
| E | 14.0 | 10.0 | 1.0 | 58.5 | 38.0 | | 52.0 | 39.0 | 122.5 | 1111 |
| P2 | 8.0 | 13.0 | 1.0 | 49.0 | 40.5 | | 46.0 | 45.0 | 97.0 | 1005 |
| L3 | 9.5 | 10.0 | 1.0 | 44.5 | 23.5 | | 54.5 | 34.0 | 120.0 | 909 |
| V1 | 8.0 | 8.0 | 1.0 | 46.0 | 39.0 | | 41.5 | 33.0 | 96.0 | 901 |
| Er | 7.0 | 7.0 | | 34.0 | 20.0 | | 31.0 | 19.0 | 71.5 | 626 |
| C1 | 2.5 | 6.0 | | 24.5 | 25.0 | | 41.0 | 26.0 | 69.5 | 587 |
| M | 4.0 | 5.0 | | 19.0 | 21.5 | | 22.5 | 14.0 | 68.0 | 461 |
| O | 2.0 | 5.5 | | 21.0 | 15.5 | | 30.0 | 5.0 | 79.0 | 445 |
| V2 | 6.5 | 2.0 | | 19.5 | 14.0 | | 20.0 | 10.0 | 52.0 | 394 |
| L2 | 3.0 | 3.0 | | 18.0 | 8.0 | | 15.0 | 5.0 | 54.0 | 308 |
| Va | 7.5 | | | 14.5 | 7.0 | | 14.0 | 4.0 | 41.0 | 281 |
| S | 5.5 | 1.0 | | 15.0 | 10.0 | | 9.0 | 3.0 | 43.0 | 274 |
| P1 | 5.5 | 1.0 | | 16.0 | 8.0 | | 8.0 | 5.0 | 37.5 | 265 |
| F | 3.0 | 2.0 | | 5.0 | 4.0 | | 8.0 | 3.0 | 40.0 | 163 |

TABLE 9

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|------|-------|------|-----|-------|------|-------|------|
| P1 | 49.0 | 6.0 | 14.0 | 101.0 | 42.0 | 7.0 | 37.0 | 23.0 | 101.0 | 1689 |
| Va | 47.0 | 10.0 | 0.5 | 113.5 | 84.5 | 1.0 | 138.5 | 67.0 | 276.5 | 2440 |
| F | 44.5 | 10.0 | | 96.0 | 79.5 | 1.0 | 139.0 | 63.0 | 261.5 | 2263 |
| V2 | 30.0 | 10.0 | 1.0 | 81.0 | 80.0 | 1.0 | 78.0 | 54.0 | 220.0 | 1809 |
| L2 | 15.5 | 3.0 | | 56.5 | 46.0 | | 65.5 | 29.0 | 108.0 | 1095 |
| S | 13.5 | 5.0 | | 34.0 | 38.5 | 1.0 | 51.0 | 19.0 | 125.5 | 879 |
| O | 4.0 | 3.0 | | 27.0 | 24.5 | | 47.0 | 7.0 | 82.0 | 582 |
| V1 | 4.0 | 2.0 | | 14.0 | 25.0 | | 14.0 | 10.0 | 61.0 | 384 |
| M | 4.0 | 1.0 | | 15.0 | 21.0 | | 26.0 | 1.0 | 56.5 | 376 |
| E | 3.0 | 3.0 | | 15.0 | 28.5 | | 13.0 | 2.0 | 47.5 | 374 |
| L1 | 3.0 | 0.5 | | 19.0 | 16.5 | | 12.5 | 5.0 | 60.0 | 335 |
| P2 | 3.0 | | | 13.0 | 22.5 | | 13.0 | 4.0 | 65.0 | 330 |
| C2 | 5.5 | 1.0 | | 16.0 | 8.0 | | 8.0 | 5.0 | 37.5 | 265 |
| Er | 4.0 | 1.0 | | 11.0 | 11.0 | | 12.0 | 5.0 | 50.0 | 261 |
| C1 | | 1.0 | | 5.0 | 13.5 | | 8.0 | 6.0 | 37.5 | 179 |
| L3 | 1.5 | 1.5 | | 8.0 | 6.5 | | 5.5 | 3.0 | 40.0 | 169 |

TABLE 10

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|-------|-------|------|-------|-------|-------|------|
| P2 | 14.0 | 8.0 | 7.0 | 77.0 | 61.0 | 19.0 | 55.0 | 55.0 | 82.0 | 1439 |
| E | 26.0 | 38.0 | 2.0 | 140.5 | 129.0 | | 134.0 | 153.0 | 313.0 | 3061 |
| L1 | 12.0 | 9.0 | | 57.5 | 41.5 | | 44.0 | 43.0 | 151.0 | 1102 |
| V1 | 11.5 | 13.0 | | 43.5 | 47.5 | 1.0 | 46.5 | 33.0 | 114.0 | 1030 |
| C2 | 8.0 | 13.0 | 1.0 | 49.0 | 40.5 | | 46.0 | 45.0 | 97.0 | 1005 |
| L3 | 6.0 | 10.0 | | 39.0 | 27.5 | 1.0 | 32.5 | 29.0 | 103.0 | 768 |
| V2 | 7.0 | 2.0 | 1.0 | 19.0 | 33.5 | | 23.0 | 20.0 | 81.0 | 558 |
| C1 | 4.5 | 7.5 | | 19.5 | 19.0 | 1.0 | 27.0 | 21.0 | 79.0 | 519 |
| Er | 3.0 | 9.0 | | 32.0 | 13.0 | 1.0 | 20.0 | 13.0 | 70.0 | 516 |
| O | 1.5 | 6.0 | | 23.0 | 13.5 | | 25.0 | 7.0 | 96.0 | 452 |
| M | 2.0 | 6.0 | | 16.0 | 19.0 | | 14.0 | 10.0 | 84.0 | 403 |
| Va | 3.0 | | 1.0 | 17.5 | 22.5 | | 19.5 | 9.0 | 58.0 | 386 |
| P1 | 3.0 | | | 13.0 | 22.5 | | 13.0 | 4.0 | 65.0 | 330 |
| S | 4.0 | 2.0 | | 15.0 | 9.5 | | 9.5 | 5.0 | 46.0 | 274 |
| L2 | | 1.0 | | 14.0 | 10.0 | | 10.5 | 6.0 | 47.0 | 233 |
| F | 1.0 | 1.0 | | 6.0 | 11.5 | | 15.0 | 4.0 | 58.0 | 222 |

TABLE 11

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|-------|------|-----|-------|------|-------|------|
| M | 33.0 | 18.0 | 8.0 | 123.0 | 86.0 | 8.0 | 116.0 | 80.0 | 237.0 | 2442 |
| O | 13.5 | 9.0 | | 43.0 | 46.0 | | 51.0 | 56.0 | 146.0 | 1093 |
| Er | 7.0 | 6.0 | | 37.0 | 31.0 | | 35.5 | 32.0 | 119.0 | 778 |
| C1 | 3.0 | 8.5 | | 19.0 | 21.5 | | 27.0 | 28.0 | 93.0 | 547 |
| V1 | 1.0 | 8.0 | | 24.0 | 29.5 | | 17.5 | 9.0 | 79.5 | 515 |
| C2 | 4.0 | 5.0 | | 19.0 | 21.5 | | 22.5 | 14.0 | 68.0 | 461 |
| L1 | 3.0 | 5.0 | | 20.0 | 18.0 | | 20.0 | 12.0 | 76.5 | 438 |
| V2 | 4.0 | 3.0 | | 16.5 | 22.0 | | 27.0 | 4.0 | 67.0 | 425 |
| S | 2.0 | 5.0 | | 18.0 | 19.5 | | 25.0 | 6.0 | 71.5 | 422 |
| P2 | 2.0 | 6.0 | | 16.0 | 19.0 | | 14.0 | 10.0 | 84.0 | 403 |
| L2 | 3.0 | 4.0 | | 16.5 | 19.5 | | 22.0 | 10.0 | 55.0 | 397 |
| P1 | 4.0 | 1.0 | | 15.0 | 21.0 | | 26.0 | 1.0 | 56.5 | 376 |
| E | 1.0 | 4.0 | | 14.0 | 17.5 | | 19.0 | 13.0 | 77.5 | 373 |
| L3 | 2.0 | 7.0 | | 15.5 | 16.5 | | 15.0 | 7.0 | 53.0 | 362 |
| F | 5.0 | 2.0 | | 12.0 | 17.5 | | 19.0 | 4.0 | 64.5 | 350 |
| Va | 4.0 | 1.0 | | 13.5 | 14.0 | | 24.0 | 2.0 | 66.5 | 338 |

TABLE 12

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|-------|------|-----|-------|------|-------|------|
| F | | 1.0 | 2.0 | 5.0 | 7.0 | 6.0 | 4.0 | 3.0 | 25.0 | 154 |
| P1 | 44.5 | 10.0 | | 96.0 | 79.5 | 1.0 | 139.0 | 63.0 | 261.5 | 2263 |
| Va | 40.5 | 7.0 | | 101.0 | 68.5 | | 133.0 | 54.0 | 283.0 | 2159 |
| V2 | 26.0 | 8.0 | | 63.5 | 56.0 | | 79.0 | 38.0 | 204.0 | 1476 |
| L2 | 14.5 | 3.0 | | 43.5 | 38.0 | | 66.0 | 28.0 | 107.5 | 967 |
| S | 8.0 | 4.0 | | 32.0 | 33.0 | | 50.0 | 13.0 | 116.0 | 753 |
| O | 8.0 | 1.0 | | 23.0 | 20.5 | | 52.0 | 9.0 | 86.5 | 581 |
| M | 5.0 | 2.0 | | 12.0 | 17.5 | | 19.0 | 4.0 | 64.5 | 350 |
| Er | 7.0 | 2.0 | | 9.0 | 7.0 | | 14.0 | 5.0 | 36.0 | 256 |
| V1 | 2.5 | 3.0 | | 7.0 | 13.5 | | 8.0 | 5.0 | 43.0 | 233 |
| P2 | 1.0 | 1.0 | | 6.0 | 11.5 | | 15.0 | 4.0 | 58.0 | 222 |
| L1 | 1.5 | | | 13.0 | 9.0 | | 8.0 | 1.0 | 44.0 | 207 |
| C1 | 1.5 | 1.0 | | 5.0 | 9.5 | | 15.0 | 9.0 | 40.0 | 202 |
| E | 1.5 | 2.0 | | 6.0 | 10.5 | | 10.0 | 3.0 | 31.0 | 185 |
| C2 | 3.0 | 2.0 | | 5.0 | 4.0 | | 8.0 | 3.0 | 40.0 | 163 |
| L3 | 1.0 | 2.0 | | 3.5 | 4.5 | | 5.0 | 3.0 | 40.5 | 130 |

TABLE 13

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|-------|------|-----|------|------|-------|------|
| V1 | 41.0 | 19.0 | 7.0 | 125.0 | 79.0 | 4.0 | 74.0 | 60.0 | 207.0 | 2280 |
| P2 | 11.5 | 13.0 | | 43.5 | 47.5 | 1.0 | 46.5 | 33.0 | 114.0 | 1030 |
| E | 10.5 | 11.0 | | 46.0 | 48.5 | | 46.5 | 26.0 | 114.5 | 1007 |
| C2 | 8.0 | 8.0 | 1.0 | 46.0 | 39.0 | | 41.5 | 33.0 | 96.5 | 901 |
| L1 | 6.0 | 4.0 | | 38.0 | 30.5 | | 38.5 | 35.0 | 133.0 | 785 |
| L3 | 6.0 | 8.0 | 1.0 | 29.0 | 28.0 | 1.0 | 25.5 | 22.0 | 87.0 | 677 |
| C1 | 4.0 | 8.5 | | 19.5 | 27.0 | 1.0 | 26.0 | 19.0 | 59.5 | 536 |
| V2 | 9.0 | 3.0 | | 22.0 | 22.5 | | 27.0 | 13.0 | 70.0 | 527 |
| M | 1.0 | 8.0 | | 24.0 | 29.5 | | 17.5 | 9.0 | 79.5 | 515 |
| Er | 3.0 | 6.0 | | 22.5 | 14.5 | | 16.0 | 17.0 | 66.5 | 431 |
| O | 3.0 | 5.5 | | 24.5 | 15.0 | | 10.0 | 5.0 | 66.0 | 399 |
| Va | 5.0 | 2.5 | | 14.0 | 19.0 | | 21.5 | 11.0 | 63.0 | 394 |
| P1 | 4.0 | 2.0 | | 14.0 | 25.0 | | 14.0 | 10.0 | 61.0 | 384 |
| S | 4.0 | 6.0 | | 15.0 | 16.5 | | 13.0 | 9.0 | 66.0 | 380 |
| L2 | 3.0 | 1.0 | | 19.5 | 15.5 | | 19.0 | 9.0 | 60.0 | 365 |
| F | 2.5 | 3.0 | | 7.0 | 13.5 | | 8.0 | 5.0 | 43.0 | 233 |

TABLE 14

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|-------|------|-----|-------|------|-------|------|
| V2 | 48.0 | 15.0 | 3.0 | 91.0 | 63.0 | 5.0 | 87.0 | 56.0 | 211.0 | 2038 |
| Va | 49.5 | 9.5 | 2.5 | 123.5 | 80.5 | | 120.5 | 67.0 | 288.5 | 2467 |
| P1 | 30.0 | 10.0 | 1.0 | 81.0 | 80.0 | 1.0 | 78.0 | 54.0 | 220.0 | 1809 |
| F | 26.0 | 8.0 | | 63.5 | 56.0 | | 79.0 | 38.0 | 204.0 | 1476 |
| S | 12.0 | 6.0 | | 42.0 | 40.5 | | 59.0 | 17.0 | 124.5 | 946 |
| L2 | 12.0 | 4.0 | | 41.5 | 38.5 | | 39.0 | 26.0 | 100.0 | 851 |
| L1 | 9.5 | 1.0 | | 47.5 | 19.5 | | 32.0 | 13.0 | 89.0 | 687 |
| E | 11.5 | 4.0 | | 19.0 | 30.5 | | 23.0 | 24.0 | 73.5 | 593 |
| P2 | 7.0 | 2.0 | 1.0 | 19.0 | 33.5 | | 23.0 | 20.0 | 81.0 | 558 |
| V1 | 9.0 | 3.0 | | 22.0 | 22.5 | | 27.0 | 13.0 | 70.0 | 527 |
| O | 5.0 | 2.0 | | 27.0 | 12.5 | | 33.5 | 4.0 | 69.5 | 464 |
| M | 4.0 | 3.0 | | 16.5 | 22.0 | | 27.0 | 4.0 | 67.0 | 425 |
| C2 | 6.5 | 2.0 | | 19.5 | 14.0 | | 20.0 | 10.0 | 52.0 | 394 |
| L3 | 4.0 | 4.0 | | 11.5 | 16.5 | | 10.0 | 6.0 | 57.0 | 319 |
| Er | 5.5 | 2.0 | | 12.0 | 7.5 | | 16.0 | 5.0 | 50.5 | 284 |
| C1 | 2.5 | 1.0 | | 5.5 | 17.0 | | 19.0 | 6.0 | 58.0 | 276 |

TABLE 15

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|------|------|-----|------|------|-------|------|
| Er | 22.0 | 3.0 | 5.0 | 55.0 | 33.0 | 6.0 | 49.0 | 35.0 | 166.0 | 1159 |
| O | 20.5 | 10.0 | | 65.0 | 60.5 | | 71.0 | 42.0 | 169.0 | 1423 |
| M | 7.0 | 6.0 | | 37.0 | 31.0 | | 35.5 | 32.0 | 119.0 | 778 |
| C1 | 2.0 | 7.0 | | 29.0 | 26.0 | | 41.0 | 34.0 | 101.5 | 671 |
| S | 10.5 | 3.0 | 1.0 | 31.5 | 22.0 | | 34.0 | 7.0 | 87.0 | 628 |
| C2 | 7.0 | 7.0 | | 34.0 | 20.0 | | 31.0 | 19.0 | 71.5 | 626 |
| L1 | 5.0 | 6.0 | 1.0 | 36.0 | 14.0 | | 22.0 | 20.0 | 80.5 | 573 |
| P2 | 3.0 | 9.0 | | 32.0 | 13.0 | 1.0 | 20.0 | 13.0 | 70.0 | 516 |
| E | 5.0 | 5.0 | | 32.0 | 13.0 | | 23.0 | 12.0 | 71.0 | 506 |
| L3 | 1.5 | 6.0 | | 26.5 | 12.5 | | 21.0 | 6.0 | 74.0 | 432 |
| V1 | 3.0 | 6.0 | | 22.5 | 14.5 | | 16.0 | 17.0 | 66.5 | 431 |
| Va | 5.0 | 1.0 | | 20.0 | 9.0 | | 18.0 | 3.0 | 54.0 | 332 |
| L2 | 4.0 | 1.0 | | 16.0 | 9.5 | | 14.0 | 7.0 | 48.0 | 292 |
| V2 | 5.5 | 2.0 | | 12.0 | 7.5 | | 16.0 | 5.0 | 50.5 | 284 |
| P1 | 4.0 | 1.0 | | 11.0 | 11.0 | | 12.0 | 5.0 | 50.0 | 261 |
| F | 7.0 | 2.0 | | 9.0 | 7.0 | | 14.0 | 5.0 | 36.0 | 256 |

TABLE 16

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|------|-----|-------|------|-----|-------|------|-------|------|
| Va | 41.0 | 7.0 | 3.0 | 65.0 | 26.0 | 7.0 | 39.0 | 24.0 | 102.0 | 1261 |
| V2 | 49.5 | 9.5 | 2.5 | 123.5 | 80.5 | | 120.5 | 67.0 | 288.5 | 2467 |
| P1 | 47.0 | 10.0 | 0.5 | 113.5 | 84.5 | 1.0 | 138.5 | 67.0 | 276.5 | 2440 |
| F | 40.5 | 7.0 | | 101.0 | 68.5 | | 133.0 | 54.0 | 283.0 | 2159 |
| L2 | 16.0 | 4.0 | | 53.0 | 34.0 | 1.0 | 70.5 | 28.0 | 113.0 | 1049 |
| S | 13.5 | 7.0 | | 45.0 | 42.0 | | 63.0 | 18.0 | 145.0 | 1028 |
| O | 6.5 | 2.0 | | 19.0 | 16.0 | | 38.0 | 4.0 | 50.0 | 441 |
| L1 | 6.5 | | | 21.0 | 18.0 | | 18.5 | 2.0 | 66.5 | 401 |
| V1 | 5.0 | 2.5 | | 14.0 | 19.0 | | 21.5 | 11.0 | 63.0 | 394 |
| P2 | 3.0 | | 1.0 | 17.5 | 22.5 | | 19.5 | 9.0 | 58.0 | 386 |
| M | 4.0 | 1.0 | | 13.5 | 14.0 | | 24.0 | 2.0 | 66.5 | 338 |
| Er | 5.0 | 1.0 | | 20.0 | 9.0 | | 18.0 | 3.0 | 54.0 | 332 |
| C2 | 7.5 | | | 14.5 | 7.0 | | 14.0 | 4.0 | 41.0 | 281 |
| E | 2.0 | 2.0 | | 11.0 | 16.0 | | 14.0 | 7.0 | 38.0 | 274 |
| C1 | 2.0 | | | 7.0 | 12.0 | | 18.5 | 4.0 | 42.0 | 226 |
| L3 | 1.5 | | | 9.5 | 7.0 | | 8.5 | 2.0 | 55.5 | 191 |

TABLE 17

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|----|------|-----|-----|------|------|-----|------|------|-------|------|
| S | 35.0 | 2.0 | 7.0 | 52.0 | 21.0 | 2.0 | 50.0 | 30.0 | 86.0 | 1101 |
| Va | 13.5 | 7.0 | | 45.0 | 42.0 | | 63.0 | 18.0 | 145.0 | 1028 |
| V2 | 12.0 | 6.0 | | 42.0 | 40.5 | | 59.0 | 17.0 | 124.5 | 946 |
| P1 | 13.5 | 5.0 | | 34.0 | 38.5 | 1.0 | 51.0 | 19.0 | 125.5 | 879 |
| L2 | 10.5 | 5.0 | | 47.0 | 26.5 | | 45.0 | 19.0 | 97.0 | 819 |
| F | 8.0 | 4.0 | | 32.0 | 33.0 | | 50.0 | 13.0 | 116.0 | 753 |
| O | 6.0 | 5.0 | | 39.0 | 25.5 | | 39.0 | 13.0 | 87.0 | 686 |
| Er | 10.5 | 3.0 | 1.0 | 31.5 | 22.0 | | 34.0 | 7.0 | 87.0 | 628 |
| M | 2.0 | 5.0 | | 18.0 | 19.5 | | 25.0 | 6.0 | 71.0 | 422 |
| V1 | 4.0 | 6.0 | | 15.0 | 16.5 | | 13.0 | 9.0 | 66.0 | 380 |
| C1 | 1.0 | 2.5 | | 13.0 | 12.5 | | 23.0 | 3.0 | 52.0 | 297 |
| L1 | 1.0 | 1.0 | | 21.0 | 9.5 | | 11.0 | 3.0 | 61.0 | 291 |
| P2 | 4.0 | 2.0 | | 15.0 | 9.5 | | 9.5 | 5.0 | 46.0 | 274 |
| C2 | 5.5 | 1.0 | | 15.0 | 10.0 | | 9.0 | 3.0 | 43.5 | 274 |
| L3 | 1.5 | 3.5 | | 10.5 | 6.5 | | 3.0 | | 49.0 | 195 |
| E | 3.0 | 0.5 | | 12.0 | 7.0 | | 5.0 | 4.0 | 30.0 | 191 |

APPENDIX 4

This table provides a cross listing of the marginal illustrations in all of the manuscripts against the full set of illustrations contained in MS *P3*, that set being most extensive of all. The left-hand column lists the figures according to the number designating them in the commentary to the English translation. The top row lists the manuscripts by sigla.

| | P3 | V1 | E | M | L1 | P1 | Va | C2 | L3 | S | L2 | P2 | R | F | O | C1 | V2 | Er |
|-------|----|----|---|---|----|----|----|----|----|---|----|----|---|---|---|----|----|----|
| 1.1 | x | x | x | x | . | . | . | . | . | x | . | . | . | . | . | . | . | . |
| 1.2 | x | x | x | x | x | x | x | . | . | x | . | x | x | . | . | . | . | . |
| 1.5 | x | x | x | x | . | . | . | . | . | . | . | x | . | . | . | . | . | . |
| 1.7a | x | x | x | x | x | . | x | . | . | . | . | x | . | . | . | . | . | . |
| 1.7b | x | x | x | x | x | . | x | . | . | . | . | . | . | . | . | . | . | . |
| 2.5 | x | x | x | . | x | . | . | . | x | . | . | . | x | . | . | . | . | . |
| 2.6a | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.7 | x | x | x | x | x | x | . | . | . | . | . | . | . | x | . | . | . | . |
| 2.8 | x | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.9 | x | x | x | x | x | . | . | . | . | . | . | x | . | . | . | . | . | . |
| 2.10 | x | . | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.11 | x | x | x | x | x | . | x | . | . | . | . | x | . | . | . | . | . | . |
| 2.12a | x | x | x | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.12b | x | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.13 | x | x | x | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.14 | x | x | x | x | x | x | . | x | . | . | . | . | . | . | . | . | . | . |
| 2.15a | x | x | x | x | . | x | . | . | . | . | . | . | x | . | . | . | . | . |
| 2.15b | x | x | x | x | . | x | . | . | . | . | . | . | x | . | . | . | . | . |
| 2.17 | x | x | x | x | . | x | x | . | . | . | . | . | x | . | . | . | . | . |
| 2.18 | x | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.19 | x | x | x | x | x | . | x | x | . | . | . | . | . | . | . | . | . | . |
| 3.1 | x | x | x | x | x | . | x | x | x | x | . | . | . | . | . | . | . | . |
| 3.3 | x | x | x | x | x | . | x | x | x | . | . | . | . | . | . | . | . | . |
| 3.4 | x | x | x | x | x | x | x | x | x | x | x | x | . | . | . | . | . | . |
| 3.5 | x | x | x | x | . | x | x | . | x | . | x | x | x | x | x | . | . | . |
| 3.7 | x | x | x | x | x | x | x | x | . | x | x | . | . | . | . | . | . | . |
| 3.9 | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | . | . | . |
| 3.12 | x | x | x | x | x | x | . | x | x | x | x | . | . | . | . | . | . | . |
| 3.13 | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.14 | x | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.15 | x | x | x | x | . | . | . | . | . | . | . | . | . | . | . | . | . | . |

**LATIN-ENGLISH
INDEX**

LATIN-ENGLISH INDEX

The following index is somewhat restrictive in that it does not include pronouns, conjunctions, prepositions, or the copulative (*esse*). It also includes few adverbs beyond those that are based on listed adjectival forms. Each Latin term is listed according to its occurrence by page and line-number. For instance, the first entry, “**abicere** 328.91” says that *abicere* occurs in some form on line 91 of page 328. Multiple entries follow the format of “**ablatio** 128.1, 11; 129.28,” which says that *ablatio* occurs in some form on lines 1 and 11 of page 128, as well as on line 28 of page 129. For each Latin term I have supplied the various English renderings to be found in the translation, each rendering followed by its appropriate page-number(s). In some cases, of course, the translation is too loose to permit such a one-to-one correlation of Latin and English terms, so there will at times be gaps in the English concordance. Finally, certain terms, such as *apparere*, crop up so often that it is not feasible to cite every instance by page and line-number. In such cases, I have cited the term as “frequently recurring,” listing its occurrence in the Latin text by page only and giving its various English renderings without appropriate page-references in the translation.

abicere 328.91 **to make vanish** 621
ablatio 128.1, 11; 129.28 **change** 450 **removal** 450
ablatus *see* **aufere**
abscidere / **abscindere** 37.154; 77.126; 161.75 **to cut** 473 **to interrupt** 393 **to intersect** 366
abscisio 27.151 **interruption** 359
abscondere 290.165; 291.211; 295.28; 304.85; 305.104, 119, 121, 126; 312.16 **to be insensible** 603 **to be/render invisible** 591, 596, 602, 603 **to block out** 603, 608 **to mask** 593
absconsio 307.160 **invisibility** 603
absens 223.214 **absent** 517
abstergere 72.132 **to wipe away** 390
abstulere 266.243; 270.79; 281.95 **to remove** 575, 578 **to set aside** 585 *see also* **aufere**
acus 312.9, 13, 15, 18, 19 **needle** 608
acutus 290.191 **bright** 592
addere 23.48; 105.236; 106.246; 280.66 **to add** 357 **to exceed** 434, 435 **to increase** 585
additio 106.253 **exceeding** 435
adiunctio 142.124 **combination** 460
admiscere 4.49; 5.56; 22.19, 21, 22; 24.69, 71; 25.84-86; 32.294; 36.119, 121, 123; 51.290; 56.124; 57.146, 159-161, 166; 58.190; 59.216; 61.286, 289, 294; 62.297, 298; 63.56;

admittere**albus**

- 64.79, 81, 84, 85, 88; 65.101, 104, 106-108, 116; 66.122, 124; 75.81, 83, 85, 86, 90; 114.186, 187; 115.210, 215; 116.256, 261; 120.62, 63; 189.292 **to compose** 357 **to confuse** 492 **to exist along with** 356 **to mingle/mix** 344, 356, 357, 362, 365, 376, 380, 381-385, 392, 440-442, 444
- admittere** 57.168 **to be transformed** 380
- admixtio** 68.182; 81.61 **confusion** 419 **mingling** 387
- adquiescere** 176.224 **to grasp** 483
- adquirere** 110.60; 111.88; 173.128; 176.221; 177.232, 236; 210.6; 227.11; 229.71; 292.7; 296.10; 300.112; 301.4; 302.17; 305.129; 312.2; 323.38; 336.3; 337.29 **to acquire** 481, 484, 520 **to apprehend** 594, 597, 599, 600, 603, 608, 617, 627 **to derive** 484, 507, 519 **to gain** 437 **to grasp** 438, 483
- adquisitio** 176.223; 177.230, 239, 240; 296.5; 312.299; 319.2 **apprehension** 597, 608, 613 **carrying out** 484 **grasp** 483
- adunare** 53.33, 37; 54.63; 70.82; 72.139; 210.21-2; 213.112 **to combine** 507, 509 **to meet** 389 **to squint** 390 **to unite** 377
- adunatio** 53.40 **union** 377
- aer** 5.3-5; 6.22; 10.14; 23.27, 30, 49, 52; 24.81; 27.149, 163; 30.231; 31.281; 34.71, 85; 44.65, 66; 46.136, 137; 48.189, 192, 200; 50.254, 256; 56.119, 120, 123, 125, 129, 136, 138; 57.144, 147, 159, 160, 162, 165-167, 169; 58.173; 59.210, 216, 217; 65.110, 111, 114, 116, 117; 68.10; 72.130, 132, 2; 73.10, 13; 74.61; 75.74, 75; 77.124, 125, 127, 129, 130; 78.158, 159, 161, 164, 169, 171, 175; 121.101, 112, 116; 122.118, 120, 121, 125, 127-129, 145; 123.148, 149, 151, 154, 157, 158, 160, 162-164; 124.189, 193, 195, 199, 204; 125.207, 216; 202.97; 285.4, 8; 286.32; 288.128; 289.129, 132, 135, 137, 138, 141, 142, 145, 146; 290.176; 291.209, 210; 295.44; 296.46; 297.34; 299.76, 79; 300.108; 329.1, 5; 330.11, 13, 14, 17, 19, 20, 25, 27, 29, 32, 36, 40; 331.42, 45, 48, 52, 53
- air** 344, 347, 356, 357, 359, 361, 362, 364, 370, 372, 373, 375, 379, 380, 381, 385, 387, 390-394, 445-448, 502, 588, 591-593, 596, 597, 599, 621-623
- affirmare** 31.280; 49.212; 86.183, 184; 107.288 **to confirm** 374 **to determine** 362 **to prompt** 421 **to verify** 436
- affirmatio** 107.284 **being affirmed** 436
- aggregare** 23.40; 43.37; 49.235; 73.4; 78.182; 202.79; 286.33; 328.81; 337.27 **to aggregate** 620 **to coexist** 502 **to conclude** 370 **to conjoin** 627 **to draw upon** 374 **to meet (as a whole)** 390, 394, 589 **to summarize** 356, 370
- aggregatio** 193.127; 337.17 **convergence** 627 **joining** 495
- alacritas** 111.105 **joy** 438
- albedo** 7.53, 71; 9.16; 13.73; 62.1, 4, 10, 14, 20; 63.38, 51; 67.167 **whiteness** 345-347, 349, 383, 384, 386
- albugineus** 13.72, 79; 16.150, 151, 154; 26.136; 68.6, 12, 18; 69.21, 24 **albugineous** 349, 351, 359, 387
- albumen** 13.73 **(egg) white** 349
- alburalmon** 208.261 **abu qalamun** 506
- albus** 3.11, 22; 4.31, 48; 5.55; 7.52, 55, 62, 66; 9.16, 32, 33; 10.35; 11.25; 12.42, 44; 13.71; 60.233; 62.7, 13, 16, 17; 63.37, 40; 67.166, 169, 170; 71.114; 264.196; 306.154; 312.30; 313.38; 321.60; 324.72; 331.41; 333.62; 336.60 **white** 343-349, 381, 383, 384, 386,

alterare**antecedens**

- 390, 573, 604, 609, 615, 617, 622, 624, 626
alterare 10.7; 14.115; 56.130, 135; 59.204; 69.29; 71.113; 75.87; 87.212; 94.137 **to**
alter 379, 381, 388 **to change** 390, 422, 427 **to shift** 350 **to transform** 379 **to**
vary 392
aluerach 299.64 **aluerach (firefly)** 598
amigdalatus 210.31, 32 **almond shaped** 508
amigdaleitas 212.74 **almond shape** 509
amigdalus 297.28-30 **almond tree** 597
amilialmon 10.38 **amilialmon** 347
ampliare 11.17; 168.288 **to enlarge** 348, 478
amplificare 14.96 **to expand** 350
amplificatio 14.95 **expanding** 350
amplitudo 192.102; 193.105, 112; 211.37; 212.81, 83, 85, 92; 235.236 **breadth** 495,
509 **extent** 495 **length** 524 **width** 508, 509
anatomicus 22.34 **anatomist** 355
angulus 18.219; 21.4; 30.229; 69.29; 90.13, 22; 91.25, 26, 46, 49; 92.51-53, 75, 78; 93.88;
95.145, 147, 148-150, 153, 155; 164.149-151, 158, 161, 164, 165, 167, 170; 165.182,
187, 191, 194, 198; 166.204, 210, 217, 227, 230; 167.234, 235, 245, 248; 168.260, 263,
266-268, 272, 278; 169.297, 6; 170.26, 28, 29, 31, 40; 171.58, 59, 60, 64, 76-78;
172.79, 84, 85; 174.157; 175.178, 180; 178.259, 283, 286; 179.290, 292, 294, 3, 13;
182.82, 93, 95, 98, 100, 101, 105; 183.108, 110, 112, 113, 116, 118, 119, 122, 130;
185.177, 183, 188; 186.204, 210; 187.247, 248, 253; 188.256, 259, 271, 273, 275;
189.295, 7, 9; 190.25, 29; 249.74, 80; 250.93, 96, 100, 109; 254.206; 264.189, 193,
206; 267.281-283, 286; 268.297, 298, 5; 282.137; 283.140, 144; 284.181; 303.56, 59,
67; 304.84; 305.105, 106, 111, 112; 306.130, 131, 137; 307.179, 182, 185; 308.187,
195, 196, 202, 205, 213; 315.28, 30, 31, 39; 319.15; 323.26; 326.16, 18; 330.17; 332.16;
335.24 **angle** 353, 355, 361, 424, 425-428, 474-480, 482, 484-493, 564, 565, 567,
573, 576, 586, 587, 602-606, 610, 619 **corner** 388, 573, 574, 602, 614, 616, 619, 621,
623, 625
angustiare 52.298, 1 **to distress** 376
angustum 72.140 **narrowing** 390
anima 105.216-218; 106.255, 266; 107.281; 109.30, 54; 110.62, 64, 67, 70; 114.193, 194;
115.214; 127.280, 281; 129.33, 40; 137.265, 267; 138.283; 140.37; 142.122; 167.258;
168.265, 290; 173.131; 174.150, 160; 175.173; 205.182; 214.134; 222.188, 190; 223.194,
196, 205, 215, 218; 224.220-225, 227, 229, 230, 231, 234, 236, 237, 239, 241; 225.246,
249, 250, 252, 256-259, 261, 262, 265; 226.281, 283, 287, 289, 291, 294; 227.2, 5, 7,
11; 228.53; 229.60; 231.114, 134; 233.174, 175, 177; 239.40 **soul** 434, 435, 437, 438,
440, 441, 449, 451, 456, 458, 460, 477, 478, 481, 482, 504, 510, 516-523, 526
animal 7.73, 77; 8.80; 101.99; 192.88; 207.221, 224; 208.269; 209.277, 283, 289; 210.28;
234.217, 218; 235.225; 237.288, 289, 291; 288.106, 108, 110; 298.58; 300.107; 311.285;
324.57 **animal** 346, 431, 494, 505-508, 523-525, 590, 598, 599, 607, 617
animalitas 237.296 **being an animal** 525
animus 310.256; 311.284 **soul** 607
antecedens 15.135; 17.200; 18.207; 26.128, 129; 27.143, 145; 83.109; 84.126; 126.264;

antecedere**appropriare**

127.265, 291; 159.19; 162.109; 192.92; 230.98; 240.72; 316.56 **lying in front of** 351, 352, 358, 359, 420 **presupposition** 610 **previous** 449, 450, 471, 473, 494, 521, 527

antecedere 14.100 **to lie in front of** 350

anterior 11.2, 4, 6, 8; 12.34, 35, 37, 40, 50, 52, 54; 13.57, 74, 75, 81, 82, 85, 86; 14.110; 15.141; 16.150, 159, 162, 164, 169, 171, 172; 17.178, 182, 188, 192, 198, 203; 18.205, 214, 225, 229, 231; 19.240, 242, 249, 255; 23.25, 35; 52.14, 16; 53.42; 59.210; 68.5, 6, 19; 69.27, 30, 37, 52; 70.53, 59, 61, 63; 80.13, 21, 23; 81.45; 83.101, 102, 107; 84.125; 85.160, 166, 168, 170; 86.186, 202; 209.289 **anterior/lying at the front** 348-353, 356, 376, 381, 387, 388, 418, 420, 421, 422, 507 **inner** 387 **upward** 377

apellare 80.23 **to call** 418

aperire 3.8; 43.55; 72.127; 277.274; 278.7 **to make clear** 582 **to open** 343, 370, 390, 583

apertio 128.3, 12; 129.27 **opening** 450

apparens 6.32; 10.41; 54.67, 70; 60.248, 253; 114.189; 133.142; 199.3; 201.63; 203.105; 208.252; 294.42; 302.19; 308.206; 313.34, 46, 52; 314.61; 315.54; 319.143; 320.28; 321.63; 325.86, 93; 328.86, 87; 329.108; 331.51; 333.56 **apparent/appearing** 345, 381, 440, 500, 501, 506, 601, 605, 609, 611, 622, 624 **appearance** 609, 613, 618, 621 **perceived** 614 **seen** 595, 615, 620 **showing** 453 **visible** 377, 382

apparentia 192.96; 284.194; 290.183; 304.76; 305.109; 307.181; 309.214; 318.134; 328.91; 333.58 **appearance** 495, 592, 602, 603, 605, 613, 621, 624 **form** 588 **perception** 606

apparere *frequently recurring* (6-10, 29, 38, 57, 59-64, 66, 67, 69, 71, 72, 83, 87, 88, 100, 103-105, 107-109, 119, 120, 128, 132, 139, 155, 156, 158, 161, 171, 180, 185, 186, 192, 200, 201, 203, 205-210, 213, 217-220, 222, 224, 238, 239, 241, 261, 263, 266, 271, 275, 276, 280, 292-297, 299-307, 309, 312, 313, 315-317, 319, 320, 322, 323, 326-328, 330-333, 334, 336) **to appear, to arise (as perception), to be apparent/evident/manifest/revealed/visible, to be apprehended, to be exposed to view, to be found, to be seen, to become/make clear, to look (as), to seem, to shine, to show up**

applicare 12.31; 73.22, 24, 28, 29; 74.32, 35, 44; 128.14, 16, 19; 129.30; 132.118; 203.115; 264.199, 206; 273.167; 274.196, 197; 275.227; 278.17 **to affix/attach** 348, 573, 581 **to be placed/lie against/upon** 391, 450, 452, 503 **to fasten** 580, 583 **to lay snugly** 574 **to place** 391, 581 **to touch** 391

applicatio 37.161; 74.34; 236.252; 275.212; 276.236 **coincidence** 366 **direct contact** 391 **fit(ting together)** 524 **placement** 581, 582

appropinquare 7.55, 64, 66, 68; 37.159; 38.185; 42.1; 167.254; 195.188; 251.123; 274.195; 278.294, 7; 282.126 **to approach** 366, 477, 497, 586 **to bring near/to** 345, 565, 581 **to coincide (nearly)** 583 **to converge** 369 **to incline (toward)** 366 **to place** 345

appropinquatio 72.135; 148.277, 279; 152.113, 114, 117; 161.70; 162.100; 167.257; 169.16; 195.189; 201.47; 206.203 **approach** 390, 497 **convergence** 478 **decrease in distance** 477 **nearness** 463, 466, 473, 501, 505 **proximity** 473

appropriare 42.297, 7, 19, 20; 44.87; 45.97; 49.240; 71.99; 85.153, 160, 163; 115.218;

aqua

aspiciens

- 222.183; 229.72; 231.122, 131, 136; 234.198, 201, 203; 236.263 **to be constituted** 369, 374, 389, 421 **to belong to** 441, 520 **to be specific to** 521-524 **to characterize** 521 **to define** 523 **to function accordingly** 369 **to provide the means of recognition** 516 **to qualify** 369 **to relate** 371 **to take place accordingly** 369
- aqua** 44.73, 74, 77; 293.34, 35; 328.65, 67, 69, 84, 88; 330.21, 33 **water** 370, 594, 620, 622
- aranea** 13.61 **aranea** 349 **spiderweb** 349
- arbor** 101.99; 134.183; 192.89; 207.224; 239.60, 61, 64, 65; 240.71; 297.26; 298.45, 58; 300.114; 302.28; 317.89 **tree** 431, 454, 494, 505, 527, 597, 598, 600, 601, 612
- arcualis** 42.10, 12 **curved** 369
- arcualitas** 161.75; 231.138 **arching** 522 **curvature** 473
- arcuitas** 161.81 **curvature** 473
- arcus** 92.77, 79 **arc** 426
- arguere** 104.190; 108.2-4, 9, 10, 26, 28, 29; 109.30, 31, 48; 134.171; 137.256; 204.134 **to deduce** 436, 437, 454, 456, 503 **to proceed (in an argument)** 433
- argumentatio** 104.185, 192; 105.212, 220; 106.257; 107.270; 109.50; 110.73, 77; 111.88; 112.118, 130; 114.193; 116.245, 247, 251; 118.27; 121.92, 94; 126.253; 127.268, 274, 284; 134.170; 136.229, 246, 250, 252; 166.221, 223; 185.167, 170, 171; 202.93; 204.152; 216.192 **deduction** 439, 442, 444, 445, 449, 454, 456, 476, 489, 502, 504, 512 **deductive reasoning** 437, 438, 440, 455 **judgment** 455, 456 **logical argument** 433-435
- argumentum** 104.192-194, 198; 107.275, 276, 280, 290, 292, 298; 108.4, 8, 21, 27; 109.30, 33, 36, 43, 47 **argument** 433 **basis for conclusion** 433, 437 **deduction** 436, 437 **deductive process** 435, 436 **(logical) procedure** 433
- ars medicinalis** 55.91 **medical science** 378
- ascendere** 3.5, 11 **to flood** 343 **to illuminate** 343
- ascribere** 318.130 **to attribute** 613
- asinus** 297.23, 26; 298.45; 301.125 **ass** 597, 598, 600
- aspectus** 3.12; 4.23; 177.244; 217.29; 218.44, 47, 63, 69; 219.71, 83, 97; 228.56; 233.171; 239.45; 242.124-127, 130; 246.26, 30 **(first) glance** 513, 526, 528 **glimpse** 520 **look** 484, 512-514, 562 **sight** 522 **stare** 343
- asperitas** 111.93; 199.2, 4; 200.21, 25, 30, 32, 36, 38, 40, 43, 46; 201.50, 52, 56, 58; 202.79, 85, 92; 208.245; 238.20; 240.78, 85, 91; 293.15; 311.280, 282, 283, 287, 290, 291, 295; 312.2; 317.99, 101, 104, 106, 107; 321.52, 53; 324.60-62; 327.42, 43; 330.36, 37; 333.50, 52; 336.52 **roughness** 438, 500, 622, 624, 626 **texture** 527, 607, 608
- asperus** 199.3, 15; 200.16, 18, 20, 37; 201.55; 202.84; 311.289, 293; 327.44, 45; 330.37, 38; 333.50; 336.53 **rough** 500-502, 607, 619, 624, 626 **having texture** 608
- aspicere** 3.3, 18; 4.33, 36, 45, 47, 52; 5.55, 7; 6.25; 47.164; 52.2; 60.258; 65.111; 72.123, 129, 140; 96.193; 102.141; 119.39; 133.143; 137.280; 151.76; 155.179; 170.48; 171.66, 69; 173.125; 174.166; 175.174; 176.215; 218.61; 240.81; 255.228 **to examine** 466 **to look (at)** 343-345, 373, 382, 385, 428, 444, 453, 468, 479-482, 484, 512, 513, 527, 567 **to notice** 456 **to scan** 483 **to see** 390, 432 **to stare** 343, 344, 376, 390
- aspiciens** 3.2, 10; 4.35; 5.7; 6.25, 28, 32; 7.79; 24.62; 52.2; 53.27, 29, 40; 66.138; 72.119,

asserere**axis communis**

- 139; 96.175, 184; 130.66; 133.143; 151.75; 171.51, 71; 173.113, 114, 117; 177.237, 247; 181.47; 228.37; 246.31 **observer** 343-346, 357, 479-481, 519 **viewer** 376, 377, 386, 390, 428, 451, 453, 466, 481, 484, 486, 562
- asserere** 23.46 **to describe** 356
- assignare** 303.45 **to ascribe** 601
- assignatio** 297.15, 36; 300.108 **ascribing** 597 **ascription** 599
- assimetrus** 211.59 **disproportionate** 508
- assimilare** 115.234; 118.19; 136.240; 181.56, 57 **to assimilate** 441, 443, 455, 487
- assimilatio** 102.125, 128; 115.227; 119.31; 172.97; 173.124; 177.228; 189.293 **assimilation** 432, 441, 444, 480, 481, 484, 492
- assimulare** 12.36, 42, 46, 48, 51; 13.59, 61, 72; 50.269; 227.9, 20, 24; 234.215, 217, 218; 235.231, 233; 236.259, 266, 270, 272 **to assimilate** 519 **to be like** 348, 349, 375 **to resemble** 523-525 **to simulate** 348
- assimulatio** 226.1; 227.19, 25; 236.268; 237.282-284 **assimilation** 519 **resemblance** 525 **similarity** 519
- assuetudo** 136.251; 137.255; 177.243 **being accustomed to** 456 **being normal** 484
- assuetus** 101.99, 101; 102.146; 108.5; 115.221, 231; 120.75; 138.299, 4; 139.10; 142.106; 154.172; 162.108; 165.177; 173.111, 130; 176.225, 227; 181.58; 182.83, 84, 88, 90, 104; 183.119, 121, 122, 125, 130, 131; 196.215; 232.166; 233.169, 176, 177, 179, 184; 234.197, 214, 215; 236.275; 242.145; 243.156; 247.9; 270.64, 70, 77; 273.153, 158 **accustomed** 498 **customary** 436, 528 **familiar** 431, 432, 441, 445, 457, 459, 473, 475, 481, 483, 487, 488, 522, 523, 525, 528, 529, 562 **ordinary** 578, 580 **routine** 468
- attestari** 27.141 **to attest** 359
- attritio** 12.33 **roughness** 348
- auditus** 141.79, 80, 86-88, 90, 91, 93, 94 **hearing** 459
- aufere** 3.12; 4.24, 27, 45, 52; 5.55, 19; 7.61, 71; 26.135, 138; 43.52; 57.156; 58.199; 59.205; 122.124, 140; 128.295; 140.45, 52; 171.65; 193.116; 264.200; 265.232; 266.253, 258; 274.194; 277.269; 280.57 **to disappear** 344, 380, 381 **to displace** 573 **to lift (away)** 344, 379 **to make vanish** 495 **to remove** 345, 346, 358, 359, 370, 446, 450, 575, 581, 582, 584 **to shift** 343, 344, 458, 480 **to wear off** 343
- augmentare** 8.5²; 9.6, 16; 114.199; 117.285; 179.7; 239.61; 306.139, 140; 315.49 **to extend** 485 **to increase** 347, 441, 443, 527, 604 **to make more intense** 346
- augmentatio** 105.238; 106.243; 167.256; 175.192; 178.282, 285, 286; 179.287 **additional amount** 434, 435 **increase** 477, 483, 485
- augmentum** 111.103 **excess** 438
- avis** 208.261; 298.63; 300.107 **bird** 506, 599 **flying creature** 598
- axis** *frequently recurring* (80-82, 89-97, 144, 146, 178, 186-188, 219, 248-253, 255-263, 265-273, 276, 277, 280-282, 287, 290, 291, 295, 298, 305, 314, 316, 318, 331) **axis, visual axis**
- axis communis** 254.225; 255.229, 232, 233, 239, 242, 243; 256.260, 263, 269, 274, 279, 285; 257.295, 8, 11; 258.21, 25, 32, 36; 259.48-50, 59, 60, 62, 66, 74; 260.77, 82; 261.116, 122; 262.131, 133; 265.213; 270.85; 272.126, 132, 133, 139-141; 273.145, 146, 149, 151, 161; 322.19 **common axis** 567-572, 574, 578-580, 616

axis radialis**causa**

axis radialis 89.280, 290, 296; 93.101; 144.172, 175; 145.187, 188; 146.225; 160.42; 163.125; 177.251, 256; 179.299, 3; 185.194; 186.199; 219.78; 220.112, 114, 131; 221.137; 222.164, 165; 253.184; 272.127, 131, 138; 276.251, 253; 277.256; 278.9, 12; 280.54, 56; 282.120; 285.20, 24; 286.28, 60; 287.66, 70, 76, 79, 83 **visual axis** 424, 426, 461, 472, 474, 484, 485, 490, 513-515, 566, 579, 582-584, 586, 588, 589, 590

baculum 293.34 **stick** 594

basis 33.50; 34.71; 50.248; 76.96; 80.28; 164.160; 168.271; 170.35; 172.85; 185.176; 189.292; 248.39, 43 **base** 363, 364, 375, 393, 418, 475, 477, 479, 480, 489, 492, 563

benignitas 70.65 **beneficence** 388

bipartitus 301.9 **of two kinds** 600

bonitas 71.103; 72.143 **goodness** 390 **providence** 389

brachium 174.141 **arm** 481

brevis 209.277; 232.165; 331.10 **brief** 522, 623 **short** 507

brevitas 332.22 **brevity** 623

cacumen 132.115, 116, 121, 126 **peak** 452, 453

cadere 29.223; 52.13; 125.214; 296.56; 297.36; 299.90; 303.48, 54; 305.105, 111; 308.199; 309.226; 314.18, 20; 315.47, 48, 50, 51; 316.61, 73, 83; 317.86; 321.61; 322.19; 324.74; 325.82; 326.23; 327.60; 328.89; 331.42 **to fall/shine upon/strike** 596, 599, 601, 606, 610, 611, 615, 616, 618, 620, 622 **to lie upon** 611 **to meet** 610 **to occur** 376, 448, 597, 619 **to reach to** 612 **to subtend** 603 **to take into account** 605

candela 57.148, 151, 153-156; 207.233, 239; 321.61 **candle** 379, 506, 615

capacitas 307.179, 182; 308.202; 326.16 **extent** 605, 619

capillus 193.116; 311.281, 283, 292; 317.99; 323.39, 41 **hair** 495, 607, 608, 612, 617

caput 76.96; 320.23 **head** 614 **vertex** 393

carere 73.16; 77.137; 122.139, 143-146; 123.149, 150, 166; 124.194, 197-199; 132.112; 149.12; 181.71; 193.113, 114; 204.143; 210.27; 215.154, 162, 168; 285.12, 13; 286.34; 289.139 **to be without/lack** 393, 446, 447, 452, 487, 495, 508, 511, 588, 589, 591 **to dwindle** 464 **to fail to meet** 391, 588 **not to be exposed to** 503

cassare 26.133 **to disrupt** 358

casualis 298.48 **fortuitous** 598

causa 43.50, 56; 44.58; 64.69, 71, 75; 66.143; 69.51; 70.68; 73.19, 22, 30; 74.58; 75.66, 73; 77.134, 137; 78.178, 181; 85.173; 104.190; 106.261; 162.95; 191.48; 205.170-172, 186; 245.6¹; 247.45; 261.109; 270.76; 272.122; 285.200, 1; 292.230; 293.38; 294.2; 295.39; 296.48; 298.40; 299.70, 76; 300.111; 301.129, 3; 302.24, 31; 307.160, 180; 308.187, 194; 309.231; 312.21; 313.43, 51; 315.41; 321.73; 322.2, 4; 323.47, 49; 325.91; 328.76; 329.95, 98, 103; 330.12, 37; 331.47, 50, 2; 333.58, 68; 334.72; 335.28; 336.66, 2, 8, 10; 337.27, 40 **cause** 370, 493, 588, 595, 596, 598-601, 606, 609, 617, 618, 621-627 **determinant** 421 **producer** 616 **reason** 384, 386, 388, 391-394, 433, 435, 473, 561, 562, 571, 578, 579, 593, 594, 601, 604, 605, 608, 610, 616, 617, 620-622, 625 **source** 621 **that which is responsible** 615

causare**certificare****causare** 43.57; 44.58 **to cause** 370**celestis** 8.2²; 42.16; 132.114 **celestial** 369, 452 **sky-blue** 346**celum** 4.36; 5.3; 6.30; 47.164, 166; 65.111, 112; 171.69, 70, 72; 207.238, 240; 294.43
heavens 373, 385 **sky** 343-345, 373, 385, 480, 506, 595**centrum** 15.129, 131, 132, 137, 139-141; 16.145, 146, 148, 152, 156-159, 165-167; 17.191, 192, 199, 200; 18.206, 208, 209, 211, 213, 214, 216-218, 223, 224, 226-228, 230-232; 19.239, 241-243, 245, 248, 249, 251, 252, 257, 258, 262, 266; 20.269, 275, 277, 279, 295; 21.2, 3, 10, 11, 15-18, 20, 22, 24; 32.11; 33.29, 32; 34.80; 40.246, 247, 252; 41.277, 280, 281, 284-289; 42.1, 22; 47.150, 152, 155, 158; 70.53, 71, 74-76; 71.89; 80.11, 13, 17, 20; 82.71, 77, 82, 92; 83.93, 110, 111, 115; 89.295; 90.9, 12; 91.26; 92.53, 71-73, 75, 76; 93.87, 105, 106, 108; 119.56; 120.59; 168.261; 186.213; 248.44, 50; 249.53, 60, 69; 250.87, 92, 93; 253.185, 186, 189, 196, 198; 254.203, 207, 209, 213, 215, 222; 255.233, 236, 240, 241, 247; 256.265; 258.33, 36; 259.47, 70, 73; 260.76, 98; 262.138; 263.166, 170; 269.34, 48, 50; 271.101, 102, 109; 308.203, 204 **center** 350-355, 362-364, 368, 369, 372, 388, 389, 417-420, 424-427, 444, 563, 564, 566-568, 570-573, 577, 605 **center of sight** 419, 477, 564 **center of the eye** 419, 420, 490, 605 **centerpoint** 351, 353-355, 368, 419, 420, 424, 577-579**centrum visus** 34.69, 70, 78, 80; 35.100; 37.151, 173; 40.243; 42.300, 25; 43.36, 44; 49.219; 50.247, 248, 250, 253, 267; 59.219; 71.85; 76.96, 99, 109, 114; 80.3, 8, 20, 22, 26; 82.70, 75, 76; 83.115; 84.126; 89.290, 295; 164.159, 162, 170; 165.199, 200; 166.205, 211, 227; 167.246; 168.263, 279, 280, 283; 169.297, 1, 10; 170.40; 172.80; 174.161; 179.3; 182.105; 185.178, 183, 189; 187.248, 254; 188.256, 272; 248.38, 39; 255.245, 246; 282.137; 283.142; 284.182 **center of the eye** 364-366, 368-370, 374, 375, 389, 393, 417-420, 424, 563, 568 **center of sight** 381, 475-480, 482, 485, 488-492, 563, 586, 587**cera** 264.196 **wax** 573**cerebrum** 11.3, 6-8; 13.86, 87; 52.14, 16; 54.82; 55.84; 70.55, 59, 61, 63; 81.45; 86.202
brain 348-350, 376, 378, 388, 418, 422**certificabilis** 282.123 **determinate** 586**certificare** 106.266; 129.50-53; 131.100; 132.133; 133.153, 156; 135.198, 199, 209, 211, 212; 136.225, 232, 234, 235, 237, 241, 249; 137.271, 276, 279; 138.291, 294, 300; 149.8, 13, 25; 150.32, 33; 151.64, 66, 67, 69, 72, 76; 152.100; 153.120-124; 154.169; 155.177, 195, 197; 159.4, 12; 160.40, 43, 53; 162.100; 163.123, 131; 164.142, 144, 146, 147, 149-151; 166.218; 170.47, 49; 171.50; 172.107; 173.120, 135; 174.138, 146, 163; 175.183; 176.211, 213; 177.244, 248, 257; 178.261, 268, 279, 280, 284; 179.290, 293-295, 11, 12; 180.25, 32, 38, 40; 181.46-48, 55, 61; 185.192; 186.202, 205, 206, 209, 211; 188.260; 190.23, 29, 31; 197.225, 226; 218.50, 52, 54, 64, 66; 219.72, 93, 98; 220.109, 129; 221.138; 222.182, 184; 223.198; 224.233, 238, 244; 227.23; 228.37; 229.66, 79; 232.159; 239.48, 60; 240.69, 76; 241.105, 115; 242.126; 245.3², 5²; 252.169; 261.123; 275.207; 289.154 **to certify** 435 **to corroborate** 483 **to determine accurately/precisely** 451, 453-457, 464-469, 471-474, 476, 479, 481-487, 490, 491, 493, 498, 513-517, 519, 520, 522, 526-528, 561, 591 **to focus** 581 **to grasp with certainty** 451 **to make determinate/sure** 456, 566, 572 **to perceive accurately/precisely** 452

certificatio**clarus**

- certificatio** 136.252; 144.167; 160.46; 172.102, 103; 179.15; 183.126; 188.278; 219.79; 220.107, 108; 228.43; 229.71; 243.151, 157, 162, 163; 263.175; 275.203; 276.235
accurate determination 456, 461, 472, 480, 486, 488, 492, 514, 520, 529 **certainty** 573 **clarity** 582 **determinateness** 513, 529 **distinctness** 581
- certificatus** 130.76; 131.86, 94; 136.240, 243; 137.272; 138.283, 291, 296; 142.120; 144.160, 162, 163, 166; 148.287; 150.47; 151.82; 170.44; 172.99; 176.211, 213; 180.36, 42; 181.50, 52, 58; 182.87; 183.128; 185.180, 181, 184, 186, 187, 190, 192, 197; 188.274; 190.40; 218.65; 219.71, 96; 220.118; 221.135; 222.187; 225.246-248; 238.35; 240.87, 88; 241.100, 101, 116; 243.162; 252.165; 260.88; 261.103, 107, 109, 117; 262.131, 132, 151; 275.202; 276.248, 254; 277.261; 278.296; 282.128; 285.21 **accurately/correctly/precisely determined** 452, 455-457, 460, 461, 464, 466, 480, 483, 486-490, 492, 527 **definite** 452, 571 **determinate** 483, 486, 489, 490, 493, 513-515, 517, 526, 528, 529, 566, 571, 572, 582, 583, 586, 588 **determined** 516, 527 **distinct** 581, 586 **perceived with accuracy/precision** 452, 465, 479
- certitudo** 29.223; 136.246, 248, 249; 137.264; 152.96; 232.156; 323.38 **accurate determination** 455, 456, 466 **certainty** 360, 617 **determinate perception** 522
- cessare** 187.238 **to stop** 491
- cilium** 22.30; 72.137 **eyelash** 355, 390
- ciphus** 314.26 **goblet** 610
- circuitus** 12.41; 203.113, 127; 257.294; 260.75; 335.34 **area encircled** 348 **(area)** around 571, 626 **vicinity** 503, 569
- circulari** 12.35, 41 **to encircle** 348
- circularis** 195.175, 191; 196.220; 197.227, 228, 234; 289.158; 298.54; 302.42; 303.60; 304.83; 314.25; 315.32, 42; 319.14 **circular** 598, 601, 602, 610, 614 **rotary** 497, 498, 591 **rotating** 498 **round** 610
- circulus** 13.66; 16.147, 170; 17.177, 184-187, 190, 193-195; 18.204, 212, 215; 20.284, 287; 119.48, 50, 54, 57; 120.60, 62; 165.202; 166.203, 205, 207, 212, 213; 293.14 **circle** 349, 351, 352, 354, 444, 476, 594
- circulus consolidationis** 17.175, 177, 180, 187, 189, 191, 195, 201, 202; 18.211, 212, 214, 218, 219, 221, 232; 19.236; 20.283, 290, 293, 295, 297, 298; 21.300, 3 **circle of attachment** 351-355
- circulus sectionis** 16.145, 167, 168; 17.174, 176, 177, 179, 185, 188, 194, 196, 197, 203; 18.209 **circle of intersection** 351, 352
- circumdare** 251.134; 256.275, 278; 257.10; 260.83 **to surround** 565, 568, 569, 571
- circumferentia** 14.91, 94, 97; 15.131; 17.186; 20.284, 290, 298; 80.22; 119.38, 47, 48, 50, 54, 57; 120.59, 62; 155.206; 159.22; 160.30, 31, 33, 35, 37, 40-42, 46, 48; 164.144, 145 **circumference** 350, 352, 354, 418, 444, 469, 471, 472, 474
- circumgirare** 119.56 **to spin** 444
- citrinus** 67.173 **yellow** 386
- civitas** 223.207-209 **city** 516
- clarescere** 9.14, 22 **to brighten** 347
- claritas** 9.7; 291.212; 328.67, 78; 329.103 **clarity/clearness** 346, 593, 620, 621
- clarus** 4.31; 7.53; 8.5²; 9.28; 12.43; 13.72; 44.73; 289.135; 328.86, 89; 329.97; 330.14 **bright** 343, 345, 347 **clear** 346, 348, 349, 370, 591, 620, 621

claudere**communis**

- claudere** 4.26, 40, 50; 43.54; 124.192; 125.209; 128.297, 298; 171.52 **to close** 343, 344, 370, 447, 448, 450, 479
- clausio** 128.4, 10; 129.28 **closure** 450
- coacervare** 198.268 **to summarize** 499
- cognitio** 101.97, 103, 109, 113-116, 118, 120, 124; 102.125-127, 132, 133, 145; 103.158, 161, 163, 165, 166, 168; 104.209, 211; 106.257; 107.273, 280, 284, 287, 295; 108.4; 109.42, 46; 110.60, 65-67, 76; 112.119, 122; 115.213, 220, 222, 227, 231, 237, 239; 116.242, 249, 252; 117.275; 118.28; 121.93; 126.253, 264; 127.268, 275, 291; 138.3; 139.11; 154.175; 162.109; 173.123; 177.228; 182.93; 183.121, 123; 192.92; 216.192; 226.295; 227.5; 229.63, 70, 76, 77, 80; 230.94, 98, 105, 108, 110, 112; 231.133; 232.164; 233.185; 236.277; 238.34, 36; 239.43, 53, 66; 240.71, 83; 241.110, 117; 242.128, 131, 137, 141; 243.148, 153 **acquaintance** 473 **apprehension** 520, 528 **knowledge** 437, 449, 450, 521-523, 525-529 **recognition** 431-439, 441, 442, 444, 445, 449, 457, 468, 481, 484, 487, 488, 494, 512, 518-521, 526, 527 **thought** 436
- cognoscere** 101.97, 99, 100, 104, 107, 108, 111, 122; 102.137; 115.226, 231, 233, 235, 239; 116.240; 136.226; 137.271; 138.5; 154.172, 176; 173.126; 182.84, 85, 100; 183.114, 116, 132; 200.16; 201.56, 59, 66; 222.180; 223.198, 209; 227.15, 17; 228.41, 46; 229.61, 64, 68, 69, 76, 79; 230.86, 91-93; 231.115, 120, 140; 232.143, 145, 147; 236.272, 273; 237.293, 294; 239.39, 47, 51, 65; 240.84; 241.106, 109, 112; 242.130, 132; 292.10; 293.28; 297.26; 302.21 **to apprehend** 441, 455, 456, 525, 526, 528 **to know** 441, 516, 525, 594, 597 **to perceive** 468, 488, 521 **to realize** 481 **to recognize** 431, 432, 441, 442, 457, 468, 487, 488, 500-502, 519-522, 526-528, 594, 601
- collatio** 306.130, 136; 315.53; 334.7 **assimilation** 604 **being measured** 611 **collating** 603 **comparing** 625 **comparison** 625
- collatus** 305.125 **as a whole** 603
- collocare** 111.99, 100, 102-104, 106, 107, 109, 115; 139.28; 153.138; 172.93 **to be part of a set/a subtype** 458, 467, 480 **to subsume** 438, 439
- collum** 119.38; 235.235 **axis** 444 **neck** 524
- color** *frequently recurring* (4-10, 22-29, 32-36, 41-46, 49-51, 55-65, 67-69, 73, 75, 77-79, 83, 87-89, 97, 99, 110, 111, 113-121, 123-126, 133, 143, 153-155, 180, 191, 203, 206, 208, 210, 211, 216, 217, 220, 222, 225, 232, 235, 236, 238, 240, 260, 263, 264, 288, 290-296, 298-301, 306, 307, 309, 313, 318, 321, 327-329, 333, 334, 336, 337) **color**
- colorare** 4.47, 53; 6.50; 7.65; 8.1²; 9.18, 24, 30; 10.42, 6; 22.10; 23.49; 33.43, 54; 34.56, 61; 59.226; 62.19, 21; 63.25; 64.73, 75, 76; 65.90; 77.134; 78.166; 113.165, 169; 114.183, 184, 197, 209; 116.255, 263; 117.270, 271; 143.142; 191.54; 192.76; 203.105; 295.40; 312.24; 327.48 **to color** 344, 345, 347, 356, 363, 381, 383-385, 393, 394, 440-442, 460, 494, 502, 596, 608, 619 **to tinge** 344, 346 **to tint** 347, 356
- coloratio** 89.267; 99.51; 113.174; 116.259; 117.290, 296, 298 **coloring** 423, 430, 440, 442, 443
- columpnatus** 264.197 **cylindrical** 573
- communicare** 296.8 **to assimilate** 597
- communicatio** 296.9 **assimilation** 597
- communis** 16.156; 19.244, 249, 251; 33.32; 41.281; 47.159; 90.11; 175.191; 248.43; 249.76; 250.92, 94; 270.67; 296.6; 297.22, 24, 27 **common** 351, 353, 363, 368, 372, 563, 564,

complere**concavitas**

- 578, 597 **dividing** 483 **same** 424 *see also* **axis communis, differentia communis, nervus communis**
- complere** 28.185, 188; 43.30; 44.79, 82; 46.124, 126; 48.199; 49.228, 234; 52.24; 54.79; 55.89; 68.186, 2; 69.34; 71.105; 72.134; 76.123; 81.47, 58; 82.89; 84.138; 103.164; 126.262, 263; 127.265, 274; 164.165; 169.18; 216.187; 220.122, 129, 131; 238.29; 243.171; 285.16; 286.30, 41 **to accomplish** 514, 515, 526, 588, 589 **to account for** 387 **to achieve** 360, 369, 370, 372, 373, 378, 387, 389, 393, 419, 433, 449, 475 **to bring about** 388 **to complement** 374 **to complete** 376, 478 **to finish** 374, 390, 420, 511, 529 **to realize** 370, 418, 449
- componere** 11.1, 19, 23; 12.39, 49; 13.64, 77; 14.105; 15.117; 16.161; 18.220; 19.238; 69.36; 70.54, 60; 80.5, 6, 18; 81.44; 82.64; 104.192; 111.96; 119.42; 139.31, 34; 144.164; 186.216; 197.234, 235; 205.173, 175, 181; 211.49; 213.123; 214.129, 141, 148, 150; 216.4, 8; 217.17, 26, 28, 34; 220.106; 222.180, 181; 225.271; 231.116; 236.254; 253.187 **to affix/attach** 348, 350, 351, 353, 388, 417-419, 438, 444, 490, 498, 508, 510, 512, 514, 566 **to be a function of (a combination)** 458 **to be based upon** 433, 458 **to compose** 348, 388, 498, 512 **to combine** 504, 510 **to conjoin** 504 **to comprise** 512, 516 **to consist of** 461 **to derive** 518 **to form** 521 **to make (up)** 524 **to put together (in a summary)** 356
- compositio** 22.31, 33; 100.84; 104.191; 205.173, 176; 206.211, 212; 207.216; 210.20, 21; 213.96; 301.7 **arrangement** 509 **combination** 431, 504, 505, 507 **composite** 600 **composition** 355, 505 **conjoining** 505 **juxtaposition** 433 **structure** 355
- comprehendere** *frequently recurring* (3-8, 10, 24-26, 28, 36, 40, 41, 43, 44, 46-50, 52-56, 58-69, 71-81, 85, 88, 93-205, 208, 209, 213-243, 245-248, 251-253, 257, 258, 261, 262, 265, 270-274, 276, 277, 279, 282-293, 296, 302, 303, 306, 307, 311, 314-317, 320, 324-332, 334, 335, 337) **to apprehend, to discern, to grasp, to make out, to perceive**
- comprehensibilis** 245.6², 301.15; 332.32; 333.67 **perceptible** 561, 600, 623, 624
- comprehensio** *frequently recurring* (3, 6, 8, 10, 41, 42, 44, 54, 60, 62, 65-68, 72, 73, 77, 79, 81, 84, 89, 96-110, 112, 114-121, 123-131, 134, 135, 138-148, 150-164, 166, 167, 169-178, 180-185, 187, 189-194, 196-202, 204, 205, 214-223, 225-243, 245, 246, 253, 275, 277, 283-289, 292-294, 296, 298, 300-302, 307, 309, 312, 314, 316, 317, 321, 324-326, 332, 334, 335) **apprehension, making out, perceiving, perception**
- comprehensivus** 295.18 **apprehensible** 595
- compressio** 12.50, 51, 54 **flattening** 349
- concavitas** 12.32, 39, 49; 13.62, 63, 71, 74, 77, 78, 81, 82, 86; 14.88, 106-108, 113, 115; 15.118; 16.160, 163; 18.220, 222, 226; 19.237; 20.273, 284, 285, 290, 296, 298; 21.1, 5, 6; 80.6; 87.212; 111.101; 155.181; 161.68, 71, 73; 162.86, 91, 95; 163.119, 134; 253.193, 196, 199, 200; 254.201, 210, 211, 218, 220; 255.234, 237; 256.259, 263, 268, 269, 274, 277, 283, 286; 257.292, 5; 258.25, 29, 34, 35, 42; 259.47, 60, 65, 69, 73; 260.78, 97; 261.112, 130; 262.137, 141; 263.165, 169, 173, 187; 264.194, 204, 206; 269.33; 271.100, 108; 272.136 **cavity** 354 **concave (part)** 348 **concavity** 438, 468, 473, 474 **hollow** 348-351, 353-355, 417, 422, 567-573, 577-579 **notch** 573, 574 **socket** 567

concauum**coniungere**

- concauum** 12.38; 52.22; 55.88, 101; 70.58; 80.11, 12, 18; 81.44, 63; 82.65, 67, 77, 85, 87; 83.96; 86.195, 201; 87.209, 234; 88.238, 246, 249; 93.110; 94.118, 119, 121, 130, 133, 139; 95.158, 163; 112.121, 124, 127, 129, 133, 145, 147; 113.150-152, 158, 161, 164-166, 168, 173; 121.105, 106; 123.165; 124.178, 181, 186; 160.32, 45; 253.187 **cavity** 349 **hollow** 348, 376, 378, 388, 417-420, 422, 423, 427, 428, 439, 440, 445, 447, 472, 566
- concauum ossis** 11.12, 13, 16, 26; 14.92; 19.257; 80.9; 186.226; 253.188 **cavity of the bone** 348 **eyesocket** 348, 350, 353, 417, 490, 566
- concauus** 12.28, 32, 44; 13.75; 15.127, 129, 130; 16.143, 149, 155; 155.179; 156.227; 158.282, 284, 287, 294; 159.298; 161.75 **concave** 348-351, 468-471, 473
- concludere** 104.193; 294.46; 302.17; 310.246; 311.283; 312.27; 315.40; 317.86; 334.10 **to base a conclusion (on)** 433 **to base a perception (on)** 600 **to conclude** 595, 606-608, 612, 625 **to interpret** 610
- conclusio** 104.188, 189, 196, 199, 200, 211; 105.216-219; 106.248, 252, 254, 266, 267; 108.7; 129.25; 302.17; 313.34, 40, 47; 314.61; 318.135; 319.143 **conclusion** 433-436, 450, 600, 609, 613 **final judgment** 613 **final perception** 609
- concurrere** 11.8; 33.31; 34.65; 35.99; 37.169; 39.215; 40.242; 41.284; 42.300, 22, 25; 43.36; 47.155; 53.32; 54.61, 65; 55.85, 92; 70.68, 83; 80.3; 82.70; 83.104; 258.32, 39, 44; 259.48, 50, 68, 70, 72; 261.126, 128, 130; 262.133, 135, 140, 152, 154, 156; 265.212, 226; 266.268; 267.272, 289, 292; 268.7; 269.25, 44; 270.55, 57, 63, 66, 67; 271.97; 272.144; 273.148, 150, 160; 287.70 **to converge** 577 **to intersect** 348, 363, 364, 366, 369, 570, 572, 574-580, 589 **to join** 378, 388 **to meet** 367-369, 372, 377, 378, 389, 417, 419, 420 **to touch** 589
- concurus** 54.62; 55.86; 259.74; 260.88, 89, 92; 261.107; 262.150, 151; 276.245-247; 311.292 **coexistence** 607 **intersection** 570, 571, 582 **intersection-point** 572 **juncture** 377, 378
- conditio** 25.95 **circumstance** 358
- confiteri** 106.266 **to assimilate** 435
- confusio** 300.92 **commingling** 599
- confusus** 333.48 **blended** 624
- congregare** 13.60; 71.110; 73.15; 82.74; 97.2; 213.95, 103; 215.164; 248.26; 282.135; 283.147; 285.5; 286.40 **to combine** 429, 511 **to compress** 586 **to contract** 419 **to form a whole** 509 **to keep together** 389 **to meet (as a whole)** 391, 563, 588, 589 **to put together** 349
- congregatio** 61.290; 172.91; 212.68; 283.147, 151; 284.185, 192; 301.11 **arrangement** 600 **combination** 480 **compression** 586, 587 **juxtaposition** 509 **union** 382
- coniugatio** 210.29 **juxtaposition** 508
- coniunctio** 67.157; 205.171; 210.29; 211.40, 43, 46, 51; 213.108, 109, 121; 214.144, 148, 150; 215.161; 250.97; 251.130; 252.146; 253.178; 256.286; 260.83, 84 **abutment** 386 **combination** 508-511 **conjunction** 504, 508, 510 **contiguity** 508 **intersection** 564-566, 569, 571
- coniungere** 13.87; 14.91; 103.164; 190.40; 213.106, 111; 214.142; 217.21; 248.27, 42, 46; 249.54, 57, 71, 73; 250.88, 105; 251.121; 252.153, 154, 160, 166, 171; 253.175, 177,

conservare**contactus**

- 179, 200; 254.212, 220; 255.228, 232, 238, 252, 256; 256.264, 270; 257.299, 1; 302.29, 32; 326.34; 328.74 **to ally (with)** 433 **to be contiguous** 601 **to cluster together** 601 **to combine** 493, 509, 510, 620 **to conjoin/join** 349, 509, 512 **to connect** 350 **to intersect** 563-569 **to meet** 563, 568
- conservare** 71.110, 112; 72.125, 132; 82.68; 86.204, 205 **to conserve** 422 **to keep** 389 **to preserve** 389, 390, 419 **to protect** 390
- considerare** 25.95; 26.124; 47.160; 100.86; 152.89; 168.266; 177.245; 178.281; 200.31; 213.104, 107; 218.63; 227.22; 228.38; 232.143; 238.28; 242.143; 273.158; 275.216; 280.69, 70, 76, 78; 281.104; 282.116; 292.222; 293.40; 296.62; 302.18; 305.111; 308.195; 322.21, 23 **to consider** 358, 372, 596 **to evaluate** 477, 501, 513, 519, 526 **to examine** 431, 484, 485, 509, 522, 528, 581, 585, 586, 593, 600 **to gauge** 603, 605, 616 **to investigate** 580 **to look** 585 **to scrutinize** 466, 519 **to see** 594
- consideratio** 107.293, 295; 164.166; 167.234, 235; 168.274, 276; 174.153; 180.41; 217.30, 33; 218.55; 226.298; 232.157, 160; 241.120; 243.147, 152, 159; 272.124; 276.243, 249; 278.8; 280.52; 281.88, 92, 93; 282.118; 308.204; 309.239 **comparison** 518 **consideration** 606 **deliberation** 436 **evaluation** 475-478, 512, 513, 522, 529 **examination** 482, 486, 528, 579, 585 **experiment** 585 **gauging** 605 **investigation** 582-584, 586
- consimilis** 11.4, 10, 15, 22; 12.55; 16.173; 20.286-288; 21.12, 25; 29.201; 40.251; 41.275; 55.94, 95, 99-101; 70.62; 72.121; 77.127, 131; 83.111, 112, 114; 84.126, 131; 86.177; 87.209, 214, 230; 88.239; 94.132; 98.16, 29; 99.53, 56; 101.100; 199.12, 14; 201.66; 202.83; 208.270; 209.279, 281; 210.26, 27; 215.171, 173, 176; 217.31; 222.175; 247.7, 15; 248.32, 46, 52; 250.106, 113; 251.117, 119, 122, 124, 127, 128, 132, 134, 135, 140; 252.147, 149, 150, 156, 162, 164, 168; 253.192; 254.202, 204, 205; 255.231, 244, 253; 256.259, 261, 265, 282-284; 257.290, 296, 297, 4, 9, 16; 259.51, 58; 260.80, 90, 94-96; 261.119; 270.55, 58, 68; 274.175, 176; 287.63, 64, 71, 72; 289.136; 312.13; 326.17 **consistent** 360, 390 **constant** 354, 368 **corresponding** 388, 423, 565-571, 589 **equal** 349 **equivalent** 562, 563 **identical** 423, 511, 512, 516, 580 **matching** 348 **same** 348, 354, 378, 427, 432, 563, 577, 578 **similar** 348, 355, 378, 429, 430, 506, 507, 608, 619 **uniform** 351, 393, 420-422, 500, 502, 508, 568, 569, 591
- consimilitudo** 17.186; 86.179; 97.9-11; 98.17, 22, 24-26; 99.43, 60-62; 101.116; 111.95; 114.182; 160.53; 161.78; 201.56, 57, 75; 202.90; 215.170, 173, 176; 238.23, 25; 260.91, 99 **correspondence** 571 **similarity** 429, 430, 432, 438, 440, 472, 511, 526 **uniformity** 352, 421, 473, 501, 502
- consolidare** 11.20; 13.66; 14.97, 102, 109; 21.27 **to affix** 350, 355 **to conjoin/join** 349, 350 **to connect** 350 **to form** 348
- consolidatio** 16.170; 17.181 **attachment** 352 *see also* **circulus consolidationis**
- consolidativa** 11.26; 12.31, 33, 34, 41; 14.99, 101, 102, 109; 15.134; 19.255; 21.27; 71.107 **sclera** 348, 350, 351, 353, 355, 389
- consonoritas** 211.49 **harmony** 508
- constringere** 72.139; 307.182 **to narrow** 390 **to shrink** 605
- consuetudo** 102.146; 103.180; 109.49; 172.88 **custom** 437, 480 **familiarity** 433 **habit** 432
- contactus** 48.181; 74.48; 124.197; 125.232; 126.237, 244 **contact** 373, 391, 447, 448

contingutio**conus**

contingutio 193.126, 128, 133 **contiguity** 495, 496

contiguus 154.157; 193.129, 130, 132; 332.27; 335.27 **contiguous** 495, 623, 625 **having contiguity** 468

continere 11.12; 12.33, 53; 13.60, 65, 66; 14.99, 100, 107; 19.253; 22.29; 33.50; 34.84; 50.251, 259; 68.18; 70.76, 78; 71.88, 107, 109; 80.22, 27; 91.46, 49; 92.74, 77; 93.88; 94.124; 95.147, 149, 152, 155; 97.206; 114.179; 156.225-227, 229, 230; 157.240, 263; 161.82; 162.110; 164.159, 160, 162; 166.227, 228, 230; 167.247; 169.296, 298; 170.24, 33, 35; 171.58; 172.82; 175.178, 180, 184, 195; 176.201, 202, 222; 185.177; 186.210; 189.291, 7, 9; 190.26; 203.117; 248.40; 249.74, 80; 250.99; 251.130; 253.197; 264.195; 293.18; 327.55 **to circumscribe** 418, 573 **to comprehend** 475, 483 **to consist of** 470 **to contain** 348-350, 363, 375, 387, 389, 425, 475, 476, 563, 567, 620 **to cover** 355 **to enclose** 353, 389, 473 **to encompass** 349, 350, 364, 389, 418, 427, 475-480, 482, 489, 490, 492, 493, 503, 594 **to envelop** 469, 470, 473 **to form** 349, 427, 428, 479, 482, 490, 493, 564 **to include** 565 **to lie at** 483 **to subtend** 425, 426 **to surround** 348, 349, 429, 440, 483

contingere 13.74, 75, 83; 16.149, 154; 23.26; 26.130; 30.231; 44.58, 61; 45.94, 95, 104; 67.150; 74.37; 88.247; 121.100; 122.127; 123.163, 164; 124.189, 193, 196, 203; 125.207, 216; 127.273; 133.149, 153, 160; 192.91; 213.114; 239.50, 63, 67; 240.69, 77, 84, 85; 241.107, 113; 273.153; 297.33 **to arise/happen/occur** 358, 494, 527, 528, 580, 597 **to be contiguous** 349, 351, 356, 361, 386, 446, 453 **to create/have an effect** 370, 371, 423, 510 **to develop** 527 **to form** 526 **to make contact** 445, 447-449 **to touch** 391, 447

continuare 15.121, 139; 16.144, 166; 18.208; 19.253; 23.49, 52; 27.148, 150; 54.82; 65.112; 86.201; 122.128; 130.55-58, 71, 78; 131.87, 93, 97, 107, 110; 132.114, 129, 133; 133.167; 134.180, 192; 135.197, 207, 213, 216, 219; 137.268, 274, 275, 278; 138.290, 293, 294; 172.100, 101, 106, 107, 109; 174.146; 175.171; 176.207; 177.249; 178.270; 181.52; 190.24, 35; 191.60, 62; 192.79, 87; 249.81; 272.142; 299.73 **to be contiguous** 356, 385, 494 **to be continuous** 350, 353, 359, 446, 451-457, 480, 481, 485, 486, 493, 494, 579 **to be successive** 483 **to connect** 351, 352 **to extend** 564 **to join** 351 **to link** 359, 378, 422 **to place against** 598 **to surround** 482

continuatio 45.107; 111.92; 155.184; 193.119, 125, 126, 134; 207.234; 209.296; 211.51; 251.139; 272.137 **continuity** 438, 468, 495, 496, 506, 508, 565, 579 **extension** 371 **ligature** 507

continuitas 294.44; 309.230, 239; 316.67, 71; 320.29, 37; 323.40, 44, 49; 326.26; 330.25; 332.29; 335.27 **close succession** 595 **continuity** 606, 611, 614, 617, 619, 622, 623, 625

continuus 24.82; 34.72, 84; 50.255; 72.127; 73.10; 77.125; 87.211; 112.143; 133.150; 193.121, 123, 131; 207.235; 232.145; 251.135; 260.85; 272.137; 273.154; 285.9; 293.38; 309.219, 223, 232, 233, 238; 316.69, 76; 320.33, 36; 323.46; 326.25; 330.25; 332.28; 335.26 **coincidental** 364 **continuous** 357, 364, 375, 390, 393, 422, 439, 453, 495, 506, 522, 565, 571, 579, 580, 588, 594, 606, 611, 614, 617, 619, 622, 623, 625

contradicere 58.185 **to counter** 380

contrarius 9.31; 271.109 **opposite** 347, 579

conus 33.49; 34.66, 70, 78; 50.248, 253; 80.22; 248.39 **vertex** 363, 364, 375, 418, 563

convenientia**crescere**

- convenientia** 98.26; 105.237; 106.243; 329.106; 331.50 **agreement** 430 **being identical** 621, 622 **conjunction** 434, 435
- convenire** 25.95, 97; 26.125; 49.231, 233; 72.122; 96.174; 295.17; 329.101 **to agree** 428 **to be compatible** 374 **to be identical** 621 **to conform** 374, 595 **to correspond** 358 **to suit** 358, 390
- conversio** 82.83; 142.109 **reflection** 460 **reversal** 419
- conversus** 36.145; 37.167; 38.178; 39.210; 82.83; 83.93; 296.57 **directed** 596 **reversed** 365-367, 419
- convexio** 111.102 **convexity** 438
- convexitas** 155.181; 158.269, 279; 161.57, 61, 63, 85; 162.91, 96; 163.119, 134 **convexity** 468, 470, 472-474
- convexus** 11.12; 15.130; 16.143; 155.179; 156.227; 157.262, 266; 158.277, 279; 161.61 **convex** 350, 351, 468-470, 472
- cooperire** 5.17; 12.34, 40; 53.43; 57.155; 66.138; 68.5; 72.131; 122.130, 140; 132.115; 133.140; 170.42; 171.53, 56, 61, 68-70, 72; 253.179, 180; 271.88, 92, 115; 272.116; 275.224; 278.299; 279.35; 294.43; 314.5; 321.69 **to block** 446, 453, 479, 566 **to cover** 348, 377, 387, 479, 480, 578, 579, 581, 583, 584, 595, 615 **to hide** 452 **to obstruct** 446 **to occlude** 609 **to screen** 344 **to shield** 379, 386, 390
- coopertorium** 3.14; 5.19; 57.156 **screen** 343, 344 **shielding body** 379
- copulare** 249.75; 250.90; 253.195; 254.203, 207, 208, 213, 215, 221; 255.233, 240 **to join** 564, 567, 568
- cornea** 12.42; 13.69, 76, 79, 82; 15.120, 123, 126, 140, 142; 16.143, 149, 153, 155, 159; 18.224, 228, 230; 19.239, 243, 248; 23.27; 26.135; 31.281; 33.34, 35; 40.256; 68.3 **cornea** 348-351, 353, 356, 358, 363, 387
- cornu** 12.42; 263.188; 264.205 **bridge (of nose)** 573, 574 **horn** 348
- corporalis** 303.45 **bodily** 601
- corporeitas** 111.92; 156.212; 157.239, 245, 249, 259, 261, 265; 158.286, 289, 292; 159.299, 6, 10, 11, 13, 18, 19, 23-25; 160.27; 163.114; 184.161, 163; 185.166, 169; 207.220; 303.70, 71; 304.72, 73, 78, 79 **body** 471 **corporeity** 438, 469-472, 474, 505, 602; **mass** 489
- corpulentus** 323.42 **thick** 617
- corpus** *frequently recurring* (3, 4, 6-12, 14, 22, 23, 27, 29, 31, 33, 34, 42-49, 51, 52, 56-65, 67, 69, 70, 73-78, 81, 83-88, 97, 99, 100, 103, 111-113, 116, 121-125, 128, 130-138, 140, 148, 150-152, 155-159, 161, 162, 165, 172-176, 178, 181, 184-186, 190-193, 199-204, 207, 209, 210, 216, 217, 220, 234, 235, 260-262, 285, 286, 288-296, 298-300, 302-318, 320-327, 330-337) **body**
- corrumpere** 68.9, 10, 17 **to cause to deteriorate** 387 **to damage** 387
- corruptio** 27.142 **degeneration** 359
- credere** 309.232, 237; 310.261, 266 **to believe** 607 **to take to be** 606, 607
- crementum** 13.67, 69; 108.10; 233.170 **arising** 349 **development** 522 **growth** 436
- crepusculum** 298.58 **twilight** 598
- crescentia** 173.129; 176.223 **development** 481, 483
- crescere** 11.4, 7; 239.61, 62; 306.141; 309.220 **to arise** 348 **to emerge** 348 **to grow** 529, 606 **to increase** 604

cristallus**defere**

- cristallus** 295.40, 41, 43; 299.73, 74; 325.5, 7; 326.29 **crystal** 618, 619 **glass** 596, 598, 599
- cubitum** 165.185, 186, 189, 190; 177.231, 236, 238, 240, 242; 263.177 **cubit** 475, 484, 573
- curvus** 42.11, 12; 304.76, 87 **crooked** 369 **curved** 602
- curvitas** 111.101; 161.81; 162.104 **curvature** 438, 473
- custodire** 14.103, 110; 19.263; 68.16; 85.164 **to hold** 350 **to keep** 350 **to maintain** 354, 387, 421
- dare** 14.90; 70.56 **to endow** 350, 388
- debere** 25.94; 47.177; 53.46; 57.160; 82.92; 83.109, 111; 85.151; 245.4¹; 264.208; 265.216, 224; 266.253; 277.285 **to be obligated (must/need/ought/should)** 358, 373, 377, 380, 419-421, 561, 574, 575, 583
- debilis** *frequently recurring* (3-10, 52, 58-60, 62-69, 75, 96-97, 99, 118, 203, 204, 208, 286, 288, 291, 293-296, 306, 319-321, 328, 334-337) **attenuated, faint, weak**
- debilitare** 7.60; 72.128 **to attenuate** 345 **to debilitate** 390
- debilitas** 64.65, 66; 65.92; 67.178; 68.184; 99.45; 117.294, 295; 123.167; 243.167; 290.174, 177; 294.7; 298.57; 306.144, 148, 150; 319.8, 13; 320.30; 322.83; 334.1, 7, 18; 335.24; 336.67 **deficiency/insufficiency** 614 **dullness** 430 **faintness** 387, 443, 592, 598, 604 **vanishing** 384, 385 **weakness/weakening** 447, 529, 592, 595, 604, 614, 616, 625, 626
- deceptio** 245.4¹, 6¹-8¹, 10¹, 12¹, 11²; 246.36, 41, 42; 247.44-46; 272.122; 285.200, 2 **deception** 561, 562 **illusion** 561, 562, 579, 588
- decipere** 245.9², 11²; 246.27, 33, 35 **to deceive** 561, 562
- declinabilis** 249.55 **inclined** 563
- declinare** 3.18; 6.45; 14.104, 114; 27.139; 29.212, 215, 217, 219, 220; 30.233, 238, 241, 243, 258; 31.267, 270, 278; 32.10, 20, 21; 37.149, 156, 166, 171; 38.201; 40.250, 264, 265; 55.96; 89.272, 274, 296; 90.300, 1, 19, 21; 91.36, 43; 92.50, 66, 82; 93.102; 95.151, 154; 148.295; 187.230, 237, 238; 249.57, 71, 74, 76, 77, 79, 83; 250.85, 91, 108; 251.126; 256.284; 257.288; 269.39; 302.39, 40, 42; 303.54, 55; 314.19, 24; 315.27, 30, 32, 35, 37; 317.111; 319.12; 322.16; 325.10; 330.13; 332.14; 333.54; 334.19 **to be oblique/intersect obliquely** 360-363, 365-368, 423-428 **to bend/flex** 350, 366 **to displace** 378 **to incline/slant** 345, 360, 361, 464, 491, 577, 601, 602, 610, 612, 614, 616, 618, 621, 623-625 **to lie beside/on a side** 563-565, 569 **to shift** 343 **to turn aside** 359
- declinatio** 14.106, 111; 15.117; 20.271, 274, 286, 287, 291, 299; 21.2, 6; 147.266; 148.285, 296; 151.58; 290.173; 291.200; 295.20; 298.52; 303.43, 44, 57, 58, 64-66; 314.22; 315.28; 316.64, 70; 317.112; 322.18, 22, 23; 326.11; 330.14; 333.55, 58; 334.19 **flaring out** 354 **flexing** 350, 354, 355 **inclination/obliquity/slant** 354, 463-465, 592, 593, 595, 598, 601, 602, 610-612, 616, 618, 621, 624, 625
- defectus** 19.256 **shortfall** 353
- defere** 77.151; 121.101; 123.162, 164; 124.189, 193, 195, 200, 204; 125.207, 216 **to carry** 394 **to transmit** 445, 447, 448

deficere

differentia communis

- deficere** 19.254 **to except** 353
deformare 313.45; 329.96; 331.48 **to deform** 609 **to disfigure** 621 **to render ugly** 622
deformitas 313.44; 318.125, 135; 321.70; 325.84, 87; 328.92; 329.98; 331.47; 333.66, 68; 336.64 **disfigurement** 621 **ugliness** 609, 613, 615, 618, 621, 622, 624, 626
delectare 206.190 **to delight in** 505
demittere 315.48 **to lower** 611
demonstrare 108.13 **to show** 436
demonstratio 48.206 **demonstration** 374
densitas 77.133; 78.180; 285.8; 286.32; 288.120, 122, 124, 126; 321.55 **opacity** 393, 394, 588, 590, 591, 615
densus 6.50; 7.59; 8.1²; 9.16; 12.30; 27.147; 34.73; 60.258, 263; 61.267, 268, 275, 276, 292; 74.42, 43; 75.68, 71; 77.127, 134; 78.166, 179; 285.7, 9; 289.137 **crass** 359 **opaque** 364, 382, 391-394, 588, 591 **solid** 345-348
dependere 38.198; 68.187 **to bear/hang upon** 366, 387
depingere 311.285, 286; 317.100 **to decorate/paint** 607, 612
deprehendere 322.18 **to grasp** 616
depressio 324.64 **depression** 617
deprimere 312.4, 6 **to depress** 608
descendere 56.142; 300.118; 309.224; 313.31; 317.111; 327.59; 328.65; 333.55, 63; 336.60 **to radiate** 379 **to shine** 600, 606, 609, 612, 620, 624, 626 **to stream into** 620
destructio 27.142, 145, 151; 129.28 **destruction** 359 **disappearance** 450 **disruption** 359
destruere 23.47; 26.131, 134, 138; 43.55, 57; 44.75; 55.90; 57.155; 128.296, 299, 1, 4, 10; 140.46, 53 **not to stand** 356 **to cause to cease** 370, 450 **to cause to disappear** 450, 458 **to destroy** 358, 370, 378 **to extinguish** 358, 359, 379 **to remove** 378
determinare 32.6; 96.175; 113.156; 166.226; 177.233, 234, 237; 185.173; 217.25; 247.18; 265.214 **to define** 563, 574 **to determine** 440, 476, 484 **to enumerate** 362 **to explain** 512 **to show** 428 **to specify** 489
deturpare 318.127; 325.85 **to disfigure** 613, 618
deviatio 303.71; 304.72 **curvature** 602
diafonitas *frequently recurring* (9, 12, 13, 23, 26, 27, 29-31, 35, 43, 44, 46, 50, 51, 56, 57, 68, 69, 73, 77, 78, 83, 85-88, 99, 100, 103, 111, 202-204, 208, 238, 285, 286, 288, 289) **capacity to transmit light, transparency**
diafonus *frequently recurring* (7, 9, 12, 13, 23, 26, 27, 29, 43-46, 48-51, 56-59, 62, 64, 65, 68, 69, 73, 76-78, 84, 85, 87, 88, 99, 100, 202-204, 208, 285, 288, 289) **transparent**
dictio 102.146, 149, 150, 152; 232.143 **word** 432, 522
dies 3.22; 4.36; 5.2, 3; 7.76, 79; 10.39; 65.109, 111, 116; 66.120, 121; 208.266; 299.65 **day** 343, 344, 346, 347, 385, 506, 598
differentia 5.2; 149.10; 153.146; 154.155; 155.187; 193.130; 250.85; 251.137; 252.159; 267.285, 286; 268.3; 270.69; 275.203; 276.230, 236; 284.177 **difference** 344, 464, 467, 468, 495, 564-566, 576, 578, 581, 582, 587 **distinction** 467, 581
differentia communis 84.124; 90.5, 14, 16, 18, 20, 21, 24; 91.27, 44, 48; 92.50, 52, 54, 56, 57, 59; 93.86, 89 **common section** 420, 424-426

diffinitio**distantia**

- diffinitio** 296.5, 10; 297.15; 299.66, 75, 77, 81; 300.108 **definition** 597-599 **nature of a thing** 597, 599
- digitus** 192.88; 263.177; 277.267 **digit** 573, 582 **finger** 494
- dilatare** 11.16 **to expand** 348
- dimensio** 156.213, 218, 224; 158.281, 291, 294; 277.267; 323.34, 35 **dimension** 469-471, 617 **side** 582
- diminuere** 47.167; 114.199; 165.175; 168.260; 190.19, 20; 193.116; 275.209; 276.240; 299.76; 306.149; 328.82; 330.11 **to be small/tiny** 495, 604 **to become less distinct/diminish** 373, 475, 581, 582, 620 **to decrease/lessen** 441, 477, 493, 599, 621
- diminutio** 63.36; 167.250, 255; 290.170, 175; 295.31; 300.108; 323.36; 325.83 **decrease (in size)** 477, 592, 599 **diminution** 592 **shadowing-effect** 383 **smallness** 596, 617, 618
- dimittere** 108.15 **to reject** 436
- directio** 144.185; 145.192, 208; 146.220, 236; 149.3; 150.46; 152.91; 189.287; 206.210; 248.22; 296.49; 317.91 **direct focus** 612 **directly facing disposition** 461-466, 492, 563, 596 **evenness** 505
- directus** 144.169, 170, 186; 145.199, 200, 207; 146.221-226, 229, 232, 234, 236, 239; 147.253; 148.285, 286, 295; 149.21, 25; 150.26, 27, 34, 36; 151.61, 62, 68; 152.109; 153.130, 133; 156.232-234, 236; 157.237, 242, 252, 254-257; 158.274, 278; 189.286, 294, 4, 11; 190.14, 17, 19, 21, 29; 304.82; 305.118; 313.40; 314.5; 315.34; 324.74 **directly/perfectly facing** 461-467, 469, 470, 492, 493, 602, 609, 610, 618 **lying in a direct line with** 603, 609
- dirigere** 248.21, 25; 265.237; 266.256, 261, 265; 267.270, 276; 273.170; 274.187, 192, 199; 275.217, 226; 276.232; 277.272, 276, 287; 279.19, 29, 32, 38; 280.60, 64, 75; 281.107; 282.112; 307.161; 313.54 **to direct** 461, 563, 575, 576, 580-586, 609 **to focus** 581 **to radiate** 604
- discretio** 71.103; 72.142; 111.92; 193.124; 306.132; 309.240 **discernment** 603
- discontinuity** 438, 606 **perspicacity** 389, 390 **separation** 495
- discretus** 309.220, 237, 241 **discrete** 606 **disjoined** 606
- disiungere** 330.24 **to separate** 622
- disponere** 315.47; 316.60 **to place** 611 **to set up** 611
- dispositio** *frequently recurring* (3-6, 8, 10, 17, 21, 22, 25, 29, 32, 35, 44, 46, 48, 54, 61, 66, 71, 78-80, 86-89, 93-97, 99, 101, 112, 120, 122, 134, 171, 182, 186, 187, 192, 205, 207, 218, 219, 221, 222, 227, 235, 242, 248-252, 259, 260, 262, 265, 267-269, 272-275, 279-282, 304, 315, 316, 319, 329) **arrangement, basis, case, circumstance, condition, disposition, example, fact, instance, orientation, phenomenon, position, proportion, respect, result, situation, state, time, way**
- dissimilis** 295.34; 313.56, 60; 318.138; 319.142; 329.107; 335.46, 49; 337.33 **different** 596, 621 **dissimilar** 609, 613, 626
- dissimilitudo** 160.52; 296.6; 313.54; 318.136; 319.142, 143; 321.74; 325.89, 90, 92; 329.100, 108; 331.49; 333.71; 334.72; 335.50; 336.54, 64 **difference** 626 **dissimilarity** 472, 597, 609, 613, 615, 618, 621, 622, 624-626
- distantia** 73.21; 79.15; 91.29, 31, 38, 40, 41; 92.56, 60, 67, 69, 73; 93.90; 133.139, 160;

distinctio**diversare**

- 134.187, 195; 192.96, 99, 102; 193.105, 106, 112, 117, 120-122; 200.28, 35, 42; 201.48, 51; 237.293; 249.66; 281.97; 300.94, 110; 307.184; 308.205, 207, 209; 311.297; 313.37; 314.14; 319.7, 21; 320.26, 36, 41, 42; 322.8; 326.25; 331.10 **distance** 417, 425, 426, 453, 454, 495, 501, 564, 585, 605, 608-610, 614, 616, 623 **interval** 599 **separation** 391, 495, 501, 525, 599, 614, 619
- distinctio** 21.15; 49.229; 99.46, 51; 100.76, 82, 83, 88, 91, 94; 102.148; 103.169, 171, 173; 104.206, 210; 105.228; 107.295; 108.12; 109.39, 43, 54, 57, 58; 110.60, 69; 112.118, 120, 130; 114.177, 190; 116.245-247, 251; 117.272; 118.24, 27; 119.31, 32; 121.91, 94; 126.264; 127.265, 268, 274, 279; 128.293, 18; 129.25, 37; 140.40, 42; 141.75, 83; 153.148; 155.200; 166.221, 224, 231; 168.262, 269; 172.82, 89; 191.50, 51, 53, 57, 62, 64, 66, 71-73; 192.76, 78, 81, 83, 85, 90, 91, 94, 95; 193.115; 194.137, 143; 205.164; 206.207; 217.22; 219.76, 77; 222.176, 178; 230.103, 106; 239.51; 241.121; 243.159; 293.13; 309.217, 219, 221, 228, 234, 236; 316.63; 320.29, 32; 324.73 **account** 513 **determination** 480 **development** 526 **differentiating faculty** 434 **differentiation** 430-434, 436-440, 442, 444, 445, 449-451, 458, 459, 467, 476, 477, 512, 513, 516, 521, 529, 594 **discernment** 436, 440 **disjunction/division/gap/separation** 494-496, 606, 611, 614 **distinction** 437, 442, 458, 469, 505 **faculty of discrimination** 476, 477, 480 **individuality** 496
- distinguere** 6.43, 47; 9.9, 11; 16.170; 22.20; 24.72, 76; 25.87, 92, 96; 26.110, 115, 122; 28.186, 191, 193; 32.296, 300, 14; 35.90, 104, 113; 36.118, 129, 131; 41.269; 42.4; 45.97; 46.127; 50.241, 257, 258, 266; 56.126, 142; 57.148, 152, 160; 59.219; 60.244, 246; 62.12, 17; 63.35; 64.57; 65.95, 118; 67.162; 70.77; 71.87, 105; 75.84; 76.97, 100, 109, 115; 79.17; 80.26, 33; 92.76, 79; 93.88; 96.172; 97.205, 8; 99.43, 58; 100.93, 94; 102.133, 151, 154; 104.183, 211; 107.278; 108.1, 12, 26; 112.133; 113.162; 116.240; 117.282, 298; 118.299, 10; 120.69; 127.287; 134.191; 138.284; 140.41, 42; 141.74, 75-77, 81-83, 85; 149.6; 150.26, 34; 152.106; 153.129, 138, 146, 148; 155.187, 198, 202; 156.210, 211, 214; 168.265; 177.245; 179.298; 180.34, 45; 181.49; 184.145-147, 155; 191.52, 53, 55, 58; 192.75, 77, 85, 97, 98; 193.115, 133; 194.137, 142; 196.200, 222; 199.292; 201.48, 50; 204.146; 207.233, 235; 214.131, 133, 143; 215.166; 217.19; 220.102, 103; 222.173; 229.83; 235.234, 242; 238.13; 244.174; 245.7; 246.26; 283.145; 288.105, 107, 112 **to analyze** 489 **to cut** 365 **to define/describe/determine/judge/specify** 351, 417, 429, 469, 477, 486, 561 **to demarcate/mark off** 364, 365, 375, 389, 393, 418, 426, 586 **to differentiate/disjoin/individuate/separate** 356, 365, 430-433, 436, 440, 442, 443, 454, 456, 459, 464, 466, 467, 469, 484, 489, 494-497, 500, 506, 511, 512, 514, 516, 524, 590 **to discern** 345, 346, 357, 358, 360, 362, 365, 368, 369, 379-381, 383-386, 389, 392, 435, 436, 439, 443, 449, 459, 465, 501, 504, 510, 520, 526, 562 **to distinguish/perceive (distinctly)** 345, 357, 358, 360, 362, 371, 372, 374, 379, 385, 428, 432, 458, 459, 468, 485, 486, 494, 524, 590 **to enclose/form (an enclosure)** 375, 381 **to lay out/list** 498, 529 **to reach (a conclusion)** 434
- diversare** *frequently recurring* (6, 10-12, 23-26, 29, 31, 32, 35, 36, 39-42, 46, 52, 55-58, 61, 69, 76, 79, 80, 83, 86, 88, 91-93, 95, 96, 98, 100, 107, 112-115, 117, 119, 121-126, 129, 139, 146, 153, 156, 162-167, 170-172, 192-195, 197-200, 202, 205, 208, 209, 211, 213, 216, 222, 225, 226, 236-238, 243, 247, 252, 260, 262-264, 268-270, 293,

diversificare**dubitabilis**

294, 296, 313, 314, 317, 321, 326, 327, 333, 337) **to be different, to change, to differ, to vary**

diversificare 44.88; 89.275; 296.10 **to differ** 371 **to differentiate** 597 **to vary** 423
diversitare 234.214 **to vary** 523

diversitas 10.39, 7; 19.256; 31.280; 42.26; 55.112; 76.113; 79.16, 20; 85.171, 174, 175; 86.180, 182, 183, 189, 190; 88.247; 96.191; 97.203, 10; 98.34, 37; 99.44, 61-63; 111.95, 104; 114.180, 182, 201, 205; 119.43; 137.260; 139.9; 144.177; 145.193, 202; 146.218; 149.300, 14, 16; 152.110; 153.127; 154.154, 162; 155.184, 186; 160.54; 162.87; 164.172; 165.184, 192; 166.206; 168.281; 183.128; 184.136; 193.111; 194.156; 196.198-201, 203, 218; 198.259, 260, 264, 273; 199.4; 200.29, 34, 35, 42; 201.53; 202.86; 209.282, 284, 286, 291, 297; 211.38; 216.180, 183; 217.31; 220.103; 222.176; 226.279, 281; 232.141; 237.279, 5; 238.12, 24, 32; 247.45; 249.65, 83; 250.84, 95, 111; 262.147; 268.5, 11; 270.56, 59, 73, 75; 284.173, 176, 179, 183; 290.173; 293.22; 294.8, 9; 295.21, 30; 312.3, 5; 313.58; 316.81; 317.86; 318.140; 321.75; 322.81; 329.103, 105; 331.50; 333.47; 335.30, 32 **change** 496-499 **difference/dissimilarity** 353, 362, 378, 421, 422, 428-430, 438, 440, 444, 461, 462, 464, 466-468, 473, 475, 478, 499, 507, 511, 514, 516, 525, 526, 562, 564, 565, 572, 576, 587, 594-596, 609, 611, 612, 615, 621, 622, 624, 626 **disagreement/discrepancy/skew** 369, 456, 457, 467, 488, 495, 578 **variation** 347, 393, 417, 423, 441, 476, 499-502, 508, 512, 518, 522, 595, 608
diversus *frequently recurring* (6, 10-12, 23-26, 29, 31, 32, 35, 36, 39-42, 46, 55-58, 61, 69, 83, 88, 91-93, 95, 96, 98, 100, 112-115, 117, 119, 121-126, 139, 146, 153, 156, 162, 163, 165, 166, 170-172, 192-195, 196-200, 202, 205, 208, 209, 211, 213, 216, 222, 237, 247, 260, 262-264, 268-270, 293, 294, 296, 313, 314, 317, 321, 326, 327, 333, 337) **being of another (kind), different, distinct, not the same, variable, various, varying**

divertere 332.24 **to take away** 623

dividere 11.9; 12.56; 111.91; 122.133; 129.23; 135.222; 138.287; 139.15, 29; 144.169, 181, 184; 159.21; 160.28; 242.144; 244.175; 254.209, 212, 221; 304.84; 309.234; 316.69, 76; 320.33; 326.23 **to be divisible/bisect/disjoin/divide/separate/split/subdivide** 348, 349, 446, 456-458, 461, 471, 528, 529, 567, 606, 611, 614, 619 **to be manifold** 602 **to detail** 450 **to fall under** 455, 461, 472 **to go through an analytic procedure** 450 **to reduce to** 438

divisio 129.26; 134.188; 138.285; 144.185; 207.231; 214.130; 243.171; 316.67; 320.32; 323.39, 40; 326.22, 36; 330.23; 332.24, 25; 335.26, 27 **analytic procedure** 450 **discussion/explanation** 529 **disjunction/juncture** 611, 614, 617, 619, 622, 623, 625 **distinction** 619 **division/separation/split** 454, 456, 461, 505, 622, 623

dolere 3.2, 4, 7; 52.299; 72.138 **to hurt/suffer** 343, 376, 390

doleum 11.18 **jar** 348

dolor 51.297; 52.298-300, 4, 7, 8, 10; 55.105, 110, 111, 113; 58.178; 69.46; 86.196, 197 **pain** 376, 378-380, 388, 422

dolorosus 52.12 **painful** 376

domus 4.35, 38; 132.134, 136; 327.59, 60 **room** 343, 453, 620

dubitabilis 164.156; 259.71; 261.103; 262.141, 147; 274.189; 276.253; 278.295, 13; 279.24, 33, 42, 48; 282.122, 128, 131; 283.146, 149, 157; 284.197 **indefinite** 570-572

dulcedo**elongatio**

- indistinct** 581-584, 586-588 **subject to debate** 475
dulcedo 212.74 **charming nature** 509
duplex 262.145 **doubled** 572
duplus 209.278 **paired** 507
durare 246.30, 32; 310.248; 311.270; 335.38 **to continue/keep on/maintain** 562, 606, 607, 626
duratio 290.177; 296.50 **duration** 592
diameter 33.32; 42.1, 16; 165.202; 166.205-207, 212; 169.5; 185.194; 187.235, 239, 240, 249; 189.290; 190.30; 221.132; 246.18, 19; 251.116, 120; 252.155; 255.250; 260.77, 81; 261.105; 263.180, 185, 187; 264.191; 265.213, 221, 230; 266.244, 246; 269.35, 40, 42; 270.82, 85; 271.88, 91-93, 95, 98, 103, 110, 113; 272.118, 119, 124; 276.255; 277.257, 259; 278.7; 287.67, 69; 303.60; 315.28, 31, 41, 42 **cross-section** 478, 490-493, 515, 565, 566, 571, 582, 589 **diagonal** 561, 573-575, 577-579, 583 **diameter** 363, 369, 476, 602, 610
- eclipsare** 62.14; 63.38 **to dim** 383 **to outshine** 383
econversus 38.204; 82.72 **opposite** 367 **vice versa** 419
efficere 11.9, 10, 17; 27.149; 38.179; 53.33, 37; 82.72, 75; 106.267; 143.155; 256.270; 257.293, 8, 12, 16; 258.43; 290.174; 299.72; 300.102; 305.108; 310.243; 323.47; 328.74; 329.4; 337.17, 32 **to cause (to)/cause to end up/lead to** 366, 592, 598, 621 **to create/form/make into/produce** 348, 359, 377, 419, 435, 461, 568-570, 599, 603, 606, 617, 620, 627 **to fall to** 419
effundere 306.154 **to blanket (with)** 604
egredi 290.167, 168, 173; 292.229, 231; 293.25, 30; 294.47; 295.25, 42; 296.47; 298.61; 299.72; 302.26, 35; 307.172, 175; 309.230; 310.243; 314.1, 22; 318.123; 319.1, 13; 321.67; 322.1; 325.1 **to be inordinate/fall outside** 592-596, 598, 601, 604-606, 609, 610, 614, 616, 618 **to exceed** 613 **to show forth/through** 613, 615
egressio 290.171; 298.56; 313.41 **falling outside of** 592, 598
egritudo 290.178; 301.124 **disease** 592, 600
elevare 30.228, 256; 33.31; 36.143; 53.43; 70.84; 133.142; 135.220; 144.173, 176; 165.195; 166.203; 178.263; 264.203 **to be high/stand above** 453, 455, 484 **to cause to fall/drop (a line)** 365, 389 **to elevate/raise/lift** 377, 475, 476, 574 **to erect** 361, 363, 365
elevatio 144.173, 176; 160.56; 161.59, 64; 162.88, 90, 93 **height** 472, 473
electio 108.15, 22; 298.48 **choice** 436, 598
eligere 108.18, 19, 24; 298.47; 305.125 **to choose** 436, 598 **to cull out** 603
elongare 14.95; 84.120; 88.242; 165.174, 185, 190; 167.239, 246, 253; 168.259, 288, 291; 170.46; 195.188; 206.195; 290.181; 298.43; 302.34; 307.167, 169; 310.246; 312.18; 314.19, 26; 317.90, 94, 105; 318.117; 329.8; 334.13 **to continue on/extend** 420, 478 **to recede** 477, 497 **to get farther away/move away/lie far from/remove** 350, 423, 475-479, 505, 592, 598, 601, 604, 606, 608, 610, 612, 621, 625
elongatio 195.189; 290.172; 291.201; 294.13, 15; 295.26; 306.146, 149; 307.160, 168, 172, 175; 308.196, 197, 206; 310.248; 312.8; 313.53; 315.49; 322.9, 10; 330.10 **dis-**

eminentia**excrementum**

- tance** 592, 593, 595, 596, 604-606, 608, 609, 611, 616, 621 **receding** 497
eminentia 319.18; 324.64 **bulge** 614 **protrusion** 617
eminere 293.35; 312.4, 6; 314.6 **to be above/prominent** 594, 608 **to jut out** 609
emittere 13.85 **to emanate** 349
enumerare 292.221, 226; 302.21 **to enumerate** 593 **to list** 593, 601
equalitas 111.103; 145.194, 196, 197; 146.218; 148.292; 149.1; 150.42, 44; 151.71; 153.121, 123; 154.168; 155.192; 160.55, 56; 161.78; 162.89, 94; 163.140; 188.282; 189.287, 1; 198.274, 283; 199.284, 285, 290, 291, 293; 201.62, 69, 73, 74; 215.170; 216.183, 186; 222.175; 324.56 **being equal** 473, 617 **equality** 438, 462, 464, 465, 467, 468, 472-474, 492, 499, 511, 516 **uniformity** 501, 502
equidistans 15.127, 142; 16.155, 171; 17.175, 180, 184, 187, 190, 195, 196, 199; 18.204, 213; 34.83; 56.140; 57.163; 69.52; 70.70; 144.182; 146.240; 165.196; 166.204; 263.178, 179, 181; 265.213; 267.291; 316.61 **parallel** 350-352, 364, 379, 380, 388, 389, 461, 463, 475, 476, 573, 574, 576, 611
equivalentia 105.236 **equality** 434
equus 101.97, 98; 231.140; 234.218; 235.222, 227, 228, 230, 232-234, 238, 239, 241, 242; 297.23, 25; 298.45, 46; 301.124 **horse** 431, 522-524, 597, 598, 600
erectio 175.167, 169; 234.194; 235.226, 240 **height** 482 **upright posture/stance** 523, 524
erectus 18.218; 21.3; 32.18; 134.183; 174.166 **dropped to** 363 **standing (upright)** 353, 355, 454, 482
erigere 30.245; 264.198, 201; 277.270; 278.298; 279.18, 37, 46; 280.58, 73; 281.109; 312.9, 13 **to cause to stand** 573, 574, 582-586, 608 **to erect** 361
erraticus *see stella erratica*
erroneus 304.97; 319.147; 325.86; 330.18 **erroneous** 603, 613, 618, 622
error *frequently recurring* (123, 132, 163, 191, 227, 292-327, 329-337) **error**
erumpere 324.76; 331.44 **to show forth** 618, 622
essentialis 116.257, 264 **essential** 442
estimatio 136.227; 137.257, 259, 264; 138.288, 7, 8; 139.11; 146.219; 150.35; 151.74, 75; 153.126, 128; 170.23; 305.126; 308.199, 208; 310.268; 311.294; 319.147; 321.64; 324.76; 335.38 **estimate** 456, 457 **estimation** 455, 456, 462, 465-467, 479 **judgment** 603, 605, 607, 608, 615, 618, 626
evagatio 310.264 **falling outside** 607
evagatus 312.300 **inordinate** 608
evenire 45.108; 103.182; 106.252; 107.285, 286, 289; 110.65; 114.194; 115.213; 224.227, 243; 293.19, 34; 298.63; 302.31; 306.151 **to arise/come about/happen** 371, 594, 598, 601, 604 **to occur to/realize** 435, 436, 517 **to reach** 433, 440, 441 **to present** 437
excedere 304.95; 308.206; 313.43; 323.32 **to be larger** 616 **to exceed** 605, 609
excessus 162.89, 92, 93; 163.140; 164.143; 165.187; 189.291; 303.47, 51; 310.259; 313.37; 315.30; 316.63; 324.54; 330.30; 332.32 **change** 492 **difference** 474, 475, 601, 607, 610, 617, 622, 623 **excess** 473, 609, 611
excludere 304.97; 311.277, 290 **to obviate** 607 **to preclude** 603, 607
excrementum 290.170; 308.213; 323.34; 324.52; 330.31 **difference** 622 **excess** 617

exemplum**expositio**

- increase** 592, 606
- exemplum** 105.213; 210.5, 6; 300.104; 335.39; 336.5, 6 **example** 434, 507, 599, 626, 627
- exigere** 85.152; 88.252; 285.16 **to require** 421, 423, 588
- exire** 11.16; 14.92; 16.146; 19.245; 21.28; 22.2; 24.80; 30.235, 237; 31.263, 268, 270, 272, 273, 276; 33.35-37, 43, 53; 35.92; 37.160, 165, 170, 172; 39.218, 221; 40.247; 41.289; 45.110; 46.123, 134; 47.162, 165, 168-170, 173-175, 177; 48.182, 185, 187, 195, 201; 49.211; 62.21; 70.73, 77; 71.85, 90; 89.292, 297; 90.299, 2, 9; 91.45; 92.73; 93.87; 126.256; 131.100; 158.272; 189.8, 9; 249.60, 63, 68, 73; 250.87, 91, 98, 101, 110; 253.198; 254.210; 256.264; 258.33; 262.148; 263.160, 161; 267.291, 295; 268.2, 10, 15, 17-20, 22; 269.28, 30, 36, 38, 40; 270.61; 281.89, 101; 283.142; 295.38; 298.38; 320.22 **to come out/issue** 348, 350, 355, 371-374, 389 **to drop** 351, 363, 364, 366 **to emanate/shine/stream from** 355, 357, 363, 373, 383 **to emit** 373, 449 **to extend** 361-363, 366, 389, 426, 470, 493, 563-565, 567, 572, 573, 576-578, 585, 586 **to originate** 368 **to pass beyond/out of/through** 367, 369, 372, 452, 568, 570, 596, 614 **to project** 353 **to radiate** 363
- existere** 91.29; 92.78; 195.164, 171, 190; 196.193; 227.13, 16; 231.114; 233.177; 235.250; 239.40; 285.10; 308.208; 313.41; 320.35 **to be placed** 614 **to be present/exist** 521, 523, 524, 526 **to lie** 426 **to meet** 588 **to persist** 519 **to remain fixed** 496, 497
- existimare/estimare** 132.113, 122; 133.149, 152; 136.253; 137.256; 138.5, 6; 142.105; 144.166; 149.9, 17, 20; 150.35; 181.56; 185.180, 187, 190; 240.86, 87; 241.109; 293.27, 32; 297.25, 28, 35; 299.69, 74, 80; 302.18, 29, 33; 303.51, 58, 66; 304.75, 88, 95; 305.113, 116; 306.136, 140; 307.180; 308.187, 197; 309.214; 311.271, 282; 312.14; 313.39; 314.8; 315.33; 318.119, 122; 319.12; 321.57, 66; 323.27, 29, 42; 324.74; 326.24; 327.45, 49; 329.7; 330.38; 332.28; 333.64; 335.25, 26; 336.56; 337.19 **to assume** 597, 602, 603, 612 **to conclude** 452, 453, 600 **to estimate** 456, 457, 461, 464, 487, 489, 490, 606 **to gauge** 605, 610 **to impute** 608 **to judge** 453, 459, 464, 465, 527, 528, 594, 597-599, 601-605, 607, 609, 610, 614-619, 621-627
- exitus** 46.138 **extramission** 372
- experimentare** 27.163; 28.167; 29.198, 222; 38.194, 196; 59.230, 231 **to carry out (an experiment)** 366, 381 **to confirm/determine experimentally** 359, 360, 366 **to test** 359 **to try** 381
- experimentatio** 38.194, 196; 39.222; 97.204; 117.286; 118.20, 23; 132.119, 135; 134.182; 166.214; 171.73; 225.260; 269.52 **experience** 453, 518 **experiment/experimental confirmation** 366, 429, 443, 453, 454, 476, 480, 577 **experimentation** 367
- experimentator** 132.134; 133.144; 264.203, 208, 210; 265.216, 222, 224, 231; 266.253, 264; 267.269, 276; 270.79; 271.87, 115; 272.116; 273.162; 274.177, 183, 194; 275.204, 214, 224; 277.266, 285; 278.297, 15; 279.26, 35; 280.57, 72, 79; 281.95 **experimenter** 453, 574-576, 578-585
- experimentum** 263.175 **experiment** 573
- exponere** 43.46; 68.10; 291.212; 314.12 **to expose** 387, 610 **to expound** 370 **to reveal** 593
- expositio** 269.52 **explanation** 577

expressio**facialis**

expressio 311.284 **representation** 607

exprimere 311.282, 286; 317.99 **to represent** 607, 612

extendere *frequently recurring* (5, 11, 14, 16-21, 23, 24, 27, 29-34, 37-40, 42, 43, 45, 46, 48-50, 52, 54-57, 70, 75-78, 80-90, 94, 95, 112, 113, 119, 123, 127, 140-143, 158, 169, 174, 175, 178, 186, 195, 207, 253-255, 258, 264, 265, 278) **to arrive at, to continue on, to drop, to enlarge, to extend, to fill (by expansion), to propagate, to reach, to shine**

extensio 29.199; 81.48, 63; 84.140; 85.151; 86.193, 195, 202; 87.220, 223; 88.248; 147.246, 263; 150.54, 55; 151.66, 79, 84; 156.212, 218, 219, 223; 157.247, 248; 158.273, 275, 276, 280, 291; 159.297; 169.300, 18; 235.235; 274.180; 309.216 **continuation** 360, 419, 421 **extension** 422, 463, 465, 466, 469-471, 478, 580 **length** 524 **passage** 422

exterior 11.8; 18.225; 69.25; 317.85 **outer surface/outside** 348, 353, 612

extrahere 8.3¹, 8; 9.10; 15.140; 165.202; 263.180, 181; 267.279; 275.215; 276.237 **to bring out** 346 **to draw/draw away** 476, 573, 576, 581, 582

extraneitas 131.99; 132.122 **excessiveness** 452, 453

extraneus 58.197; 59.228; 102.149; 105.213; 115.232; 118.16; 120.84; 132.120; 133.148; 135.197, 215, 218, 220; 137.276; 148.282; 154.176; 165.192; 178.276, 279; 184.138; 200.25, 32, 41; 204.138; 227.32; 232.149 **considerable** 475 **excessive/exceedingly** 380, 381, 464 **inordinate** 453, 455, 456, 485, 501 **other/unfamiliar** 432, 434, 441, 443, 468, 488, 503, 519, 522

extremitas *frequently recurring* (11-14, 16, 18, 20, 31, 37, 39-43, 47, 67, 70, 75, 80-82, 89, 91-93, 96, 97, 126, 130, 131, 135, 142, 145-153, 158, 159, 161, 168, 169, 172, 174-176, 187, 286, 304, 322, 326) **edge, end, endpoint, extreme, extremity, outer edge**

extrinsecus 12.41; 13.69; 128.9; 129.39; 135.204; 241.94, 97 **external influence** 527 **outer/outside** 349, 450, 451, 454

facere 44.58, 61; 45.104; 48.201; 63.40; 72.126; 88.247; 90.20; 110.70, 73; 128.5; 129.24; 143.152; 163.125; 179.3; 199.6; 204.146; 205.159, 160, 180, 181, 184; 206.187, 188, 192, 193, 195, 196, 204, 205; 207.220, 223, 228, 231, 234, 237, 240, 243; 208.245, 247, 249, 251, 255, 263, 268; 209.282, 297, 1, 2, 4; 210.7, 8, 10, 12, 14, 15, 18; 211.39, 41, 42, 45; 212.65; 213.94, 105, 108; 214.125, 134, 144; 215.156, 159; 220.112; 250.92; 264.196, 203; 273.170; 275.228; 276.231, 238; 277.270; 278.2; 280.74; 292.220; 295.19, 28; 299.68; 300.105, 118; 301.9; 302.27; 308.207; 315.54; 317.99; 319.144; 322.3; 328.80, 84; 334.7 **to accomplish** 574 **to cast (shadow)** 383, 500, 503, 620 **to cause** 370, 423, 438, 514, 595, 596, 598, 600, 601, 612 **to construct** 573 **to create** 370, 371, 450, 504-511 **to do** 450, 580-583, 585 **to form** 424, 564 **to fulfill** 373 **to keep** 390 **to lead to** 616 **to make** 474, 506, 508, 510 **to produce** 605, 625 **to subtend** 485 **to transform into** 461

facialis 274.183; 276.244, 250; 277.263, 284; 278.3, 10, 11; 279.19, 31, 49; 280.53; 281.98, 107, 110; 282.124, 126, 133; 283.139, 152, 165; 284.198; 285.22, 27; 287.73 **facing/directly facing** 580, 582-589

facies**finis**

- facies** 26.137; 70.67; 71.114; 111.106, 107; 210.33; 212.81-85, 87, 89, 90, 92; 213.99; 223.201; 231.127, 129; 234.194, 196; 235.235; 239.48, 50, 54, 57; 299.73; 318.128; 321.71; 328.90; 333.69 **face** 388, 389, 438, 481, 483, 484, 508, 509, 516, 521, 523, 524, 526, 527, 613, 615, 624 **front** 359 **side** 598 **surface** 620
- facies terre** 132.128; 133.143; 173.114, 118; 176.225, 227; 177.248; 178.271; 179.11; 180.29; 246.28 **face of the earth** 481, 483, 484 **ground/ground level** 453, 484-486, 562
- fallibilis** 246.22 **subject to deception** 562
- falsitas** 298.47; 315.37 **being false** 598, 610
- falsus** 47.162, 167; 49.211; 301.12 **false** 372, 374, 600 **illogical** 373
- fantasia** 242.129, 131, 134 **(mere) visual impression** 528
- fantasticus** 242.128 **based on (mere) visual impression** 528
- farrago** 206.213 **hodge-podge** 505
- fatigare** 72.126, 133 **to fatigue/tire** 390
- feditas** 336.65 **ugliness** 626
- fedus** 108.17; 333.69 **ugly** 436, 624
- fenestra** 327.60, 61, 63 **window** 620
- festinatio** 333.48; 335.50 **speed/swiftness** 624, 626
- festinus** 335.47 **swift** 626
- fides** 309.218; 322.3; 328.81; 334.10, 12 **conclusion** 616, 620, 625 **conviction** 606
- figere** 51.277; 69.44; 77.141, 142, 144, 147; 78.167, 173; 119.45; 120.81; 128.1, 4, 7; 186.223; 187.245; 196.195; 219.82; 222.190; 223.205, 218; 224.229, 239; 225.246, 252, 255, 257-260, 262; 226.281, 291; 227.2, 10; 238.27; 251.140, 141; 252.161; 254.217; 259.60; 260.86, 89, 92, 96; 261.105, 127; 274.186; 275.225; 277.258; 281.105; 301.15; 302.20 **to fix** 393, 394, 444, 445, 450, 490, 491, 497, 567, 580 **to focus** 513, 526, 565, 566, 571, 572, 582, 585 **to implant/plant** 516-519 **to impress** 375, 388, 518, 570, 571, 600 **to maintain** 581
- figura** *frequently recurring* (4, 21, 49, 69-71, 74, 97, 99, 103, 110, 111, 113, 154, 156, 159, 160, 163-165, 173, 184, 187, 188, 197, 206-213, 216, 222, 223, 225, 236-240, 264, 267, 273, 274, 288, 293, 298, 301, 304, 314, 315, 318, 319, 321-323, 326, 330, 332, 334) **figure, shape**
- figurare** 50.244, 247, 267; 74.41, 47; 76.109, 114; 80.26; 160.35; 173.130; 187.255; 188.258; 222.188; 223.195, 215; 226.290; 233.174, 175, 177; 248.44 **to define** 374 **to delineate/describe** 391, 472, 491, 563 **to form** 375, 393, 418 **to impress** 481, 516-518, 523
- figuratio** 114.179, 180; 225.265; 233.175 **being impressed/impression** 518, 522 **configuration** 440
- filum** 86.198, 199; 299.87; 300.91, 94, 101 **fiber** 422 **thread** 599
- finis** 14.94; 16.170, 173; 64.65, 66, 82; 65.92; 69.44; 77.136; 78.153, 157; 88.258, 259; 100.68; 107.292; 119.38; 123.148, 168; 128.18; 136.250; 146.234, 236; 183.126; 202.98; 207.217; 208.272; 209.275, 285, 297; 210.23; 212.79, 83; 213.99; 219.81; 220.121; 221.143; 238.8; 243.150, 151, 157, 163; 260.91; 263.178, 181; 280.59; 305.116-118, 125; 319.1; 323.35; 331.1; 333.56 **boundary** 351 **edge** 444, 573 **end** 384 **limit** 446, 529, 603, 613, 617, 623 **opening** 350 **side** 584 **the ultimate** 508

finitus**fumus**

- finitus** 76.104 **finite** 393
fissura 320.32; 323.40, 43; 335.26 **crack** 617, 625 **gap** 614
fisticus 99.41 **pistachio** 430
fixio 78.173; 225.249; 302.34 **being fixed** 394, 601 **being implanted** 517
fixus 56.130; 58.201; 59.207, 215 **permanent** 379-381
flamma 295.45 **flame** 596
fletus 111.106 **weeping** 438
flos 206.191; 235.248 **flower** 505, 524
fluere 69.48, 49; 330.33 **to flow** 388, 622
flumen 317.89; 328.65 **river** 612, 620
fluxibilis 68.13 **fluid** 387
fluxus 330.34 **flow** 622
folium 236.252, 260, 262; 323.44, 46, 47 **leaf** 524 **petal** 524 **sheet** 617
foramen *frequently recurring* (4, 11-16, 18-20, 23, 26, 27, 31, 40, 57, 60, 68, 73, 74, 80, 114, 121-123, 132-134, 253-256, 258, 289, 299, 300, 313, 316, 321, 324-327, 331, 333, 336) **aperture, interstice, opening, window**
forma *frequently recurring* (4, 9, 10, 22-43, 45-71, 74-89, 91-96, 98-103, 108, 110-117, 119, 121, 123-126, 133, 134, 136, 140-143, 151-155, 159, 160, 162-164, 166-170, 172, 174, 175, 177-182, 185-188, 190, 191, 196, 199-203, 205-236, 239-242, 245, 251-253, 255-263, 269, 271, 272, 274-276, 281-284, 287-290, 292, 293, 296-298, 300-303, 307, 311, 315, 317, 323, 326, 329, 336, 337) **form, shape**
forma particularis 226.279, 282; 229.66, 68, 72, 76, 77, 79; 230.90, 91, 93; 231.136; 234.192 **particular form** 518, 520-523
forma universalis 110.71; 225.264, 272; 226.278, 280, 282, 284, 285; 227.4; 229.58, 60, 61, 63, 83; 230.88; 233.172; 234.206 **universal form** 438, 518-523
formare 34.63, 69 **to form** 363, 364
formica 299.69 **ant** 598
formosus 313.46, 47; 321.71; 329.98; 333.69 **beautiful** 609, 615, 621, 624
fortis *frequently recurring* (3-10, 12, 33, 44, 52, 58-63, 65-69, 71, 72, 75, 99, 117, 119, 200, 201, 204, 218, 286-288, 290, 291, 294-296, 300, 301, 309, 311, 319, 320, 325, 327, 328, 330, 334, 336, 337) **deep, intense, robust, strong**
fortitudo 58.197; 65.104; 67.167, 178; 68.9; 72.138; 75.82; 99.44, 54, 56; 117.294, 295; 243.165; 290.174; 294.7; 306.147 **acuity** 529 **intensity** 380, 386, 390, 392, 592, 595, 604 **strength** 385 **toughness** 387 **vividness** 430
frequentare 177.244 **to repeat** 484
frequentatio 127.282; 129.32; 138.1; 143.151; 173.121, 122, 127; 176.218; 182.87; 183.120; 200.17; 222.162 **continual recurrence/reiteration** 483, 488 **frequency/frequent recurrence** 449, 451, 457, 461, 487, 500
frequentia 167.258 **repeated experience** 477
frons 211.63, 64; 232.141 **forehead** 508, 522
frustare 13.59 **to grind (to pieces)** 349
fulgere 7.57 **to shine** 345
fuligo 321.69 **soot** 615
fumus 68.10; 72.130; 289.130 **smoke** 387, 390, 591

fundatio**homo**

fundatio 154.160 **inward projection** 468

fundus 293.34; 328.71 **bottom** 620

fuscitas 117.279 **brown** 442

fuscus 67.165 **dark** 386

galaxia 207.233 **Milky Way** 506

gena 208.274 **cheek** 506

generalis/generaliter 49.222; 111.91; 157.259; 190.34; 217.32; 220.104; 234.206; 290.166;
337.26 **general/generally/in general** 374, 438, 470, 512, 514, 523, 591, 627
on the whole 493

generare 46.136; 303.70; 329.3 **to generate** 372 **to produce** 602, 621

genus 51.297; 52.5-8, 11; 55.111; 58.178; 69.46; 99.40, 49, 51, 54, 55; 106.258; 108.14;
114.201; 162.107; 322.5 **form** 376 **kind/like** 376, 378, 380, 430, 436, 441, 473
nature 378, 388

gerere 304.79 **to carry** 602

gibbositas 161.65, 66; 330.16; 332.15 **bulge** 472, 473, 621, 623

gibbus 334.23 **bulging** 625

girare 80.7; 87.215; 119.47 **to bend** 422 **to flex** 417 **to spin** 444

giratio 80.12, 17; 82.76, 78, 80; 87.215-217; 94.117, 130, 133, 139; 95.158, 163;
186.213, 215, 224 **bend/bending** 422, 427, 428 **flex/flexing** 418, 419, 490
rotation 490

glacialis *frequently recurring* (12-14, 16-20, 23, 26-28, 31-37, 39-41, 47, 50-52, 57, 59,
68-70, 76, 80-94, 112, 113) **glacialis**

glacies 12.47, 49; 50.270 **ice** 349, 375

glaucus 12.29 **grey** 348

gracilis 212.80 **slim** 509

gracilitas 211.35, 37; 212.76, 78, 79 **slenderness/slimness** 508, 509

granum 299.70; 322.16, 18, 21 **seed** 598, 616

gravitas 207.244 **gravity** 506

grossitudo 209.285, 293; 211.36 **fatness** 508 **thickness** 507

grossus 26.136; 209.276, 277 **crass** 359 **thick** 506

habere 3.2; 7.73; 11.6; 42.8; 45.92; 61.292; 66.144; 67.165; 69.29, 33; 71.88, 102, 108;
78.153, 171; 100.93; 105.228; 109.56; 113.170; 122.140; 134.182; 135.221; 137.265;
139.31-33; 141.79; 164.150; 178.272; 181.62, 66, 69, 75; 182.78; 189.6, 11; 205.169;
210.32; 211.50, 58; 212.65, 67; 218.50; 240.68, 72; 251.127; 260.101; 268.298; 271.110;
276.253; 282.128; 285.7; 286.38; 288.101; 290.164, 179; 292.10; 305.128; 307.180;
313.33; 316.62; 320.47; 329.8 **to acquire** 527 **to be endowed with** 389 **to have/**
possess 346, 348, 369, 371, 386-389, 394, 431, 437, 440, 446, 455, 456, 459, 474,
487, 492, 493, 508, 527, 565, 576, 579, 588, 589, 591 **to retain** 594 **to suffer** 343

herba 4.44, 47; 309.221, 222 **plant** 344, 606

homo 47.180; 101.97; 106.258; 108.1, 6, 9, 11; 109.32, 37, 55; 110.70; 156.214; 173.113,

hora**immotus**

- 131; 174.139, 140, 142, 143, 147, 148, 158, 162, 165; 175.168, 170, 172, 189; 176.203, 204, 206, 222, 223; 177.243; 195.175; 207.221, 224, 242; 210.28; 223.197, 199, 200, 205, 206, 210, 213; 225.253; 231.125, 126, 131, 132, 135; 233.170, 191; 234.193, 195, 216, 217, 220, 221; 235.225, 227, 240, 243; 239.47-49, 53; 293.27; 297.19; 300.114; 307.177; 311.292; 319.5, 9, 19, 21; 320.23, 25, 26, 40-42, 44, 46, 49; 322.5, 11; 334.9
- human/human being/man/mankind/person/someone** 373, 431, 435-438, 469, 481-484, 497, 505, 506, 508, 516, 517, 521-524, 526, 594, 597, 600, 608, 614-616, 625
- hora** 4.27; 47.165; 57.158; 132.135, 137; 133.158; 182.104; 194.136; 197.247, 248; 198.257, 258, 260, 264, 270; 199.297; 252.153; 328.66; 329.6 **instant** 499, 500 **moment** 372
- time** 343, 379, 453, 488, 496, 566
- humefacere** 68.15 **to keep moist** 387
- humiditas** 12.45; 44.66, 76, 80; 68.13; 71.108; 111.108, 109 **moistness** 438 **moisture** 349, 370, 387, 389
- humidus** 12.44; 68.13; 69.34, 38; 71.110; 111.111 **fluid** 387 **moist** 349, 388, 389, 438
- humor** 12.56; 13.60, 71, 72, 78, 79; 16.150, 151, 154; 23.35; 26.130, 134, 136, 137; 27.144; 50.268; 68.6, 12, 14, 15, 18; 69.21, 24, 33, 47, 48; 83.106; 84.124; 86.200; 87.236; 88.246; 89.294 **humor** 349, 351, 356, 358, 359, 375, 387, 388, 420, 422-424
- igneus** 332.20 **fiery** 623
- ignis** 3.17; 4.32; 5.8, 11, 13, 16, 17, 19; 6.48; 7.65, 69, 72, 75-77, 79; 8.80; 66.120, 131, 132, 135-139, 141; 73.29; 116.240, 241; 207.233; 297.34; 299.65; 321.69; 331.41; 333.63
- fire** 343-346, 385, 386, 391, 442, 506, 597, 598, 622, 624
- ignorare** 303.47; 306.135; 318.139; 323.45; 326.17; 334.20 **not to apprehend/determine/know/notice** 601, 604, 613, 617, 619, 625
- illuminare** 5.58, 3, 5; 6.29, 31; 10.11; 22.2, 4, 10; 23.49; 25.90; 30.248, 251; 33.43, 54; 34.56, 61, 74; 59.226, 230; 60.234, 244; 63.32, 33, 37, 56; 64.67; 65.112; 67.154; 73.25, 28; 75.80; 77.139, 149; 78.154; 113.166, 169; 114.188; 116.253, 255; 118.299; 143.142; 191.54; 192.99; 203.105, 112; 204.137; 287.90 **to be luminous** 355, 391, 442
- to illuminate/light** 344, 347, 355-357, 361, 363, 364, 381, 383-386, 392, 393, 440, 442, 443, 460, 494, 495, 502, 590
- illuminatio** 88.266; 113.175; 114.206; 116.258; 204.138 **illumination** 423, 440, 442
- immensus** 311.287 **utter** 607
- immobilis** 261.106; 290.163 **fixed** 571 **immobile** 591
- immoderamen** 317.110; 326.28 **inordinateness** 612, 619
- immoderantia** 301.126; 309.229 **disturbed state** 600 **inordinateness** 606
- immoderatio** 303.46; 304.81; 308.189; 312.8; 316.59; 334.1 **aberration** 625 **inordinateness** 601, 602, 605, 608, 611
- immoderatus** 306.130, 134; 307.173, 183, 185; 309.216, 235; 311.295; 312.18; 316.79; 323.24; 331.53 **inordinate** 603-606, 608, 611, 616, 622
- immotus** 53.41; 195.172; 295.24; 310.266; 311.274; 317.91, 95; 320.45, 47; 322.84; 324.59; 325.95; 326.31, 36, 37; 330.34; 331.53; 332.40; 333.70; 336.11 **at rest** 607 **immobile** 377, 612, 615, 619, 624 **motionless** 612, 617, 619, 622, 624, 627 **remaining the same** 618, 623 **stationary** 497 **unchanged** 595

immutare**individuum**

- immutare** 56.129; 296.52; 316.77 **to affect** 596 **to change** 611 **to transform** 379
immutatio 58.199; 59.205; 290.178, 183; 310.257 **alteration** 380 **change** 592, 607
effect 380
impedimentum 273.151; 285.11 **interference** 580 **obstruction** 588
impedire 248.36; 289.141 **to hinder** 591 **to interfere** 563
imperceptibilis/imperceptibiliter 304.84, 93; 311.279; 324.55; 332.36 **imperceptible** 602, 607, 617, 624
implere 11.25; 13.71, 74, 75, 86; 14.88, 89; 24.68; 47.166; 329.103 **to fill** 348-350, 357, 372, 621
impressio 284.195 **being impressed** 588
imprimere 283.160, 163 **to impress** 587
incertitudo 298.47; 307.185; 334.21 **indeterminateness** 605 **indistinct perception** 598, 625
incertus 298.48; 334.7 **inconclusive** 625 **indeterminate** 598
incedere 305.120; 310.269; 311.278; 315.46; 320.46; 324.54, 55; 336.3 **to deal with** 627 **to follow** 607, 617 **to move away** 615 **to touch on** 603
incidere 300.93; 303.55; 307.162; 314.13; 327.62 **to fall** 602, 610 **to project upon** 604
to shine 620 **to strike** 599
incipere 11.5; 110.85; 187.227; 285.199 **to begin** 348, 438, 491, 588
incisura 329.93 **etching** 621
inclinare 6.37; 33.24 **to be oblique** 363 **to incline** 345
includere 304.78; 326.34 **to carry with** 602 **to hold snugly** 619
incrementum 11.2 **wellspring** 348
incurvare 304.74, 89 **to curve** 602
incurvatio 112.144; 253.187; 304.90; 323.28; 326.20 **curve/curvature** 439, 602, 616, 619 **flexing** 566
indigentia 48.195, 201, 202; 73.18; 102.147; 104.196, 209; 105.212, 219; 106.256; 107.270; 200.30; 231.132 **having to** 432, 434, 435, 501, 522 **necessity** 391 **need** 373, 433
indigere 71.116; 72.131; 84.140; 85.158; 104.186, 201; 106.260; 107.293; 108.6; 109.37, 50; 110.77; 114.193; 120.66, 70; 121.90; 127.275, 283; 128.22; 129.26; 228.42; 231.115; 237.295; 288.124 **to demand/entail/need/require** 390, 421, 433-438, 440, 444, 445, 449, 450, 520, 521, 591 **to have to** 525 **to rely upon** 450
individualis/individuus 101.124; 110.79, 80, 81; 226.288; 227.6; 234.203, 220 **individual** 432, 438, 518, 519, 523
individualitas/individuitas 233.189; 234.199, 211 **individual nature** 523
individuum 98.15, 17, 18, 20-22; 101.105, 110; 102.125-127, 129; 110.78; 223.192-194, 209; 225.267, 269, 271; 226.274-278, 280, 284; 227.6, 7; 228.53; 229.72, 73, 81, 83; 230.100; 231.125, 137, 139; 233.171, 190; 234.201, 203, 205, 207; 235.224, 228; 236.269, 270, 272, 275; 237.279, 281, 283, 284; 246.28, 29, 32, 45; 264.197, 198, 201, 202, 209; 265.211, 212, 218, 221, 225-227, 232, 235, 237, 238; 266.243, 245, 248-250, 253, 257, 258, 261, 262, 265, 266, 268; 267.270, 273, 274, 276, 288, 290, 291, 293, 294; 268.6, 7, 24; 269.25, 43, 44; 270.79; 271.97; 272.125; 273.166-168, 171; 274.194, 197; 277.269; 278.15; 279.20, 22, 24, 29, 32, 39, 41, 42, 46; 280.57, 72, 75; 297.11, 27; 298.59; 300.113, 117 **individual** 429, 431, 432, 438, 516, 518-524, 597-600

indubitabilis**intellectualis**

- individual nature** 525 **peg** 573-585 **thing** 562
indubitabilis 261.108 **definite** 571
inducere 29.198; 48.196, 197; 49.212; 52.300, 3, 10; 96.171; 205.181; 209.3; 294.3, 12; 298.56; 302.38; 308.189; 309.214; 314.2; 316.79; 325.2; 328.81 **to arouse/cause/induce/produce/prompt** 376, 595, 598, 601, 605, 609, 611, 618 **to examine** 360, 428 **to lead** 373, 374, 606, 620 **to take into account** 507
inductio 60.237, 241, 247; 102.134, 139; 211.39 **evaluation** 432 **induction** 381 **investigation** 508 **scrutiny** 432
inequalis 90.23; 91.25, 28, 41, 46; 92.51, 55, 69, 77; 150.44; 158.267; 165.199; 246.19; 249.72, 74, 76; 315.38-40 **unequal** 425, 426, 470, 476, 561, 564
inequalitas 148.293; 149.300; 150.43, 45; 151.70; 153.121, 124, 131; 154.167; 155.192; 160.54, 55; 161.59, 64, 66; 188.283; 189.285, 289, 300; 199.285, 293; 238.14; 249.77; 261.119; 262.143 **being unequal** 572 **difference** 564, 572 **inequality** 464, 465, 467, 468, 472, 492, 499, 500, 526
inficire 324.78 **to paint** 618
infigere 255.255; 256.268, 277; 257.289, 296, 300, 2, 4, 14; 258.17, 22, 23, 30, 40, 45; 259.57, 63, 64, 68, 70, 72; 260.75, 78, 84, 85; 271.108; 283.147, 164; 293.34 **to impress** 568-571, 579, 586 **to lodge** 594
infinitum 76.113 **infinity** 393
infinitus 30.237; 31.270, 273 **infinite** 361, 362
infirmitas 290.164; 296.58; 335.40 **disease/infirmity** 591, 596, 626
ingerere 311.280; 313.37; 317.93; 325.88; 334.21 **to arouse/produce** 607, 612, 625 **to induce** 609 **to render** 618
inquirere 107.287, 288 **to investigate** 436
inspectio 205.183; 296.50; 337.14 **examination** 504 **glance** 596 **view** 627
inspicere 3.1, 5, 9, 17, 21; 4.29, 31, 43; 7.75, 79; 96.180; 102.149; 133.145; 246.23, 28; 247.19; 264.209, 210; 270.65, 80; 271.115; 272.117; 277.281; 278.299, 2; 279.36, 38, 46; 285.10; 300.105, 111; 301.120; 302.28; 313.44; 317.89; 318.130; 319.15, 19; 332.29 **to examine** 346 **to fix/focus upon** 343, 578 **to glimpse** 623 **to look/look at** 343, 346, 428, 453, 562, 563, 574, 578, 579, 583, 584, 588, 599-601, 609, 612 **to see** 432 **to stare** 343, 574 **to view** 599, 613, 614
inspiciens 3.17, 21; 4.43; 5.12; 6.34, 36, 39; 7.75; 60.258; 65.111; 96.180; 245.7²; 246.25, 26; 247.19; 248.25, 27 **observer** 343-346, 563 **viewer** 382, 385, 428, 561, 562
instans/instanter 118.2; 120.66-68, 72, 76; 121.98, 100; 122.124, 126, 132-134, 136, 137, 139, 143, 147; 123.152, 153, 155, 156, 169; 124.187-189, 202, 205; 125.206, 207, 214-216; 331.8; 332.21; 333.59 **brief period/briefly** 623, 624 **instant** 443-448, 623
instituere 251.131, 133, 136; 252.155, 158, 162, 168; 256.266; 261.120; 262.136, 141; 263.163, 164, 169, 172; 269.33, 48; 271.107; 272.136; 282.135, 138; 283.139, 153, 161; 284.171, 181 **to impress** 565, 566, 568, 572, 573, 577, 579, 586, 587
instruere 108.29 **to teach** 437
instrumentum 11.18, 20; 26.129; 42.4; 52.17; 68.2; 71.104; 72.141; 84.138 **instrument** 369, 376, 387, 389, 390, 420 **utensil** 348
intellectualis 314.20; 315.27; 322.18 **imaginary** 610, 616

intellectus**intuitio**

- intellectus** 105.224, 225; 106.241, 242, 256, 260, 261; 107.294; 128.299, 2, 17; 308.195; 337.31 **intellect** 605, 627 **understanding** 434-436
- intellegere** 57.170; 104.188, 208; 105.216, 230-232; 108.29; 129.40; 174.145, 148, 158; 175.168, 172; 183.108, 111; 188.275; 227.9 **to apprehend/grasp** 433, 482, 488, 492 **to know** 434 **to reach (a conclusion)** 434 **to realize** 434, 451, 482 **to understand** 380, 433, 437, 481, 519
- intelligibilis** 274.190; 275.211, 220; 276.241; 277.268, 274; 278.296, 13 **decipherable** 581-583
- intendere** 78.183; 108.29; 117.285; 216.194; 221.135; 239.62; 244.176; 275.207; 276.232 **to focus/maintain focus upon** 581 **to get larger/to intensify** 443, 527 **to intend** 394 **to mean** 512, 515, 529 **to try** 437
- intentio** frequently recurring (73, 78, 79, 100-107, 109-116, 121, 125-127, 129, 139, 142, 143, 155, 164, 166-168, 172-174, 176-178, 180, 182, 191, 192, 198, 201, 204-206, 208-211, 213-222, 224-232, 234-245, 260, 283-285, 287-290, 301) **characteristic, feature, impression, meaning, notion, property, situation**
- intercidere** 295.44; 329.1 **to be interposed/to intervene between** 596, 621
- interiacere** 130.80; 131.83, 102, 104; 173.112, 113, 117, 126; 175.169; 176.222; 177.249; 178.273, 275; 189.296; 191.57, 60; 202.97; 306.154; 307.164; 323.47 **to extend/intervene/lie between** 452, 481-485, 492, 494, 502, 604, 617
- interius** 12.31; 28.178; 68.8; 69.31; 122.134; 123.165; 126.260, 262; 308.199, 200; 317.85; 335.36 **inner surface** 348 **inside** 446, 449, 612 **interior** 359, 387, 447, 605
- interponere** 285.10; 289.132, 136; 299.78; 306.134, 152 **to interpose** 588 **to intervene between** 604 **to place between** 591, 599
- interpositio** 331.42 **lying between** 622
- intingere/intinguere** 44.74; 67.166; 263.183; 264.197 **to paint** 386, 573 **to tinge** 370
- intrare** 11.15; 121.107; 122.123; 133.145; 263.188 **to enter** 446, 453 **to fit into** 573 **to pass through** 348, 445
- intrinsecus** 13.68; 15.126; 16.154 **inner** 349-351
- intueri** 3.10, 17; 4.26, 50; 6.34; 42.18; 96.197; 117.284; 145.199, 204, 212; 146.217; 151.79; 177.248; 181.49, 67; 187.227, 228; 201.68; 209.290; 214.125, 142; 215.166; 218.63, 65; 220.113; 228.37; 229.65; 237.287, 299; 238.8, 16, 18, 20; 239.54, 56, 60, 67; 240.70, 76; 241.105; 242.130, 133, 140, 143; 265.217, 222, 226; 270.81; 273.171; 275.207, 216; 276.238; 277.273; 278.290, 4; 280.76; 281.98; 309.217; 312.23; 315.45; 317.93; 324.66; 331.4; 333.69 **to evaluate** 511 **to examine/inspect/look carefully at/scrutinize** 369, 443, 466, 484, 486, 490, 491, 502, 507, 510, 513, 514, 520, 525-528, 581, 583, 585 **to focus/to direct one's focus upon** 429, 462, 487, 519, 580, 582 **to glance at/glimpse** 623, 624 **to look/look at** 345, 574, 578, 606, 608, 611, 612, 617 **to stare/stare at** 343, 344
- intuitio** 181.47; 187.251; 188.277, 279; 190.36; 202.90; 214.135; 217.29, 33, 41, 43; 218.47, 51, 56, 60; 219.70, 72, 74; 220.105, 111, 122, 125, 128, 129, 131; 221.136, 138; 222.184; 226.283; 227.22, 29-32; 228.38, 39, 42, 44, 47-49, 57; 229.71; 230.95, 97, 98, 101, 102, 104, 107-109, 112; 231.114; 232.164, 165; 233.184; 236.267, 269, 271, 273, 276; 237.286, 289, 292, 295; 238.9, 15, 26, 31, 32, 35; 239.46, 56; 241.111, 114, 115, 118, 119; 242.124, 136-138, 141, 143; 243.146, 151, 158; 252.150 **apprehension** 510

intuitus**lana**

- careful scan/close examination** 501, 502, 601 **close scrutiny/scrutiny/visual scrutiny** 502, 512-516, 518-523, 525, 526, 528, 529, 566 **focus** 527 **impression** 528 **inspection/visual inspection** 491-493 **perception** 486 **scan** 514 **intuitus** 201.47, 68; 214.127; 302.20; 337.22 **process of visual scrutiny** 510 **invalescere** 306.139; 307.170 **to reinforce** 604 **invehere** 295.33; 309.216; 314.17; 323.31 **to bring about/cause/induce/produce** 596, 606, 610, 616 **invenire** 3.1, 10, 14, 19, 21; 4.24, 25, 27, 34, 38, 40, 43, 46, 49, 51; 5.56; 6.31; 8.1²; 9.13, 15, 18; 10.37; 27.164; 29.200; 38.195; 42.18; 43.50, 54; 47.179; 57.161; 62.298; 96.174, 177; 100.87; 113.174, 176; 132.127; 136.246, 248, 249; 145.202; 152.98; 171.53, 67, 69; 183.133; 184.140; 193.131; 209.290, 3; 211.40; 213.105, 109; 217.14; 219.87, 91; 227.14, 16; 265.217, 219, 220, 222, 227, 229, 238; 266.239, 241, 246, 251, 257, 262, 264; 270.82; 271.86; 272.117; 274.190, 191; 275.211, 218, 228; 276.233, 239; 277.273, 282; 278.291, 300, 2, 5; 280.61; 281.99, 110; 282.113, 116; 316.58 **to apply** 611 **to arrive at** 488 **to encounter** 440, 453, 575 **to experience** 343 **to find** 343-347, 359, 360, 366, 369, 370, 373, 380, 382, 428, 431, 462, 466, 479, 480, 488, 495, 507-509, 512, 514, 519, 574, 575, 578, 581-586 **to get** 586 **to reach** 455, 456 **to see** 343, 344 **invisibilis** 8.2¹; 288.128 **invisible** 346, 591 **ioculator** 300.105 **entertainer** 599 **iterare** 105.212, 220; 106.257; 107.270; 109.50; 110.73, 78; 114.194; 126.253; 127.268; 222.171, 189; 223.193, 217, 219; 224.227, 236, 243; 225.248, 252-254, 256, 262; 226.278, 281, 290; 233.171; 241.111, 114, 115 **to be continually presented** 522 **to carry out a process** 449 **to go through steps** 434, 435, 437, 438, 440 **to occur repeatedly/recur** 516-518 **to repeat/repeat steps** 449, 516, 517, 528 **iteratio** 127.282; 129.33; 143.152; 222.172 **recurrence/repetition** 449, 451, 461, 516 **iudex** 313.52 **one who judges** 609 **iudicare** 52.299; 105.225; 107.286; 145.200, 206; 153.132; 193.128, 134; 196.216; 200.21, 23; 201.58; 312.7; 313.46, 51, 57, 60; 314.9, 24; 315.31, 32, 51; 316.67, 68, 82; 318.127, 133, 138; 321.53, 56, 59, 61, 76; 322.80, 12; 323.33, 46; 324.56, 58, 61, 68; 325.92; 326.11, 21, 37; 327.54, 56; 329.95; 330.28, 33; 331.6; 332.32; 333.69; 334.15; 335.28 **to assume** 611, 617 **to impute** 500 **to judge** 436, 462, 467, 495, 496, 498, 501, 608-611, 613, 615-618, 620-625 **to recognize** 376 **iudicium** 298.48, 50; 313.52; 324.65; 325.86, 93; 329.108; 330.18 **judgment** 598, 609, 618, 621, 622 **scrutiny** 617 **iuvare** 84.132 **to conduce to** 420

- labium** 211.35-37; 212.76, 78, 80 **lip** 508, 509 **labor** 108.2; 109.31, 49; 273.151 **effort** 436, 437, 580 **lacertus** 21.28 **muscle** 355 **lacrima** 22.29; 111.107 **tear** 438 **tear duct** 355 **lampas** 7.78 **lamp** 346 **lana** 300.100 **wool** 599

laneus

levis

laneus 300.102 **woolen** 599

lapis 9.24; 44.68; 100.69; 101.100; 297.31 **stone** 347, 370, 430, 431, 597

latentia 180.43; 181.59; 182.79, 80; 185.196; 206.197; 283.150; 284.192, 193 **disappearance** 505 **indefiniteness** 486, 487, 490 **invisibility** 487, 587

latere 5.6, 14, 18, 19; 7.56, 62, 70; 8.1¹, 5¹; 52.10; 60.249; 62.299; 66.126; 67.178; 69.23; 75.68, 70; 121.110; 122.122; 123.159; 179.299, 8, 9; 181.62, 66, 70, 75; 182.77, 79; 189.288, 5, 13; 190.18, 19; 192.95, 101, 104; 193.109; 200.45; 206.196, 201; 208.258, 259, 266; 232.167; 275.222; 276.234, 242; 278.288, 291, 293, 3, 6; 279.24, 25, 30; 280.51, 55, 65, 67, 69; 281.84, 85, 87, 90, 99, 100, 103, 110; 282.115; 286.55, 57; 288.101, 103; 295.34; 301.14; 302.20; 303.43; 306.147; 313.47, 51; 315.53; 317.112, 113; 318.129, 133; 319.21; 321.73, 76; 323.28; 324.59; 325.88; 326.20, 30; 329.103; 330.17, 30, 37; 331.48; 332.16; 333.47, 71; 335.24; 336.66; 337.23 **to be hidden/imperceptible/inapparent/insensible/invisible/obscured/unclear/unseen** 344, 346, 383, 385, 387, 445, 446, 485, 487, 506, 522, 581, 583, 584, 586, 600, 601, 604, 609, 611, 613, 615-619, 621-627 **to disappear** 345, 381, 392, 485, 487, 493, 495, 505, 589, 590, 596 **to escape (notice/sight)** 492 **to go unseen** 501, 623 **to lose discernibility/visibility** 582, 583, 585

lateratus 238.7, 9, 11, 14 **polygonal** 525, 526

latitatio 7.58 **disappearance** 345

latitudo 30.243; 122.140, 141, 143, 145, 146; 123.150; 124.194, 198; 147.264; 156.220, 224; 157.238; 158.276, 277; 162.88, 90, 94; 171.51; 187.248; 263.177, 179, 185; 264.194; 265.228; 266.266; 267.269, 271, 273, 277; 271.91; 274.180, 199; 275.205, 216; 277.271, 279, 281; 278.299; 279.19, 27, 38, 45; 280.59, 62, 63, 74; 286.38, 40, 44; 290.164, 179, 184, 186; 291.192, 203; 292.227; 323.33 **breadth** 446, 447, 463, 469, 470, 473, 479 **edge** 573, 578, 584 **range** 589, 591-593 **side** 584, 585 **width** 573-575, 581-584, 617

latus 90.22; 96.178, 187; 157.249; 161.74; 165.194, 198, 199, 201; 166.211; 191.63; 195.184; 207.241; 237.3, 4; 238.7, 12, 14; 263.166; 269.34; 274.197; 275.227; 303.48, 54, 55, 58, 67, 68; 304.82; 315.34, 35, 37, 40; 319.14 **breadth** 470 **flank** 494 **side** 425, 428, 473, 476, 525, 526, 573, 577, 581, 601, 602, 610, 614

lazuleus 4.53; 8.2² **azure** 344, 346

lectio 225.256 **word** 518

ledere 52.1; 296.56; 301.120 **to disrupt** 596, 600 **to hurt** 376

legere 225.257, 259; 281.97, 103 **to read** 518, 585

legibilis 277.283; 278.1; 279.34, 43; 280.61 **legible** 583, 584

lenis/lenitus 240.86; 263.176, 178; 311.288; 312.2; 317.106; 327.43, 44; 330.37; 333.51; 336.53, 54 **smooth** 527, 573, 607, 608, 612, 619, 622, 624, 626

lenitas 111.93; 240.91; 293.15; 311.288, 296; 312.299, 300, 7; 317.102, 105; 321.52, 53; 324.60, 61; 327.46; 330.36; 333.52; 336.52 **smoothness** 438, 527, 594, 607, 608, 612, 615, 619, 622, 624, 626

lenticula 12.51 **lentil** 349

lentiginosus 318.128; 321.71 **freckled** 613, 615

lesio 296.58; 301.122 **disruption** 596, 600

levis 71.116 **easily moved** 390

levitas**luminosus****levitas** 52.9 **lightness** 376**liber** 22.34; 292.1; 296.4; 301.5 **book** 355, 593, 597, 600**ligneus** 300.105 **wooden** 599**lignum** 134.184; 263.176; 293.35 **stick** 454, 594 **wood** 573**linea** *frequently recurring* (15-21, 23, 24, 27-35, 37, 38, 40-43, 46-50, 56, 57, 73, 75, 77, 80-84, 89-95, 97, 119, 122-124, 139, 140, 142, 144-153, 169, 185, 186, 189, 248-250, 253-256, 258, 263-268, 270, 274, 275, 277-279, 282, 283, 300, 304, 305, 308, 314, 316, 320, 322, 326, 330, 332, 335) **line****linea radialis** 42.27; 48.207, 210; 50.243; 51.286, 288; 79.7, 17, 1²; 80.29; 81.34, 49, 51; 82.74, 82, 88, 91; 83.95, 97, 116; 84.128, 131, 132; 85.154, 161; 86.179; 89.289; 91.32; 93.103; 94.113, 126, 127, 131; 95.150; 97.208; 140.57, 60; 142.103, 104, 108; 144.182-184; 147.250-252, 255, 256, 265; 148.282; 151.59; 152.104; 153.120; 168.284, 291; 169.7, 15; 170.24; 171.57, 58; 174.161; 175.167, 187, 190; 186.208; 188.281; 189.296; 190.27; 219.77; 220.116; 247.2, 4; 282.127; 285.23; 287.81, 87 **radial line** 369, 374-376, 417-421, 424-427, 429, 458-461, 463-467, 478-480, 482, 490, 492, 493, 513, 514, 562, 586, 588, 590**lineatio** 99.62; 119.43; 136.237; 180.22; 206.200; 208.252; 217.31; 231.125, 127-129; 232.153; 234.193; 235.235; 260.101 **design** 486, 505, 506, 512, 571 **line** 444 **lineament** 455 **outline** 430, 521-524**littera** 100.84; 102.151; 206.211, 212, 214; 207.215, 217; 209.279, 280, 294, 295; 210.20; 213.101; 232.144, 146 **letter** 431, 432, 505, 507, 509, 522**littus** 317.89 **[river]bank** 612**localis** *see motus localis***locum/locus** *frequently recurring* (3-9, 11, 15, 20, 21, 26, 30, 31, 37, 48, 55, 57, 60, 62, 63, 69-72, 78, 80, 82, 87, 94, 95, 112, 113, 117-120, 125-127, 129, 132, 133, 140-145, 153-155, 160, 162, 167-169, 172, 175, 176, 186-188, 191, 192, 195-199, 203, 204, 207-210, 215, 219, 223, 240, 243, 251-253, 255-258, 260-264, 267, 272, 273, 280, 281, 299, 301, 306, 316-318, 326, 331 **area, location, place****longitudo** *frequently recurring* (122, 147, 156-158, 168, 169, 172, 174, 175, 177-179, 181, 185, 186, 188-190, 195, 249, 250, 259, 263-265, 278, 281, 290-294, 297, 298, 302-309, 311-315, 319, 322, 323, 325, 326, 329-331, 334, 336, 337) **distance, extent, length****longum** 157.249 **length** 470**longus/longe** 3.18; 59.229; 72.129; 96.189; 101.106; 208.271; 239.49; 246.18; 297.34; 306.154; 309.217, 231; 310.265; 312.23; 313.38, 44, 55; 314.23; 318.137; 323.27 **considerable** 428 **far** 597, 606-608, 613 **long** 343, 390, 431, 526 **oblong** 506, 561, 616**lotus** 311.293 **luxuriant** 608**lucidus** 263.184; 287.93; 325.6; 329.97 **bright** 573, 590, 621 **luminous** 618**lumen** 3.7, 9; 5.8; 6.30, 48, 49; 7.56, 77; 8.4¹; 9.11; 22.2, 4, 5, 7, 8, 10-14, 16, 18, 20, 22; 23.23, 29, 31, 42; 24.67, 69, 80; 33.43; 34.61, 74; 50.265; 59.226, 231; 63.37, 38, 56; 65.112; 72.127; 75.90; 115.239; 116.255, 261 **illumination** 355, 363, 364 **light** 343-346, 355-357, 375, 381, 383-385, 390, 392, 442**luminosus** 5.8; 8.4¹; 9.11; 42.9; 69.23; 73.27; 287.93 **illuminated** 344, 346, 369,

luna**manus**

- 387 **luminous** 391, 590
luna 205.185; 207.223, 229; 294.45; 304.96; 310.244, 245, 248 **moon** 504, 505, 595, 603, 606
lux *frequently recurring* (3-10, 22-25, 27-29, 33-35, 41-46, 49, 51, 52, 55-69, 72-75, 77-79, 83, 87, 88, 97, 100, 111, 113-118, 121-126, 143, 154, 155, 180, 191, 192, 199-205, 208, 222, 285-288, 290-296, 298-300, 309, 311-313, 317-322, 324, 325, 327-331, 333, 336, 337) **light**
- macula** 206.194; 208.256, 257, 259; 232.141; 239.50, 54, 56; 313.45, 47; 318.126; 321.71; 325.85 **blemish** 506, 526, 527, 609, 613, 615, 618 **spot** 505, 522
magnitudo *frequently recurring* (49, 84, 97, 103, 110, 111, 126, 150, 164, 166, 167, 169, 172, 178, 181-185, 188-190, 207, 210-213, 216, 222, 240, 282, 284, 288-290, 295, 298, 305, 308, 310, 315, 316, 319) **extent, magnitude, size**
magnum 47.180 **cardinal precept** 373
magnus 72.142; 74.55; 96.180, 191; 132.113; 133.148; 137.260; 139.9; 147.250; 149.9; 153.127; 165.187; 166.205; 171.54, 71; 184.136; 201.47; 206.214; 207.229; 212.90; 219.90; 236.267, 273; 238.15; 260.81; 261.104; 286.54; 288.102, 110, 116; 290.177; 291.204; 293.26; 295.27; 297.19, 25, 29; 298.52; 300.97; 303.64; 308.197; 310.269; 311.272; 312.1; 316.64; 317.112; 324.78; 327.43; 334.15; 336.58, 11; 337.17 **considerable/significant/sizeable/substantial** 428, 475, 476, 479, 488, 525, 592, 596, 597, 607, 608, 618 **extreme** 598, 612 **great/large** 390, 391, 428, 480, 505, 509, 514, 571, 589, 590, 593, 594, 597, 599, 602, 605, 611, 625, 626 **much** 456, 457, 467, 619
maioritas 105.231, 233; 304.88; 308.190; 309.214 **greatness/largeness** 434, 606 **size** 605
manifestare 8.84, 11; 10.2, 4; 39.221; 52.299; 59.229; 71.97; 72.142; 95.156; 96.183, 188; 97.204; 132.130; 185.196; 224.236; 227.24 **to make clear/evident/manifest/perceptible** 367, 376, 381, 428, 429, 453, 517, 519 **to reveal** 346, 347, 490 **to show** 389
manifestatio 103.180; 128.18; 180.37 **clarity** 486 **obviousness** 433, 450
manifestum 12.31 **outer surface** 348
manifestus 14.101; 15.120, 123, 128, 130, 135-137; 16.153; 19.253; 34.82; 44.72; 46.127; 47.172; 52.1, 4; 55.87; 58.191, 198; 66.142; 72.122; 75.77, 78; 95.159, 160; 96.166, 169, 170, 178, 179, 182, 186, 188, 195, 197; 97.206, 208, 210; 104.186; 105.215, 218; 106.249, 251, 264, 267; 107.281; 108.5; 109.34-36; 118.5, 21; 119.34, 37; 151.81, 86; 152.93, 94, 97; 167.242; 180.18, 19, 21, 23, 28, 34; 191.68, 70; 199.8; 218.62; 219.79, 84, 88, 92, 96; 220.101; 221.151, 158; 222.165; 223.204; 225.251; 235.235; 239.44, 46, 54; 240.80; 241.107, 109; 242.125; 261.111; 273.164; 275.202, 229; 276.243, 247, 249, 252; 277.268, 275; 278.300, 8, 11; 279.23, 33, 41; 280.53, 61; 281.82; 282.119, 121, 125, 126, 134; 283.155, 157; 284.198; 288.122 **clear/evident/noticeable/obvious** 370, 372, 373, 376, 378, 380, 386, 390, 392, 428, 429, 433-437, 443, 444, 466, 477, 486, 494, 513-517, 524, 526-528, 571, 580-588, 590 **outer/outside** 350, 351, 353, 364 **revealed** 500
manus 171.52, 53, 55-57, 60-62, 67, 70, 72; 174.141; 231.125; 274.178, 196; 275.205;

margarita**mensura**

- 326.34-37; 327.39; 335.40 **hand** 479-481, 521, 580, 581, 619, 626
margarita 324.67 **pearl** 617
mathematicus 42.26 **mathematician** 369
mathesis 49.231 **mathematics** 374
matitutinus 328.66 **morning** 620
mediare 5.3; 26.137; 34.71; 44.70; 45.105, 116; 76.120; 100.95; 141.94 **to inter-vene** 344, 364, 370, 393 **to mediate** 431 **to provide the means** 371, 459
medicina 27.141 **medical science** 359
medicinalis 55.91 **medical** 378
medietas 194.135
medietas dyametri 255.250 **radius** 568
mediocris 130.74, 75, 77; 131.88, 133.155; 135.207, 218; 137.255, 258, 269; 138.282; 144.160; 148.288; 150.30, 37, 51; 153.121; 153.127; 154.163; 159.3, 16; 162.96; 163.137; 164.147; 165.176, 178, 181, 183; 166.208; 170.49; 177.254; 178.269, 272, 273, 278; 179.16; 180.31; 181.53, 61, 63, 65, 73; 186.198; 189.2, 3, 5; 190.15, 16, 23, 27, 35; 93.107, 108; 206.201; 210.31; 212.80; 249.66; 282.132; 283.167; 284.170, 194; 286.41 **moderate** 452, 453, 455, 456, 461, 464-468, 471, 473-475, 479, 484-487, 490, 492, 493, 495, 505, 508, 509, 564, 586-588 **normal** 589
mediocritas 130.74; 131.92, 95, 106; 133.151; 178.274; 181.74; 182.76; 211.35; 212.72, 75 **being moderate/ordinate/toward** 452, 453, 485, 487, 508, 509 **threshold** 452
medius *frequently recurring* (5, 10-16, 18-21, 23, 24, 34, 43-46, 49, 64-67, 70, 72-75, 77, 78, 80-82, 90, 94, 96, 97, 119, 121, 146, 158, 159, 161, 171, 186-188, 191, 209, 219, 220, 248, 251, 253-258, 263-281, 285-289) **center, intervening (area), middle, midpoint**
membrum 46.148; 52.298; 54.81, 82; 57.172; 58.175, 181; 70.78; 71.87, 96, 98; 72.121; 76.97, 100, 104, 105; 80.4, 5; 84.134, 142, 144; 85.156, 157; 86.198, 200; 112.124, 127, 132, 138; 117.296; 123.170, 173; 124.178, 185; 125.211; 140.64; 141.76; 143.131; 153.144; 160.33, 44; 168.275; 170.26; 174.155; 186.203; 192.88; 208.268; 209.278, 283, 289; 211.49; 212.65, 66, 68, 82, 84, 86, 88, 89, 91, 93; 213.97; 234.194; 283.161, 162; 288.106, 107, 110, 112 **member** 494, 506-509, 523, 590 **organ** 372, 376, 378, 380, 389, 390, 393, 417, 420-422, 439, 443, 447, 448, 458-460, 467, 472, 477, 479, 482, 490, 587
memini 223.197; 229.67 **to remember** 516, 520
memorare 102.136; 223.199, 206 **to recall/remember** 432, 516
memoratio 223.200; 225.250 **remembrance** 516, 517
memoria 101.121; 106.255; 223.211; 231.115; 233.178 **memory** 432, 435, 516, 521, 523
mens 224.240 **mind** 517
mensura 126.238; 130.61, 68, 71; 131.85, 88, 91; 132.123, 124, 128, 134; 134.171-173, 175, 181, 193; 135.198, 199, 209-211; 136.226, 235, 238, 239, 242, 245, 253; 137.263, 265, 266, 271, 277, 279; 138.282, 288, 291, 294, 295, 1, 2; 144.162; 148.289, 290, 299; 174.138; 246.14, 15; 284.175, 179-181, 186, 187; 314.8; 316.55; 320.31; 323.37; 330.10; 331.10 **gauge** 621 **magnitude** 455, 461 **measure/measurement** 448, 451-456,

mensurare**movere**

- 464, 481, 610, 611, 623 **size** 451, 456, 457, 587, 617
mensurare 134.174, 177; 137.280; 166.226; 174.139, 143, 164; 176.203, 204, 208, 209, 217; 177.236, 251; 186.200; 290.183; 292.219; 308.201; 320.28 **to determine (size)** 456 **to gauge** 614 **to measure** 454, 476, 481-484, 490, 593, 605
mensuratio 134.178; 173.118, 119, 122; 174.144, 145; 186.201 **measure** 454, 481, 490
meta 329.2 **limit** 621
micare 208.250 **to glitter** 506
minoritas 303.56; 306.137; 307.181, 185; 308.213 **smallness** 602, 604, 605
minutia 290.187; 292.221 **small/tiny feature** 592, 593
minutus 290.165; 291.197; 293.23; 294.8; 295.20, 21, 26, 34; 298.53; 307.168, 186; 313.50, 56, 59; 318.127; 325.90; 333.67 **fine** 594 **minute** 591 **small/tiny** 592, 595, 596, 598, 604, 605, 609, 613, 618, 624 **tenuous** 595
mixtura 299.85; 300.98-100 **mingling/mixing** 599
mixtus 56.126; 299.80, 83; 300.96 **blended** 599 **mixed** 379, 599
moderamen 310.243 **ordinateness** 606
moderatio 307.167; 309.230 **moderation** 604, 606
moderatus 306.133; 334.73 **moderate** 603 **ordinate** 625
modicum/modicus 58.199; 65.95; 72.124; 88.243; 100.70; 118.8; 129.37; 147.251; 148.286, 296; 149.5, 10, 11, 23; 151.61, 68; 192.100; 200.44; 205.183; 228.57; 233.183; 236.271, 276; 237.289, 291; 238.34; 239.64, 66; 241.118; 243.146; 251.138; 267.286; 287.73, 90; 308.211; 309.234; 312.1, 17; 314.20, 26; 316.73; 317.106; 318.138; 319.11; 320.36; 321.50, 58; 323.28, 32; 326.20, 25; 328.73, 75, 83; 330.13, 16, 24; 332.19, 31, 34, 39; 332.15, 19, 31, 34, 39; 333.57; 334.13, 19, 23; 336.53; 337.18, 24 **a little bit/not very much** 423, 443, 624 **barely** 622 **brief/short** 380, 390, 504, 520, 523, 525, 623, 627 **having a modicum** 385 **minimal** 525-529, 620 **moderate** 495, 626 **narrow** 620 **slight/small/tiny** 431, 463-465, 501, 527, 565, 576, 589, 590, 606, 608, 610-614, 616, 619-621, 623-625 **slowly** 615, 624 **some/somewhat/to some extent** 451, 605, 608, 614, 615, 621, 625
modus *frequently recurring* (23, 25, 26, 28, 31, 37, 43, 46, 58-60, 63, 64, 72, 79, 87, 89, 98, 101, 102, 104, 106, 110, 112, 121, 129, 134, 138, 139, 141, 143, 144, 146, 147, 150, 152, 153, 156, 159, 160, 163, 164, 175, 176, 178, 180, 181, 183, 184, 188, 190, 192-197, 199, 200, 202, 204, 205, 210, 211, 213-215, 218-220, 222, 223, 225-230, 233, 234, 239, 241-246, 253, 257, 263-265, 291-294, 296-299, 301, 302, 306, 309, 311, 313, 315, 316, 319, 327, 328, 333, 336, 337) **kind, limit of moderation, manner, means, mode, way**
mons 132.112, 114-116, 118, 119, 121, 125, 126; 178.264 **mountain** 452, 453, 484
monstruosus 83.113; 84.120; 86.181; 88.243 **distorted** 420, 421, 423
motio 310.256; 317.97 **motion** 607, 612
motus *frequently recurring* (14, 15, 19-21, 42, 53, 71, 72, 80, 96-98, 111, 119, 120, 122, 160, 177, 179, 186-188, 190, 194-199, 207, 220, 221, 230, 235, 237, 238, 246, 248, 252, 253, 275, 276, 289, 291, 293, 300, 310, 317, 319-321, 323, 324, 326, 327, 330, 332, 333, 335-337) **motion/movement, passing, scanning/scanning process**
motus localis 197.234 **locomotion** 498
movere *frequently recurring* (5, 14, 15, 19, 42, 74, 96, 119, 120, 146, 160, 163, 177, 179,

mulus**nervus communis**

- 185-188, 194-199, 219-221, 235, 246, 248, 251, 252, 261, 275-277, 279, 281, 287, 289, 293, 294, 300, 310, 311, 317, 319-321, 323, 324, 326, 330, 332, 333, 335, 336)
to move, to scan
mulus 235.232-234 **mule** 524
mundus 3.11, 22; 239.48 **clear** 526 **pure** 434
musca 299.70 **fly** 598
mutabilis 240.93 **changeable** 527
mutatio 58.182; 117.296; 195.171, 173, 184, 185; 196.193, 220; 197.229, 236; 239.44, 63, 66; 240.69, 78, 79, 83, 85, 90; 241.94, 96-98, 103, 107, 108, 113; 327.38; 333.44
change 443, 497, 498, 526-528, 619, 624 **transformation** 380
mutare 6.46; 19.261, 262, 265, 267; 20.268, 270, 276, 278, 279, 281, 283, 289, 292, 295, 297, 299; 21.300; 53.41, 42; 89.276; 120.75, 76; 186.216, 223; 188.264; 195.169, 182, 184, 191, 192; 221.145, 153; 239.41, 43, 62; 240.87; 241.102; 258.27; 314.16; 317.97
to change/suffer change 345, 423, 445, 490, 491, 497, 526-528, 569 **to move** 354, 377 **to shift** 354, 515
- narrare** 7.54, 68; 64.70; 68.20; 127.277; 128.293; 173.135; 178.277; 198.267 **to describe** 485 **to discuss** 345, 449 **to enumerate** 384 **to point out** 345, 387 **to recount** 499
nasturtium 299.71 **water cress** 598
nasus 209.284; 211.60, 61; 212.72, 75; 231.137; 263.188; 264.205 **nose** 507-509, 522, 573, 574
natura 22.6; 23.31; 41.295; 49.232, 240; 59.206; 68.16; 71.99, 104; 72.143; 105.224, 225; 106.241, 242; 107.294; 109.49; 128.299, 2, 17; 240.92; 312.26 **condition** 387
nature 355, 356, 369, 374, 389, 390, 434-437, 527, 608 **physical realm** 374
naturalis/naturaliter 23.45; 42.8, 11, 18; 55.94; 86.204; 108.6; 126.258; 188.257, 258; 227.9 **natural/naturally** 369, 378, 422, 434, 436, 491, 519 **natural philosopher** 356, 449
naturari 71.100 **to be naturally constituted** 387
navis 317.88 **boat** 612
negare 321.58 **to prevent** 615
nemus 319.20, 21; 320.23, 24, 27, 40, 41, 43, 45, 46 **grove** 614, 615
nervus 11.4, 9-11, 15, 19; 12.39, 50; 13.63, 65, 68, 70, 78, 81, 83, 86; 14.89, 92, 93, 100, 103, 105, 110, 111, 114; 15.117; 16.161, 163; 18.220, 222, 226; 19.237; 20.271, 274, 285, 286, 288, 290, 291, 296, 298; 21.1, 5-7; 52.14, 22; 54.82; 55.83, 86, 88, 90; 70.54, 60, 68; 80.6, 7, 11, 12, 18; 81.44, 45, 63; 82.65, 68, 77, 85, 87; 83.96; 86.195, 198, 201; 87.209, 212, 216, 234; 88.238, 246, 249, 260; 93.110; 94.118, 119, 121, 130, 133, 139; 95.158, 164; 113.164, 165; 186.215, 225; 253.187; 254.201, 204, 212, 220; 255.235, 237, 238; 257.292; 258.34; 262.141; 263.169 **nerve** 348-351, 353-355, 376, 378, 388, 417-420, 422, 423, 427, 428, 440, 490, 566-570, 572, 573
nervus communis 11.15, 21; 13.87; 52.23-25; 53.32; 55.98, 101, 104, 105, 109; 56.115; 81.48, 59, 63; 82.66; 87.218, 222, 227, 232; 88.265; 95.161; 96.166; 112.121, 124, 127, 129, 133, 145, 147; 113.150-152, 158, 161, 167, 168, 173; 121.105, 106; 123.165;

niger**obliquatio**

- 124.178, 181, 186; 160.32, 45; 253.193, 200; 254.202, 211, 219; 256.259, 264, 268, 270, 275, 277, 283, 286; 257.6; 258.25, 29, 35; 259.47, 61, 65, 69, 73; 260.78, 84, 97; 261.112, 130; 262.137; 263.166, 173; 269.33; 271.100, 108; 272.136 **common nerve** 348, 349, 376, 378, 418, 419, 422, 423, 428, 439, 440, 445, 447, 472, 567-573, 577, 579
- niger** 9.10, 21; 12.29; 62.14; 67.167, 168, 171, 174; 68.18, 19; 208.272; 311.292; 313.38; 316.65; 318.121; 324.73; 326.22; 330.22; 331.41; 332.25; 335.25 **black** 346-348, 383, 386, 387, 506, 607, 609, 611, 617, 619, 622, 623, 625, 626
- nigredo** 68.20; 208.265; 318.122; 321.65, 68; 324.77; 325.79; 332.26; 333.62, 64; 336.60, 62 **blackness** 387, 613, 615, 617, 618, 623, 624, 626 **dark** 506
- nix** 306.154, 155 **snow** 604
- nocere** 72.127, 130, 140 **to harm/hurt** 390
- noctiluca** 7.78; 66.120 **firefly** 346, 385
- nocumentum** 3.2; 72.132, 135 **harmful residue** 390 **impairment** 343 **something harmful** 390
- nota** 291.194; 313.55, 59; 318.138, 139; 319.141; 321.76; 322.79, 80; 325.89; 336.60 **feature** 592, 613, 615, 618 **mark** 609, 626
- notabilis** 291.194, 197; 315.30 **distinguishing** 592 **marked** 610 **noticeable** 592
- notitia** 293.13, 15 **intellectual grasp** 594 **notion** 602
- notus** 100.85; 117.272; 175.195, 196; 293.27; 297.19-21, 25; 298.46; 306.136; 307.177; 308.202; 310.249, 256; 311.283 **determinate/determined** 483, 604, 605 **known** 431, 442, 594, 597, 598, 605-607
- nox** 5.1, 4, 7; 7.78; 66.131; 118.9; 208.250, 265-267; 299.64; 319.6, 11, 15, 19; 320.30, 39, 49; 321.52, 55, 70, 73 **night** 344, 346, 385, 443, 506, 598, 614, 615
- nubis** 132.112, 114-118, 120, 124, 125; 293.31, 37; 294.43; 310.261 **cloud** 452, 453, 594, 595, 607
- nubula** 289.129 **cloud** 591
- numerare** 237.299; 337.28 **to count** 525 **to list** 627
- numerus** 30.253; 31.282; 57.152; 111.93, 103; 194.135, 140, 145; 207.237, 239; 235.229; 237.294, 298; 302.22; 309.240, 241; 316.79; 320.29, 33; 323.49; 326.26; 330.26; 335.27 **number** 379, 438, 496, 506, 524, 525, 601, 606, 611, 614, 617, 619, 622, 625
- obicere** 140.42 **to be right in front of** 458
- obliquare** 29.207, 220; 86.189; 87.236; 88.239, 240, 242; 89.270; 93.103; 94.113, 115, 121, 131, 136; 144.174, 176; 145.188, 189, 205, 206, 208; 146.227, 230; 148.282; 261.122; 277.278, 285; 278.289, 1, 4, 6; 279.26, 31, 44, 49; 280.50, 62; 281.98-100 **to be inclined/oblique** 360, 426, 427, 461, 462, 464, 572 **to divert** 360, 427 **to face obliquely** 461 **to incline** 583, 584 **to refract** 422, 423, 427
- obliquatio** 27.166; 29.221; 86.183-185; 88.243; 94.137; 95.142-144, 146, 148, 149, 151, 153, 154, 156, 157; 112.144; 144.169, 175, 177, 185; 145.191; 146.214, 220; 147.250, 254; 148.272, 280-282, 286; 149.2, 4, 5, 10, 18, 19, 21, 25; 150.47, 49, 50; 151.61, 66, 68, 82, 83, 86; 152.90, 94, 118; 157.246; 158.285, 286; 159.300, 1, 5, 9, 14, 15; 162.103; 189.290, 292; 190.28; 191.66, 68; 192.80, 82; 269.50; 277.280, 286; 278.292, 12; 279.28;

obliquus**oculus**

- 280.66, 68; 282.127, 135; 283.141, 166; 284.185, 187; 285.23; 286.59; 287.74, 82, 87
bending 360, 421, 439 **displacement** 577 **inclination/slant/slope** 461, 464-466, 470, 471, 473, 494, 583-588 **obliquely facing disposition** 461-464, 493
obliquity 464-466, 492, 583, 586, 587, 589, 590 **refraction** 359, 421, 423, 427
obliquus 93.111; 141.85; 147.265; 149.6; 150.26, 27, 34, 36; 151.62; 152.109, 114; 153.130; 156.226, 228, 235; 157.248, 253, 256; 187.231, 233, 242, 243; 188.284; 189.290, 293, 3, 7, 8, 13; 190.15, 18; 191.65; 260.97; 262.149; 263.170; 265.238; 269.47, 49, 50; 271.96, 104; 278.293, 12; 280.53, 55; 281.108; 282.125, 127, 131, 134, 136; 283.142, 146, 163; 284.169, 171, 177, 184, 197; 285.22; 286.59; 287.73, 81, 87 **inclined/slanted/sloping** 470, 494, 583, 586-588 **oblique/obliquely facing** 427, 463-467, 469, 470, 492, 493, 584, 586, 589, 590 **to the side** 459, 491, 571-573, 575, 577-579, 586, 589
oblivio 224.223, 224; 225.257, 260 **forgetting** 517, 518
oblongus 302.41; 303.53, 59, 61, 69; 315.32, 33, 39 **oblong** 601, 602, 610 **oval** 601, 602, 610 **rectangular** 610
obscurare 69.21, 27; 114.204 **to darken** 387, 441
obscuratio 192.78 **darkness** 494
obscuritas 63.30, 39; 66.146; 67.158, 162, 169; 111.94; 117.291, 293, 297; 118.10; 191.54, 56, 59, 61; 192.79; 204.155; 208.263; 321.62 **darkening/darkness** 383, 386, 438, 443, 494, 504, 506, 615
obscurus 3.12, 19; 4.24, 25, 33, 38, 39, 46; 5.4; 7.74; 8.3¹, 5¹, 8¹, 3²; 9.8, 9, 20, 21, 25; 57.149, 150; 60.234, 235, 242, 243; 62.14, 22, 23; 63.29; 64.58, 63; 66.144; 67.151, 152, 159, 161, 162, 173; 69.23, 25; 117.280, 283; 118.6, 8, 9, 11; 203.118, 121; 208.264-266; 294.10; 319.11; 320.31; 321.61; 329.5 **dark** 343, 344, 346, 379, 381, 383, 384, 386, 387, 443, 503, 506, 595, 614, 615 **dusky** 621 **opaque** 387
obticus 11.4, 9, 10; 13.68; 14.89; 52.14; 70.54, 55 **hollow** 348-350, 376, 388
obumbrare 7.59, 61; 204.147 **to cast a shadow** 504 **to shade** 345
obumbratio 204.141, 144 **darkening/darkness** 503
occasio 26.130, 132; 69.28; 70.66; 285.11 **injury** 358, 387, 388, 588
occultare 8.82, 12; 10.1, 5; 69.50; 295.20, 31; 296.59; 303.45; 304.90; 306.141, 149; 307.158, 167, 174, 182; 310.256; 312.10, 19; 313.45; 314.12; 315.27; 316.74; 318.127; 319.15, 18; 320.40; 323.26; 324.65; 325.85; 326.19; 329.94, 98; 330.10, 14; 335.48; 337.13 **to block** 388, 608 **to hide** 611, 614, 621, 626 **to make disappear** 604 **to obscure** 596, 601 **to occlude** 346, 347, 608, 610 **to render imperceptible/inapparent/invisible** 595, 602, 604, 607, 609, 610, 613, 614, 618, 619, 627
occultatio 67.164; 303.43; 305.104; 306.143, 145, 151, 156; 307.171; 312.18; 322.80 **blocking** 608 **disappearance** 604 **hiding** 601 **imperceptibility/insensibility/invisibility** 603, 604, 615 **overshadowing** 386
occultus 192.103; 193.122; 238.21; 239.44, 50; 240.84; 241.113; 309.222; 310.255 **hidden** 495 **inconspicuous** 526-528 **invisible** 495 **unconscious** 607 **occluded** 607
oculus *frequently recurring* (3, 4, 6, 11, 12, 14-16, 18-22, 34, 46, 53-56, 58, 64, 70-73, 76, 80-82, 87, 124, 171, 186, 187, 208, 210, 212, 231, 243, 247, 248, 253, 264, 294, 296, 299, 301, 303, 308, 312, 315, 322, 333-335) **eye, eyeball**

operari**ordinatio**

- operari** 4.41; 5.58; 19.256; 22.6; 44.80; 51.282, 284, 285, 295, 296; 58.187; 59.202; 75.76, 78-80, 82, 89; 78.162, 170, 177; 84.122; 120.83; 128.2, 8, 9; 168.281; 182.79; 249.77; 250.85; 260.99, 102 **to affect/to make/create an effect in** 344, 353, 355, 370, 375, 376, 380, 392, 394, 420, 450, 478, 564, 571
- operatio** 4.42; 33.23, 24; 42.21; 49.236; 51.285, 291, 296; 52.4, 6, 7, 9, 11; 55.111; 75.76, 78; 108.12; 120.84; 207.242 **carrying out a task** 506 **effect** 344, 363, 369, 374-376, 378, 392, 420 **procedure** 436
- operator** 70.65; 71.103; 72.142 **creator** 388-390
- opilare** 114.203; 122.123, 124 **to block/obstruct** 441, 446
- opilatio** 26.133, 135; 55.90 **obstruction** 358, 378
- opinabilis** 47.177 **based on supposition** 373
- opponere** 22.3; 23.50; 24.60; 161.63, 68, 72, 80, 85; 171.66; 184.160; 186.218; 195.191; 219.83; 305.118; 306.157; 312.1, 30; 319.12; 326.29; 334.4; 337.18 **to face/face directly** 355-357, 472, 473, 489, 490, 497, 608, 609, 614, 625 **to lie in line with** 603 **to lie opposite/directly opposite** 513 **to place before/between** 480, 619
- oppositio** 9.26, 31; 24.58; 43.52, 53, 56; 44.59, 61, 81; 45.105; 57.150; 58.184; 60.233; 66.133; 97.201, 202; 128.295, 11, 12; 129.27, 28; 139.17; 140.39, 47, 49, 52; 141.85; 142.101, 110, 125, 127; 143.137, 138, 147-150, 155; 144.163, 164, 169, 171; 146.224, 234, 239; 147.242, 246; 148.285; 151.61; 157.242; 163.125; 184.149, 156, 157, 159; 185.172; 186.217, 219; 190.29; 196.212; 219.82; 220.119; 221.141; 232.168; 246.33; 247.20; 251.141; 277.259; 278.3; 285.6; 286.31; 289.155; 291.199; 299.84 **being placed/put against/opposite** 347, 381, 386, 459, 513, 514 **facing disposition/orientation/position** 357, 370, 379, 380, 450, 458, 460-465, 470, 489, 493, 498, 515, 563, 565, 582, 583, 588, 591, 592, 599, 606 **focus** 429 **opposition** 457, 460, 461, 490 **straight outward direction** 459, 474
- oppositus** *frequently recurring* (6, 9, 10, 12, 13, 16, 18, 19, 22-26, 30-37, 39, 43, 45, 46, 48, 50, 53, 57, 59-64, 71-74, 77, 81, 89, 94, 96, 100, 113, 121-125, 128, 139-142, 144-152, 156-158, 161, 187, 189, 190, 196, 200, 219-221, 248, 254, 255, 269, 270, 281, 285-287, 295, 298, 299, 304, 307, 310, 312, 314, 315, 324, 329) **facing, opposite**
- opus** 216.195 **work** 512
- ordinare** 25.87, 92, 97; 26.114, 122; 28.186; 32.297; 34.64; 35.98, 110; 36.132, 138, 140; 39.232, 235; 40.244, 257; 42.5; 50.241, 261, 262; 70.64; 71.95, 97; 76.98; 79.2; 80.28; 84.136; 85.157, 158; 86.187; 87.216; 89.281; 94.134; 130.55-59, 71, 72, 78, 80; 131.87, 93, 97, 107, 110; 132.129, 132; 134.176, 180, 192; 135.197, 206, 208, 213, 216, 219; 136.254; 137.268, 269, 274, 275, 278; 138.290, 293, 294; 148.289; 150.31, 38; 151.87; 152.95, 99; 172.100, 101, 106, 107, 109; 178.270; 181.52; 190.24, 35; 206.207; 210.26; 283.153, 156; 316.72; 336.7 **to arrange/arrange properly** 357, 358, 360, 362, 364, 365, 367-369, 374, 375, 389, 393, 417, 418, 420, 422, 424, 427, 505, 587, 627 **to designate** 388 **to line up** 611 **to order/to order properly** 421, 451-457, 464-466, 480, 481, 485, 486, 493
- ordinatio** 34.66; 35.100, 111; 40.258; 46.145; 51.294, 295; 55.112, 113; 56.116; 70.84; 80.30; 83.111, 112, 114; 84.123, 126, 131, 132; 85.164; 86.187, 203-206; 87.207, 209, 214, 217, 224; 89.275, 281; 92.62; 93.83, 98, 100; 94.132, 135; 104.191, 194, 197, 198,

ordo**pars**

- 201; 106.245; 111.99, 101; 113.152, 153, 157; 114.178, 181; 139.27; 153.139, 141; 154.153, 170, 173; 155.188, 193, 196, 198, 203, 206; 160.39; 161.79, 83; 164.147; 168.285, 286; 206.200, 206, 208, 209, 212; 207.219; 210.26, 27; 212.70; 220.104; 234.194; 238.25; 240.91; 247.4; 283.156, 159 **arrangement** 364, 365, 368, 372, 376, 378, 379, 418, 420-423, 425-427, 433, 435, 438-440, 457, 467-469, 472-474, 478, 505, 508, 509, 514, 523, 526, 527, 562, 587 **evenness** 505 **order** 389 **pattern** 505 **shape** 420
- ordo** 24.80; 42.17; 94.134; 213.102; 216.6; 222.177; 247.3; 315.46 **arrangement** 357, 427, 509, 512, 516, 562 **kind** 369 **row** 611
- origanum** 67.175 **wild marjoram** 386
- oriri** 3.22; 4.30, 32, 44; 5.54; 7.69; 9.14, 15, 22, 26, 34; 10.39, 43, 8, 13; 11.5; 42.9; 51.276; 58.187; 59.225, 227; 60.259; 61.265, 278; 62.295, 13, 19, 24; 63.26; 64.68, 86; 65.90, 93; 66.123; 74.57; 75.89; 77.140, 142, 143, 146, 149; 78.154, 167, 168, 173; 199.5, 13; 200.33, 36; 204.142; 287.94; 299.84; 312.8, 29; 317.88; 318.136 **to arise** 348, 599, 608, 609, 612, 613 **to illuminate/shine upon** 343, 344, 346, 347, 375, 380-385, 392-394, 500, 501, 503, 590 **to originate** 369
- ortogonaliter** 322.19 **orthogonally** 616
- ortus** 235.248, 251; 236.255, 256 **garden** 524
- os** 211.35-37; 212.77, 80, 81 **mouth** 508, 509
- os** 14.107, 113, 115; 15.118; 20.273; 253.197, 198; 255.234, 241, 247; 258.33 **eyesocket/socket** 350, 354, 567, 570
- ostendere** 29.221; 38.195 **to show** 360, 366
- otiosus** 46.139 **useless** 372
- palma** 177.236 **palm's-breadth** 484
- palpebra** 22.30; 43.55; 72.125, 130, 133; 124.192; 125.209; 128.297, 299, 3, 11, 12; 129.27, 29 **eyelid** 355, 370, 390, 447, 450
- pannus** 7.66, 67, 69-72; 10.37; 206.191; 208.246, 248, 261; 299.82, 84, 86, 87; 300.97, 98, 100-102 **cloth** 345, 347, 505, 599 **fabric** 506
- papilio** 299.66 **moth** 598
- parare** 49.237 **to be constituted** 374
- pargamentum** 273.163; 277.266, 270, 272, 274-276, 278, 280, 282, 283, 285; 278.289, 292, 293, 295, 297, 300, 1, 4, 6; 279.18, 21, 26, 30, 31, 36, 40, 44, 47-49; 280.50, 58, 60, 62, 64, 66, 68, 73, 76; 281.96, 103; 323.44 **parchment** 580, 582-585
- paries** 6.29, 30; 57.150, 152; 132.136, 138; 133.139-141, 144, 146, 147, 149, 150, 152, 154, 159; 134.184, 186; 135.221; 170.49; 171.50, 52, 54, 56, 60, 66-68; 178.264; 240.74-76, 78, 81; 309.217, 220, 223-225, 232; 312.11, 14, 17, 19; 316.72, 77; 319.20, 21; 321.60, 61, 63, 65, 67, 69; 324.72, 74, 78; 333.62; 335.35; 336.60 **wall** 345, 379, 453, 479, 484, 527, 606, 608, 611, 614, 615, 617, 618, 624, 626
- pars** *frequently recurring* (9, 11-15, 17, 19-28, 34-39, 42, 45, 46, 50, 51, 55, 65-67, 69, 70-77, 80-83, 85-87, 89, 91-93, 96, 103-106, 109, 111-114, 117, 119-126, 130, 132, 133, 135, 139-142, 144, 146, 147, 153-164, 166-171, 173-192, 195, 197, 199-205, 207, 209, 211, 213, 215, 218-222, 230-234, 236, 238, 240, 243, 244, 247-256, 260-263,

particula**percipere**

- 266, 268-284, 286, 288, 290-292, 294, 295, 301-305, 307-314, 316, 318-321, 324, 327-330, 332, 333, 335-337) **area, feature, part, portion, section, word**
- particula** 295.20, 29; 298.53; 329.93, 97; 331.41 **small/tiny part** 595, 596, 598 **spot** 622 **tiny feature** 621
- particularis** 106.253; 109.44, 51; 110.64, 68, 71, 78, 79, 83, 87; 111.90, 96, 97, 115; 114.177; 204.157; 205.159, 164, 170, 179, 180; 209.300; 210.30; 211.41, 44, 53, 58; 213.108, 115, 116, 120, 122; 214.125; 215.155, 160; 216.188, 190, 2, 5, 8, 10, 12, 13; 217.18, 19, 21, 22, 27, 35, 38; 225.268; 226.276; 229.69; 232.144; 234.201, 203; 235.241; 239.38, 41; 240.92; 245.5²; 293.22; 296.53; 301.12; 331.47; 336.65; 337.34 **individual** 522, 596, 627 **particular** 437-440, 504, 507-512, 518, 520, 522-524, 526, 527, 561, 600 **particular form** 520 **specific** 435, 622, 626
- partitio** 301.10
- parvitas** 76.107; 84.136; 123.167, 168; 200.45; 211.35, 36; 212.79, 80; 219.81; 220.121; 238.8; 290.186; 295.35, 37, 42; 299.69; 319.4; 322.15, 17; 323.48; 324.65, 77; 325.84, 87, 91, 94; 332.36 **brevity/shortness** 447, 624 **deficiency** 613 **smallness** 393, 420, 447, 501, 508, 509, 513, 514, 525, 592, 596, 598, 616-618
- parvulus** 21.28 **small** 355
- parvus** *frequently recurring* (9, 12, 59, 70, 71, 74, 76, 84, 103, 163, 177-180, 184, 206, 207, 212, 235, 237, 238, 252, 264, 267, 273, 277, 279-284, 286-291, 294, 305, 309, 313, 322-324, 330, 332, 333) **short, slight, small, tiny**
- passibilis** 51.297 **capable of being suffered** 376
- passio** 49.237; 51.292; 58.177; 69.45; 76.106; 123.173; 240.93; 248.32 **effect** 374, 380, 388, 393, 447 **passion** 376, 527, 563
- passus** 176.205; 235.236 **gait** 524 **pace** 483
- patere** 166.215; 225.261; 290.180; 293.38; 296.61; 301.5; 302.23; 306.133, 145; 311.275; 312.15; 316.83; 318.116; 319.8; 328.90; 330.14; 337.39 **to be clarified/explained** 592, 601, 608, 611 **to be clear/evident** 476, 518, 596, 604, 612, 614, 620, 621 **to be shown** 594, 600, 603, 607, 627
- pati** 22.6; 49.238; 50.245; 51.283, 284; 59.208, 211; 69.38, 45; 75.83; 123.171, 173; 140.58; 141.71, 97; 142.113, 114, 121; 335.41 **to be affected** 355, 374, 375, 458, 459, 460 **to feel** 388 **to suffer/undergo an effect** 375, 381, 388, 392, 447, 626
- paucitas** 111.103; 237.1; 293.40 **being few** 525, 595 **dearth** 438
- paucus** 207.238; 236.268, 269; 237.281; 335.43; 336.56 **brief** 525 **few** 506 **little/little (bit)** 525, 626 **scarce** 525
- pectus** 12.44; 13.62; 16.162 **body** 351 **front** 349
- penetrare** 262.142, 144; 308.200; 325.81; 328.83 **to extend** 605 **to overlap** 572 **to penetrate** 618, 620
- penetratio** 9.28; 328.79 **passage** 347
- peragere** 310.257 **to follow (a path)** 607
- perceptibilis** 304.88; 305.105; 310.269 **perceptible** 602, 603, 607
- perceptio** 229.68; 303.56; 311.278; 328.81; 332.36 **perceiving** 520, 620, 624 **perception** 602, 607
- percipere** 108.2, 4, 7, 10, 25, 27; 109.32, 38, 55, 63, 65; 127.281; 129.34; 133.151; 148.272, 275, 278, 280; 152.99; 163.133; 173.131; 175.172; 219.85; 223.212; 228.36, 40, 46;

percurrere**piramis radialis**

229.66, 67, 73, 81; 231.137; 232.150, 159; 245.11²; 246.27, 31, 33, 35, 37; 284.185; 290.165, 191; 291.207, 215; 293.36; 295.24; 302.21; 306.155; 307.159; 310.254; 312.26; 317.97; 323.48; 327.56; 331.8; 333.55, 58; 335.43-45; 336.12; 337.24, 32 **to perceive** 436, 437, 449, 451, 453, 463, 466, 474, 481-483, 514, 517, 519, 520, 522, 561, 562, 587, 591-595, 604, 607, 608, 612, 617, 620, 623, 624, 626, 627 **to realize** 562, 601 **to see** 519

percurrere 332.35 **to follow (a path)** 624

percutere 141.91 **to strike** 459

perpendicularis *frequently recurring* (16-19, 29-43, 46, 49, 50, 70, 71, 83, 89-93, 95, 145-147, 156, 248, 254, 263, 274, 314) **orthogonal, perpendicular**

pertransire 9.27; 23.28, 30, 36, 38, 43; 27.160; 28.177, 179; 29.203, 226; 30.230, 239; 31.272, 291; 35.94, 96; 37.161; 39.217, 220; 43.29; 45.89, 90, 111; 51.271, 276, 280, 286, 293; 56.123; 57.145, 166; 68.13; 69.30, 41, 44; 70.57; 71.91; 77.150; 78.174; 82.82; 83.94, 110; 88.254, 261; 92.71, 72; 127.281; 176.206; 198.279, 282; 220.123; 253.185; 286.43; 289.149 **to continue/pass/shine by/through/over** 347, 356, 359-362, 364, 366, 369, 371, 375, 376, 379, 387, 394, 419, 423, 426, 499, 517, 566 **to fall outside** 589 **to open into** 379 **to traverse** 483, 591

pertransitus 38.181; 51.291; 83.98; 220.116 **passage** 376 **passing over** 514 **passing through** 366, 420

pervenire *frequently recurring* (3, 11, 13-15, 21, 23, 24, 26-29, 31, 32, 35-37, 39, 40, 45, 46, 51-56, 60, 65-68, 70, 75-78, 80-89, 91-96, 98, 112-114, 119, 121-127, 140-143, 145, 153, 155, 160, 166-170, 173-176, 178, 179, 182, 186-188, 190, 191, 196, 199, 210, 211, 214, 219, 220, 223, 224, 226-229, 233, 243, 256-258, 263, 276, 307) **to arrive, to come, to reach**

perventio 28.169; 38.180 **arrival** 366 **having reached** 359

perventus 52.23; 55.89; 66.128, 129; 81.59; 82.92; 83.106; 84.139; 88.265; 89.267; 93.97; 116.262, 263; 142.122; 186.222; 225.264 **arrival** 378, 423 **occurrence** 518 **having reached** 376, 385, 419-421, 423, 426, 442, 460, 490

pictura 111.100; 180.22; 209.279; 210.25, 27; 240.76, 79, 86; 260.101; 311.282, 289, 295, 297; 313.50; 318.131; 321.72; 325.88 **depiction** 507, 508, 527, 571 **design** 609, 613, 615, 618 **drawing** 438 **painting** 607, 608 **picture** 486

picturatus 293.23 **designed** 594

pingere 311.281, 295, 296 **to depict** 607 **to paint** 608

pinguedo 11.25; 12.28; 19.255 **fat** 348, 353

pyramidalis 14.99, 103; 20.286, 292; 263.187; 308.196 **expanded/expanding** 350 **funnel-shaped** 354 **visual** 606

pyramidalitas/pyramidatio 14.95; 209.287; 255.237; 271.90 **divergence** 578 **flaring/funneling outward** 350, 507, 568

piramis 33.49, 50; 34.63, 65, 66, 70, 76, 78, 83; 35.88, 90, 105-107, 113; 36.119, 125; 50.248, 251, 253, 256-259, 261, 267; 59.219; 70.76; 71.86; 76.95, 97, 99, 109, 114; 80.21, 24, 26, 28, 33; 82.81; 89.278; 167.247; 168.272, 170.35; 172.82, 84, 85; 185.177, 178; 186.204, 210; 189.291; 248.38, 40 **cone** 363-365, 375, 381, 389, 392, 418, 419, 423, 477, 480, 489, 490, 492, 563

piramis radialis 89.271; 94.123; 97.208; 164.159; 166.227, 230; 168.271; 185.176; 190.26;

pirus**preesse**

- 248.44 **cone of radiation** 423, 427, 493 **visual cone** 429, 475-477, 489, 563
pirus 297.29, 30 **pear tree** 597
planities 161.77; 162.86, 91; 163.120; 200.23; 201.62, 66, 67, 70, 71, 73; 202.79, 87, 89, 92; 208.247; 211.64; 238.20 **being flat** 473 **flatness** 473, 474, 508 **smoothness** 500, 501, 526
planitudo 304.96 **flatness** 603
planum 132.112, 124 **plain** 455
planus 70.80; 83.114; 89.292, 295, 298; 90.1, 18; 91.37, 44; 93.84, 92, 104; 155.177, 182; 156.225, 231, 232; 159.9; 199.12, 15; 200.17, 18, 23; 201.64, 65, 69; 202.85; 240.75; 246.20; 263.178; 292.1; 297.35; 301.126; 304.75, 93; 317.96; 319.18; 323.29; 326.21; 330.17; 332.16; 334.12 **clear/evident/obvious** 593, 597, 600, 612, 625 **flat** 389, 468, 471, 561, 602, 614, 616, 619, 621, 623 **plane** 420, 424-426, 469 **smooth** 500-502, 527, 573
politus 324.67; 330.38 **polished** 617, 622
ponere 8.4¹; 9.26, 30; 11.18; 45.110; 265.224, 233; 266.254, 259; 273.165, 166, 170; 274.179, 184; 278.16; 280.72 **to direct** 574 **to place/position/put** 346, 347, 575, 580, 583, 585 **to pour** 348 **to suppose** 371
ponens 45.109; 47.161, 178; 48.196; 126.256 **proponent** 371-373, 449
posterior/posterius 13.58; 14.112; 17.181; 18.208; 19.247; 20.273, 275; 22.29; 41.286; 44.65, 74; 50.254; 65.113; 80.8; 83.100; 85.162; 100.72, 75, 76, 79; 156.235; 157.254; 158.273; 192.74; 202.94, 100, 103, 104; 203.105, 107-109, 111, 113, 120, 121, 123, 126; 204.129; 314.6 **back** 349, 350, 354, 355, 417, 470 **behind** 354, 368, 375, 385, 417, 431, 469, 470, 494, 502, 503 **later** 353 **posterior** 420, 421 **rear** 349, 352, 609
precedere 29.203; 102.143; 112.141; 158.293; 227.31; 228.50; 230.109, 112; 231.134; 232.164; 233.183, 185; 236.277; 238.34; 239.43; 241.117; 242.128, 132, 138, 141; 243.148, 154; 246.38; 301.5, 6 **to be earlier/previous** 372, 471, 519-523, 525, 528, 529, 562 **to come first** 432 **to precede** 439, 600
precognoscere 242.135; 243.161 **to apprehend before** 528 **to recognize** 529
predicere 11.20; 46.128; 50.268; 54.60; 55.98; 58.186; 71.89; 78.183; 80.33; 81.34, 38, 57; 83.99; 91.25; 92.51; 111.116; 146.230; 172.94; 180.35; 205.159; 211.48; 213.123; 214.130; 215.155; 216.193, 5, 13; 248.37; 273.159; 280.80; 285.19; 292.229, 232; 293.37; 294.4; 296.62; 297.16, 36; 298.41, 62; 301.125; 319.145; 322.82, 4; 325.94; 329.110; 334.74; 336.67 **to claim/describe/discuss/explain/maintain/mention/point out/say/show before/earlier** 348, 372, 375, 377, 378, 380, 394, 418, 420, 425, 439, 462, 480, 486, 504, 508, 510-512, 563, 580, 585, 593-598, 600, 626
preminentia 154.174; 163.120, 129; 200.26 **elevation** 501 **height** 474 **outward projection** 468
premittere 315.36; 317.84 **to depend upon** 610 **to suppose** 612
preparare 51.279, 287; 58.175; 59.208, 211, 212; 71.104, 110; 240.93; 241.98 **to be constituted/disposed** 375, 376, 380, 381, 527 **to design** 389 **to prepare** 389
preparatio 71.104; 72.143; 75.83 **disposition** 392 **providence** 389, 390
preesse 46.138; 56.121, 138; 101.121; 106.255; 223.203; 231.115; 233.178; 296.8; 301.122 **to be present** 372, 379, 432, 516, 521, 523 **to be currently in view** 597 **to continue to be** 600 **to exist** 435

preservare**proportionalis**

- preservare** 274.197; 275.206 **to make certain** 581 **to take care** 581
prestare 331.44 **to show forth** 622
preterere/preterire 110.70 **to escape (notice)** 604
principium 11.2; 60.239; 70.60, 62, 63; 84.134; 109.56; 117.282, 289, 292; 173.129, 133, 135; 176.223; 233.170; 310.246 **beginning** 420, 437, 443, 481, 483, 522, 606
first moment 443 **origin** 348 **source** 381 **wellspring** 388
privare 204.139 **to block** 503
privatio 66.147; 111.114; 114.207; 125.232; 126.236, 243; 193.119; 201.56; 204.132, 137, 142, 145, 153; 215.163, 168; 216.183, 186 **absence** 386, 448, 495, 501, 503, 504, 511
lack 439, 441, 511
probare 57.158 **to try** 379
probatio 105.235 **test** 434
procedere 37.162; 295.44; 308.204; 318.119; 321.63 **to arise** 596 **to continue by** 366
to extend 605 **to project** 615
processus 316.62 **continuing outward** 611
procreare 319.145, 3 **to cause to arise** 613 **to produce** 613
profundatio 154.174 **inward projection** 468
profunditas 157.246, 248; 158.274; 159.295, 297; 162.102, 104; 163.121, 130, 135; 200.40; 201.49, 51; 211.60, 63 **being deep-set** 508 **depression** 501 **depth** 470, 471, 474
indentation 473, 474
profundum 15.132, 137; 16.157, 166; 18.207; 19.241 **depth** 350-353
profundus 117.279; 162.102; 199.7, 9; 200.44; 202.81, 82, 87; 208.274; 218.60; 238.9
deep 442 **depressed** 500-502 **hollow** 506 **indented** 473
prohibere 6.23; 10.9, 16; 51.272; 56.133; 60.252; 62.3, 5; 65.98; 68.181; 73.27 **to impede** 375 **to prevent** 345, 347, 348, 379, 382, 383, 385, 387, 391
prolongare 224.222; 296.50 **to continue** 517 **to prolong** 596
prominens 162.101; 199.6, 8, 10; 200.25; 202.81, 82, 86; 208.274 **bulbous** 506
prominent 502 **protruding** 473 **raised** 500, 502
prominentia 154.159; 162.102; 163.135; 200.39; 201.49, 51; 211.62, 64 **bulbousness** 508 **elevation** 501 **outward projection** 468 **prominence** 501 **protrusion** 473, 474, 508
promittere 47.156; 64.82 **to promise** 372, 384
propinquare 286.60 **to lie near** 589
propinquitas 38.192; 159.295; 161.58, 62; 162.97; 271.96; 286.52; 291.200; 304.93-95; 308.212; 310.259, 260; 312.16; 319.20 **closeness/nearness** 366, 472, 473, 578, 593, 602, 605, 608, 614 **propinquity** 471
propinquus *frequently recurring* (28, 65, 66, 95-97, 115, 118, 132, 133, 140, 146-148, 152, 158, 163, 170, 173, 174, 178, 179, 191, 195, 246, 249-253, 259, 260, 262, 264, 266, 268-273, 276, 281, 282, 286, 300, 302, 309, 314, 328, 332, 334) **close, near**
proportio 67.156; 68.185; 181.62, 66, 69, 71, 75; 182.78; 189.6, 12; 193.113; 206.213; 211.58; 212.67; 281.90, 92; 290.182, 185; 292.220; 303.50; 305.103; 308.210
comparison 386, 387, 495, 505 **proportion** 508, 592, 593, 602 **ratio** 585, 601
relationship 487 **respect** 492
proportionalis 211.53; 212.69, 73, 78, 80, 82, 84, 86, 88, 91; 213.98, 101; 281.86; 288.111,

proportionalitas**putare**

- 115, 117; 290.183; 303.49; 304.86; 305.103, 106, 115, 116, 118, 127; 308.209; 310.258;
322.9 **proportional** 585, 602, 616 **proportionate** 508, 509, 590, 601, 603, 607
proportionalitas 211.48; 213.94, 97, 105, 110, 113, 116, 121; 214.145; 215.158, 161
proportionality 508-511 **proportionateness** 510, 511
proportionare 290.168; 291.193, 199, 208, 209, 213; 292.223; 294.14; 298.62; 307.175;
311.296 **to make proportionate** 592, 593, 595, 598 **to relate** 593, 605, 608
proponere 245.4¹; 264.209; 323.31; 336.7 **to adduce** 627 **to place** 574 **to set before/**
forth 561, 616
propositio 104.186, 188, 191, 194, 197; 105.215, 218, 219, 223; 106.249, 251-253, 256,
259, 263, 267; 107.281, 283, 285; 108.5, 25; 109.35, 36; 301.10, 11, 13; 310.255; 315.36
premise 433-437, 600, 607, 610 **principle** 434 **proposition** 436
proprius 42.298, 15; 49.238; 60.237, 257; 61.274; 64.76; 70.64; 98.25; 140.57; 201.61;
228.43; 231.118, 120; 233.181; 235.249; 236.261; 285.27; 296.8; 299.81; 329.2 **act-**
ual 384 **appropriate** 382, 388 **defining** 524 **natural** 597 **own** 621 **particu-**
lar 501 **pertinent** 430 **proper** 381, 458, 520, 588 **select** 369 **specific** 369, 374,
382, 521, 523, 524
proprietas 15.133; 22.5; 23.27, 29; 27.161; 37.162; 45.93; 49.240; 51.283, 284; 56.131,
132; 69.33; 71.100, 102; 79.17; 83.103; 85.154; 90.1 **characteristic** 388, 389, 417
nature 379 **property** 350, 355, 356, 359, 366, 375, 389, 420, 421, 424 **quality** 371
pruinosis 329.5 **misty** 621
puer 108.10, 13, 26, 27; 109.30 **child** 436, 437
pueritia 109.56, 57; 233.170 **childhood** 437, 522
pulcher 70.67; 71.114; 108.14, 15, 17, 18, 21-23; 205.182, 185; 206.190, 191, 194, 199,
200, 206, 208, 209, 214; 207.216, 218, 221, 224, 225, 229, 232, 233, 235, 238, 241,
244; 208.246, 248, 252, 269; 209.278, 279, 284, 293, 294; 210.19-22, 26, 31; 211.34,
36, 37, 39, 54, 55, 61-64; 212.66, 68, 73, 76, 77, 83, 87, 88, 92, 93; 213.100, 104, 107,
119; 215.155, 164, 165 **attractive/comely** 388, 389, 436, 504-511
pulcritudo 108.18, 21; 111.94; 204.156; 205.160-162, 166, 168, 177, 178, 180, 181, 184;
206.187, 188, 192, 193, 198, 203-205, 210; 207.220, 223, 228, 231, 234, 237, 240,
243; 208.245, 247, 249, 251, 255, 258, 260, 263, 265, 268; 209.282, 285, 287, 290,
297, 1, 4; 210.7, 8, 10, 12, 14, 15, 18, 23, 28; 211.41, 42, 45, 47; 212.71; 213.94-96, 99,
105, 109, 112, 114; 214.125, 128, 132, 134, 138, 139, 141, 144, 148, 149, 151; 215.156,
160, 162, 163, 165, 168, 169 **attractiveness/beauty** 436, 438, 504-511
pulvis 68.10; 72.130 **dust** 387, 390
punctatus/punctatim 67.166; 206.208 **in tight order** 505 **point[ed]** 386
punctum/punctus *frequently recurring* (16, 19, 25, 26, 28-39, 41, 46, 47, 50, 67, 70, 73,
75, 76, 81, 82, 87, 89-96, 112, 119, 120, 122-124, 139, 144-146, 206, 248-252, 254-
261, 264-280, 287, 300, 305, 307, 316, 324, 325) **point, spot**
pupilla 248.21, 22, 25; 264.209; 265.224, 237; 266.256, 261, 265; 267.270, 276; 273.170;
274.187, 192, 199; 275.217, 226; 276.232; 277.272, 276, 287; 279.20, 29, 32, 38; 280.60,
64, 75; 281.107; 282.113 **eye** 563 **gaze** 563, 574-576, 580-586
purus 239.56; 325.5 **intense** 527 **pure** 618
putare 47.178; 105.222, 225; 106.259; 293.28; 297.23; 298.45; 299.66; 306.137; 310.266;
311.274; 312.2; 316.65, 76; 317.90; 318.118; 319.141, 10; 320.31; 321.51, 68; 324.51;

quadrangulus**quiescere**

326.19, 31; 327.43; 328.68; 329.107; 330.22; 331.46; 332.25; 333.51, 56, 60, 63; 335.35; 336.58 **to assume** 434, 597, 598, 614 **to deem** 434 **to judge** 598, 607, 608, 611-615, 617, 619-622, 624, 626 **to suppose** 373, 435, 604, 626 **to take for/to be** 598, 611, 612, 615, 619, 623 **to think** 594

quadrangulus 315.33 **square** 610

quadratio 165.196, 200 **square** 475, 476

quadratus 165.194, 197-199, 201; 166.211; 246.17; 293.14; 298.54; 302.40; 303.48, 53, 57, 68 **quadrilateral** 561 **square** 475, 476, 594, 598, 601, 602

quadrupes 235.231 **quadruped** 524

qualitas/qualiter 10.348; 23.45, 46; 25.93; 29.198; 49.222, 230; 50.244; 58.178, 179; 67.179; 70.69; 79.1¹, 13, 14, 19; 85.165, 166, 169, 170, 172, 175; 86.180, 184; 87.217; 96.172, 173; 100.87; 104.199, 201; 107, 271, 274, 278, 282, 287, 288, 291, 296, 299; 109.44; 110.66, 67, 75, 76, 86; 117.293; 125.222; 126.242, 243; 127.277, 287; 128.20; 129.34, 45; 150.54, 55; 151.64, 66, 79, 84; 164.155, 156; 166.219; 169.17; 170.21; 172.86; 173.131; 181.46; 184.144; 196.223; 197.225, 239; 198.271; 199.291, 292; 204.158; 216.188; 217.25; 245.8¹, 10¹, 12¹; 291.209; 296.60; 321.54 **condition** 596 **how** 417, 437, 500, 512 **kind/sort** 498, 561 **nature** 615 **manner/means/way [of proceeding]** 348, 356, 357, 360, 374, 380, 388, 417, 421, 428, 431, 433, 435, 437, 438, 448-451, 465, 466, 476, 478-481, 486, 489, 498-500, 504, 511 **quality** 387, 422, 448, 593

quantitas *frequently recurring* (39, 74, 76, 84, 120, 122-126, 129-139, 144, 149-152, 154, 155, 162-193, 200, 212, 213, 219, 220, 235, 237, 238, 251, 252, 268, 273, 274, 284, 286, 290, 291, 298, 299, 303, 305-308, 315, 320, 322-324, 326, 328, 330, 332, 334) **amount, extent, magnitude, quantity, size**

quesere 220.113 **to seek** 514

questio 43.46; 56.118; 299.84 **issue** 370, 379 **question** 599

quiditas 101.102; 103.162; 115.218, 219, 221, 238; 116.241, 267; 117.273-275; 118.300, 7, 13, 22, 24; 119.29, 30, 33, 34; 120.65, 66, 68, 71, 73, 74, 77, 81, 86, 87; 121.89, 92; 125.221; 182.80; 226.293, 294, 300; 227.3, 15, 18, 26; 230.87; 232.154; 233.169, 181, 186; 236.265, 268; 289.154 **being of a certain kind** 431, 433, 441-445, 448, 487, 518, 519, 521, 522, 591 **essential nature** 524, 525

quies 15.116; 20.270, 272, 274, 277, 279, 281; 21.9; 80.19; 109.55; 110.63; 111.93, 109; 120.74, 75; 129.34; 142.124; 196.210, 216; 197.232; 199.294, 1; 207.243; 246.27, 34; 253.191; 310.265, 268; 317.93; 320.39, 49; 324.57; 326.33; 330.32; 332.34; 333.43; 335.37, 40, 42 **being ensconced** 437, 451, 460 **being fixed/immobile/motionless/stationary/still/stopped** 350, 354, 445, 498, 562, 607, 626 **immobility** 500, 506, 567 **rest** 354, 355, 418, 438, 500, 607, 612, 614, 615, 617, 619, 622, 624, 626

quiescentia 173.131 **becoming ensconced** 481

quiescere 14.114; 15.119; 23.44; 72.126; 96.177, 181, 185; 110.62, 64, 67, 70, 71; 114.193, 194; 115.214; 119.44; 120.80; 127.280, 286; 129.33, 40; 139.36; 142.122; 156.215; 167.258; 168.262, 264, 267, 290; 173.131; 174.150; 175.173; 182.89; 187.250; 195.181,

radialis**recipere**

186; 196.209, 214; 199.299; 223.194; 226.281; 227.2; 232.155; 233.175; 246.24, 31; 248.34-36; 289.161; 290.163; 310.265; 311.271; 321.51; 335.35 **to be/to remain at rest/fixed/immobile/steady/stationary/still** 350, 390, 428, 444, 445, 491, 497, 498, 500, 562, 563, 591, 607, 615 **to be accepted/established/given** 356, 460, 469, 477 **to be ensconced** 437, 438, 440, 441, 449, 451, 458, 460, 477, 478, 481, 482, 487, 516, 518, 519, 522 **to remain** 523 **to stop** 626

radialis 175.188 **ray** 482 *see also* **axis radialis, linea radialis, piramis radialis**

radius 45.109, 110, 112-114, 116, 117; 46.118, 121, 123, 134, 138; 47.161, 178; 48.196, 198; 126.256, 258; 164.162; 170.41; 175.190, 192-195; 178.260, 282, 286; 179.288, 291, 293, 9, 12; 189.8, 9; 261.110; 262.148; 267.291, 295; 268.2, 10, 15, 16, 18-20, 22; 269.28, 30, 36, 38; 270.55, 57, 60, 61, 66; 271.99, 105, 106; 272.134; 281.89, 101; 287.63, 70; 303.48, 51; 308.200; 311.273, 278; 314.14; 315.47, 48, 50, 51; 316.60, 61, 64, 74, 78; 317.113; 320.22; 328.89 **line-of-sight** 311, 607 **ray** 371-374, 449, 475, 479, 483-486, 493, 572, 576-579, 585, 589, 601, 605, 610, 611, 614, 620

raritas 290.176; 295.44; 296.46; 299.76, 78, 79; 300.104, 108; 312.8, 11, 13; 317.110; 318.116; 321.55, 56, 58; 324.66; 326.28; 327.40, 47, 49, 50, 52, 58; 328.78, 83, 90; 329.101; 330.11, 21; 331.46, 52; 333.54, 56, 58; 336.55, 58 **transparency** 592, 596, 599, 608, 612, 615, 617, 619-622, 624, 626

raro 63.48; 118.6; 151.72; 222.191; 270.71, 75; 273.147 **rarely** 384, 443, 465, 516, 578, 580

rarus 12.30; 63.47; 69.26, 36, 50; 312.25, 26, 28; 321.56, 59; 324.68, 69; 325.5, 8, 10; 326.29, 31, 34; 327.42, 45, 47-49, 51, 53, 55; 329.101; 331.45; 333.54, 59; 336.55, 57 **loosely textured** 348 **rare** 384, 388 **sheer** 299.82 **thin** 387, 388 **transparent** 608, 615, 617-622, 624, 626

radix 107.284; 115.235; 166.223, 231 **basis** 436, 441, 476 **factor** 476

rameh 11.20 **funnel** 348

ratio 47.178; 48.196; 49.212, 227; 100.69, 80, 82, 88, 91; 101.116; 102.131-133, 138, 139; 103.160, 168, 171, 173, 178, 179; 104.185, 203, 205-207; 105.215, 222, 224, 227, 228; 106.241, 251; 107.269, 272, 284, 300; 109.34, 38, 43, 54; 110.68, 73; 117.277; 166.222; 245.13; 270.77; 284.172, 190; 303.47, 59; 305.102; 310.249 **deduction** 578, 587 **inferential process** 432 **judgment** 431, 432, 434, 435, 437, 438, 561 **logic** 373 **procedure** 430 **reason/reasoning** 373, 374, 433, 601-603, 606

ratiocinare 126.258 **to argue** 449

recedere 4.33; 239.49, 61; 240.77; 296.58, 60; 300.115; 310.247; 311.274; 326.35; 332.14 **to be removed** 623 **to disappear** 526, 600 **to fall short** 596 **to leave** 527 **to recede** 606, 607, 619 **to refocus** 343 **to shift away** 343, 527

receptio 42.20; 43.30; 45.98; 46.146; 56.134, 135; 58.178, 179, 181; 71.98; 84.142, 143; 85.146, 148-150, 153, 161, 165, 166, 169, 170, 172, 175; 123.159 **acceptance** 379 **reception** 369, 371, 372, 380, 389, 421, 446 **suffering an effect** 369

recessus 58.184, 187; 59.203, 205; 293.40; 294.43 **fading** 596 **passing beyond** 595 **removal** 380 **receding** 594

recipere 23.32; 41.295; 43.31; 45.91, 106; 48.187; 50.270; 51.279, 281, 287, 290; 52.18;

rectitudo**remanere**

- 56.121, 134; 57.172; 58.173, 175, 176; 69.40; 71.100; 81.50; 84.144; 85.146-148, 162, 167; 86.188, 206; 87.207, 208; 88.253, 254; 106.256; 122.118, 120; 123.149, 150; 140.56; 182.97; 240.89; 296.57, 9 **to accept** 369, 376, 379, 435 **to acquire** 597 **to be susceptible to** 527 **to get** 488 **to receive** 356, 369, 371, 373, 375, 376, 380, 388, 389, 418, 421-423, 446, 458 **to take** 373
- rectitudo** 29.204, 217, 219, 227; 30.239, 240, 244; 31.287, 291; 32.6, 9; 33.26; 34.77; 35.92, 95, 96; 36.142; 38.177; 51.286; 81.49; 82.68, 71, 74, 82; 83.95, 118; 84.128, 140; 86.178; 94.117, 119, 125, 127, 129, 140; 111.101; 136.227; 140.60; 141.91; 142.110; 161.79, 80; 186.222; 274.180; 319.12; 326.11 **directness** 365, 614, 618 **rectilinearity** 362 **straightness** 360-364, 366, 375, 418-421, 427, 438, 458, 459, 473, 490 **true reckoning** 455
- rectus/recte** 13.83; 15.139, 141; 16.160, 166; 17.191; 18.208, 219; 20.279; 21.4, 11; 23.52; 24.81; 27.139, 151, 153, 163, 165; 29.201, 209, 210; 30.228-230, 235, 250, 252; 31.262; 32.16; 33.44, 47, 51; 34.55, 59; 39.233; 40.247; 41.283, 287, 289; 42.299, 10, 12-14, 17, 22, 24; 43.35, 43; 46.147, 148; 47.155; 49.218, 233; 50.250; 56.132, 137, 139; 57.154, 162; 73.8; 75.63, 66, 67, 70; 77.126, 128; 80.3, 10, 12, 16, 17; 81.37, 50; 82.68; 85.156; 90.18; 91.49; 92.78; 93.88; 94.137; 142.102; 144.171; 165.194; 186.215; 245.3², 8; 247.45; 253.186, 195; 254.216, 223; 263.181, 182, 186; 264.194; 266.266; 285.5; 291.199; 295.23; 302.39; 304.88; 314.24; 315.29, 31; 322.17; 332.14 **correct** 374, 561 **direct/directly facing** 357, 464, 490, 561, 562, 566, 588, 592, 595, 601, 610, 616, 623 **orthogonal** 367 **rectilinear** 351, 359 **right** 353, 355, 361, 425 **straight** 349, 351, 352, 354, 355, 357, 359-361, 363, 367-370, 372, 374, 375, 379, 380, 390, 392, 393, 417, 418, 421, 424, 426, 427, 459, 461, 567, 573, 575, 602
- redere** 23.32; 45.91, 101, 107, 113, 117; 46.118, 121; 47.175; 48.184, 188, 189, 191, 193, 194, 200, 203; 52.18; 54.55-57; 56.135; 59.212; 85.148; 110.61, 69; 115.236; 127.277; 208.256; 224.222, 224, 234; 318.132; 328.78 **to present** 437, 438 **to produce** 620 **to recur** 517 **to render** 506, 613 **to return** 449 **to transmit** 356, 371, 373, 376, 377, 379, 381, 421, 442, 449
- reditio** 45.99 **transmission** 371
- reducere** 295.30; 298.39, 50; 314.16; 317.108; 334.75 **to bring back to** 596 **to restore** 598, 610, 625 **to return to** 612
- reductio** 336.6 **being distilled** 627
- reflectere** 3.6, 7; 6.31, 33, 42, 46; 30.230, 232, 233, 241; 31.265, 279, 288; 32.3, 4, 9, 10, 17, 20; 33.28; 36.118, 127, 136, 144; 37.150, 152, 157, 159, 163, 173; 38.184, 185, 193; 39.209, 212, 213, 218; 40.266; 41.268, 271; 52.3; 82.88, 90; 83.93, 97, 104, 105, 108, 110, 118; 84.120, 130; 85.173; 86.180; 93.111; 142.111; 202.78; 311.293; 317.104; 324.67 **to reflect** 343, 345, 376, 459, 460, 502, 608, 617 **to refract** 361-363, 365-368, 419-421, 427
- reflexio** 6.37, 40; 37.160; 38.197, 198; 39.215, 216, 220, 223, 226; 73.3; 77.124; 82.91; 83.113; 85.170; 86.181, 183; 93.111; 141.99; 142.100; 311.288, 289, 291; 317.100, 101; 320.35; 330.38 **radial breaking** 390, 393 **reflection** 345, 459, 607, 612, 614, 622 **refraction** 366, 367, 419-421, 427
- relatio** 105.224 **relation** 434
- remanere** 26.132; 44.76; 47.160; 48.186; 56.118; 58.183, 187, 195, 198, 200, 201; 59.203,

rememorare**res**

- 209; 69.42, 49; 70.66; 85.158; 110.77; 114.200; 156.224; 169.18; 172.104; 222.188; 223.196, 205; 225.258; 226.289; 241.112; 246.42; 248.49; 260.75 **to be left** 373, 379, 469, 570 **to be maintained/retained** 358, 388 **to linger** 438 **to persist** 370, 380, 381, 388, 516, 518 **to remain** 372, 388, 441, 478, 481, 516, 528, 562 **to stay** 518
- rememorare/rememorari** 101.107, 109; 224.225, 228; 228.34, 46; 229.60, 74; 230.90; 231.120; 232.148, 151, 159; 240.68, 81; 241.106; 242.139, 142 **to remember** 431, 517, 519-522, 527, 528
- rememoratio** 101.113, 120 **remembering** 432
- remotio** *frequently recurring* (19, 38, 59, 70, 89, 97, 111, 119, 120, 125-139, 142-146, 148-155, 159-173, 175-186, 188-193, 195, 206, 222, 225, 235, 249-252, 255-257, 259-262, 267-271, 281-287, 303, 306-313) **distance, remoteness, separation**
- remotus** 15.132, 137; 16.156, 166; 18.207; 19.241; 38.187, 188; 60.239, 250; 66.135, 140; 67.177; 69.28; 74.56; 90.8; 95.144, 154, 160; 97.210; 133.141, 151; 147.253, 255, 267; 148.274; 152.106, 116; 158.271; 165.181, 185; 170.45, 46, 49; 171.63, 66; 173.119; 178.263; 179.300, 4; 189.1, 3; 190.14, 16; 195.170; 225.257; 246.13, 17, 20, 29; 250.108, 112; 251.126, 133; 252.160; 253.176, 180; 259.67; 260.81, 88, 89, 92; 261.104, 110, 117; 262.140, 149-152, 157; 266.252, 260; 270.83; 271.86, 91, 95, 105, 108, 109, 111, 112; 274.182, 188; 276.247, 252, 253, 255; 277.262; 279.23, 41, 42; 281.83, 84, 106; 282.114, 121, 122; 285.20; 286.45; 287.80; 297.34; 302.28; 304.90; 306.155; 313.55; 318.126; 319.20; 320.40, 45; 331.5, 7; 334.5, 10, 16 **disparate** 579 **distant** 424, 453, 479, 485, 561, 565, 570, 585, 590, 601, 604, 623 **large/long** 571, 582 **lying apart** 578 **lying away/beyond** 575, 580, 585 **lying far/far away/far off** 366, 381, 386, 427-429, 463, 466, 470, 475, 480, 481, 484, 485, 492, 493, 497, 562, 565, 566, 571, 572, 578-580, 582, 584-586, 588, 597, 609, 613, 614, 623, 625 **remote** 602 **separated** 392 **sharply different** 386
- renovare** 224.225 **to renew** 517
- reputare** 245.12; 299.71; 302.31; 303.53, 61, 68; 304.92, 97; 309.220, 222; 312.24; 319.17; 325.80; 326.13, 25; 329.98, 103; 331.43; 332.14, 16; 336.52 **to adjudge/judge** 602, 606, 608, 618, 619, 621, 623, 626 **to assume/suppose** 601-603 **to deem** 601, 602 **to take to be** 598, 606, 614, 622 **to think** 561
- reputatio** 304.98 **judgment** 603
- res** 5.10, 12; 8.82, 84, 1, 5, 11; 10.1, 3, 4, 6; 22.4; 35.110; 38.199; 42.8; 45.104, 108; 47.162, 163; 48.195, 201; 49.224; 53.43; 56.115; 68.187; 71.103; 73.27, 28; 84.137; 96.182; 97.2, 4, 7; 101.119; 103.162; 108.11, 15; 109.32; 110.79; 115.227; 127.276; 128.7; 144.180; 152.106; 183.133; 190.28; 194.147; 198.261; 199.284, 287; 205.182; 215.171; 227.24; 230.86; 231.116; 235.250; 245.8; 266.240, 248; 271.87, 89, 114; 272.118, 121; 292.1; 293.18; 296.5, 6, 9, 10; 297.14, 15, 33; 299.67, 77, 89; 302.18, 20; 305.102, 121; 307.159, 175; 308.193; 309.241; 311.298; 312.21; 313.44, 49-51; 316.60; 317.93; 321.73; 324.61; 332.15, 16 **body** 391, 429 **characteristic/feature/property/quality** 344, 346, 347, 374, 378, 429 **matter** 366, 488, 599 **object/visible object** 355, 365, 371, 377, 391, 428, 432, 433, 436, 449, 461, 493, 496, 499, 504, 511, 521, 524, 594, 597, 598, 600, 603-606, 609, 611, 612, 615, 617, 623 **organ** 420 **phenomenon** 369, 608 **something/thing** 371-373, 389, 436-438, 441, 450, 593, 597, 599, 601, 603, 608, 609 **subject** 387

res visa**rosa**

- res visa** *frequently recurring* (3, 6, 8, 10, 22-30, 32-36, 38-53, 55, 56, 60, 64-66, 70-81, 84, 89, 92-96, 100-103, 110, 112-115, 117, 118, 120, 123-130, 132, 134, 136, 137, 139-145, 151-155, 159-173, 177, 180-191, 193-199, 214, 215, 217-230, 232-234, 238, 239, 241-243, 245, 248, 249, 251, 252, 272, 276, 286-288, 290, 292, 296, 298, 301, 302, 305-308, 321-323, 325, 329, 331, 333, 335, 337) **visible object**
- res visibilis** 3.13, 8.12; 10.14; 24.55, 73, 74; 25.96, 100, 102, 108; 26.121; 34.68; 49.229; 52.20; 71.93; 74.58; 75.91; 78.178; 79.4, 13; 81.46; 84.133; 86.199; 96.176; 97.1; 99.63; 100.86, 95; 101.101; 103.176; 107.299; 110.84; 112.136; 127.271; 130.70, 73 **visible characteristic/feature/property** 346, 376, 429, 431, 436 **visible object** 343, 347, 357, 358, 364, 374, 389, 392, 394, 417, 420, 422, 428, 430, 433, 438, 439, 449, 451, 452
- resistere** 73.11 **to block** 390
- respectus** *frequently recurring* (21, 38, 63, 67, 68, 73, 76, 80, 87, 123, 132, 139, 141, 145, 147, 149-151, 155, 158, 171, 177, 181-183, 186, 189, 190, 193-197, 199, 204, 243, 247, 248, 250, 252-254, 257, 260, 268-271, 273, 283, 286, 290, 291, 294, 299, 303, 307-312, 316, 322, 323, 327, 335) **comparison, regard, respect, term (of comparison)**
- respicere** 92.52; 130.57-59, 64, 66, 70, 72; 131.85, 87, 92, 110; 132.129, 132; 133.167; 134.176, 180; 135.206, 208, 213, 216, 219, 221; 136.254; 137.267, 270, 273, 274, 277; 138.298; 144.183; 148.288; 150.30, 32, 38; 151.87, 88; 152.95, 98; 162.99; 164.170; 165.182, 199; 166.205; 167.235, 245; 168.261, 263, 278; 169.297; 170.40; 171.60, 64; 172.79, 100, 101, 106, 109; 173.115; 174.157, 158; 178.259, 266, 269, 283, 286; 179.290, 292, 294, 13; 181.52; 182.82, 91, 93, 95, 101, 105; 183.116, 117, 122; 185.183, 188; 186.205-207; 187.247, 249, 253; 188.256, 259, 272, 273; 190.24, 30, 32, 35, 37; 192.96, 99; 195.163, 164; 197.230; 203.117; 289.151; 304.77; 315.30 **to be in line with** 496 **to be opposite** 425 **to coincide** 503 **to correspond** 461, 487, 488 **to encompass** 477, 478 **to range** 451, 481, 484 **to span** 451-457, 464-466, 473, 480, 481, 484, 486, 493, 495 **to subtend** 475, 476, 479, 480, 482, 484-492, 610
- respondere** 21.17, 19; 58.194; 96.168 **to correspond** 355, 428 **to respond** 380
- resudare** 69.25 **to leak out** 387
- retentibilis** 12.45 **capable of retaining** 349
- retentio** 71.108; 111.113 **firmness, rigidity** 439
- retentiva** 71.112 **firm** 389
- retinere** 68.6; 69.24, 47 **to constrain** 388 **to hold in place** 387 **to keep** 387
- revertere** 3.16; 4.28; 7.56; 26.135; 27.140; 43.53, 56; 44.58; 55.91; 57.156; 140.47; 167.252; 239.64; 240.80; 246.25; 265.236; 266.255; 267.278; 278.297, 15; 279.36; 332.19 **to bring back/to bring back into focus** 345, 370, 527 **to come back** 370, 458 **to hark back** 504 **to recur** 477 **to replace** 583, 584 **to reposition** 575 **to restore** 359 **to return** 343, 370, 378, 379 **to revert back** 576 **to shift back** 343
- revolutio** 120.60, 72, 72; 326.35; 332.41; 333.42; 335.43, 45, 48; 337.19 **revolution** 444, 445, 624 **rotation** 619, 626, 627
- revolvere** 119.47 **to revolve** 444
- risus** 111.105 **laughter** 438
- rosa** 235.249, 250; 236.254 **rose** 524

roseaceus

secare

- roseaceus/roseus** 206.189; 235.248; 236.265 **rose-red** 505, 524
rota 332.39; 335.47, 49 **disk** 624 **wheel** 626
rotunditas 13.64; 69.31; 71.115; 210.33; 235.251; 238.10 **circularity** 388, 525 **circumference** 349 **roundness** 389, 508, 524
rotundus 12.28, 37; 13.63; 19.254; 68.20; 69.31; 71.115; 156.229; 166.213; 208.271; 237.2, 6; 238.8, 10; 246.18; 246.18; 263.187; 323.27; 331.41 **circular** 388, 476, 525, 561 **curved** 469 **round/rounded** 348, 349, 353, 387, 506, 573, 616, 622
rubedo 299.74; 301.119 **redness** 599, 600
rubeus 4.53; 115.225, 226, 229, 230; 299.73 **red** 344, 441, 598
rubor 9.19; 239.62 **redness** 347, 527
rug 206.195; 208.259 **wrinkle** 505, 506
- salus** 26.130, 132, 135; 27.143 **health** 358, 359 **soundness** 358
sanitas 285.18; 286.33; 290.164, 177; 291.217 **health** 588, 589, 591-593
scannum 309.233; 332.29 **bench** 606, 623
scientia 158.293; 159.19; 192.92; 227.31; 228.49; 230.98, 99; 246.25; 292.2, 4, 5, 9, 12; 293.13, 26, 30; 294.49; 296.2, 4, 8; 297.11, 12, 18, 34, 36; 298.40, 42, 51, 56; 299.68, 75; 300.111; 301.126, 128; 337.31, 35 **acquaintance** 494 **knowledge** 471, 519-521 **recognition** 593-595, 597-600, 627
scire 156.222 **to realize** 469
scintillare 5.54; 6.33, 36, 51; 7.65; 8.2², 5; 58.186; 63.49; 206.189; 210.25; 288.95 **to shine brightly/brilliantly** 344-346, 380, 384, 504, 508, 590
scintillatio 9.6, 16; 65.102; 114.200; 201.72; 202.76 **brightness** 346, 347, 441 **dazzle/dazzling light** 385, 502
scribere 102.145, 149; 270.81; 273.163, 164, 172; 274.174, 175; 275.219, 222; 277.267; 278.6 **to draw** 578 **to write** 432, 580-583
scriptor 100.85; 102.141, 147, 148, 150; 105.213; 232.142, 144 **writer** 431, 432, 434, 522
scriptura 8.2¹; 100.83; 111.100; 206.209, 214; 207.216; 209.292, 296; 210.19, 21, 22, 24; 213.100; 217.30; 273.164; 277.268, 273, 274, 282; 278.288, 291, 293, 295, 300, 2; 279.21, 30, 33, 40, 47; 280.51, 61, 65, 67, 68, 76; 281.96, 99, 102 **writing** 346, 431, 438, 505, 507-509, 512, 582-585
scrotula 273.163, 167, 169, 171; 274.174, 175, 178, 179, 184-186, 188, 193, 195-199; 275.201, 204, 207, 208, 214, 217, 218, 226-229; 276.230-233, 237-239; 280.80; 281.82, 83, 105, 108, 111; 282.112-114, 116 **strip** 580, 581, 585, 586
sculptura 6.26, 27, 35, 40, 43, 44, 47; 8.2¹, 6; 240.76 **engraving** 345 **etching** 527 **tracing** 345, 346
scutella 314.26 **bowl** 610
secare 15.130; 16.144, 165; 17.184; 18.206; 35.88; 37.168, 176; 38.203; 39.216; 50.252; 56.141; 57.163; 75.67, 69; 82.83, 88, 91; 83.97; 84.131; 89.292; 90.3, 14, 16; 91.45, 47; 92.80; 93.105; 94.131; 144.182, 184; 147.249; 151.58; 152.104; 153.119; 156.226, 228, 230, 233; 157.240, 252, 256, 261; 162.110; 187.248; 255.240; 263.180; 264.193; 265.220; 270.84 **to cut** 375, 392 **to interrupt** 392 **to intersect** 350-352, 364, 366, 367, 379,

sectio

signum

- 380, 419, 420, 424-427, 461, 463, 465-467, 469, 470, 473, 568, 573, 574, 578 **to mark out** 491
- sectio** 38.177, 187, 190; 157.242, 257; 158.284; 162.104, 111; 263.180, 182; 264.192; 270.80, 85; 271.101; 277.280, 287; 278.290, 17 **intersection** 366, 470, 473, 573, 578, 579, 583
- segetalis** 67.172 **grassy** 386
- semidyameter** 15.124, 125; 308.205, 209 **radius** 350, 605
- sensator** *see* **ultimus sensator**
- sensibilis** *see* **virtus sensibilis**
- sensitivus** *see* **virtus sensitiva**
- sensus** *frequently recurring* (9, 22, 27-29, 40-47, 49-52, 54-56, 63, 68-73, 76, 79, 84-88, 97-101, 103, 109, 111, 115, 116, 118, 121-123, 125-127, 129, 131, 133-135, 138, 140, 141, 143, 153, 154, 156, 158-160, 166, 171, 175, 179, 180, 184-186, 188-190, 192, 194, 205, 209, 213, 216, 217, 219, 222, 225-227, 232, 243, 245, 249, 250, 259, 274, 292-296, 301, 305, 337) **sense, sensitivity**
- sentiens (noun)** *frequently recurring* (42, 45, 53, 54, 76, 93, 114-118, 121, 125, 140-143, 154, 160, 163, 167-169, 173-177, 179, 182, 183, 185-199, 214, 216, 219-222, 226, 227, 238, 257, 283) **sense, sensing/sensitive organ, sensitive agent, sensor**
- sentiens (adj.)** *frequently recurring* (46, 48, 57, 58, 70-72, 76, 80, 84-88, 112, 113, 116, 117, 123-135, 140, 141, 143, 153, 160, 168, 170, 174, 186, 283) **sensing, sensitive**
- sentire** *frequently recurring* (22-28, 32, 33, 35, 36, 40, 43-49, 51, 59, 66, 75, 76, 78, 84-86, 93, 107, 112, 116, 117, 123, 127, 140, 142, 143, 145, 146, 152, 154, 157, 158, 163, 172, 174, 175, 177-181, 188, 189, 191-193, 195, 196, 198, 201, 203, 204, 284, 305) **to be sensitive, to feel, to sense**
- separare** 101.106; 154.157; 207.232; 252.153; 300.91 **to individuate** 505 **to remove** 431 **to separate** 468, 566, 599
- separatio** 111.93; 155.184; 309.226 **discontinuity** 468 **disjunction** 606 **separation** 438
- sermo** 10.18; 19.247; 27.166; 29.221; 38.197; 47.157; 49.229; 58.185; 129.44; 191.49; 207.242; 209.2; 225.254, 255; 245.4; 285.199 **analysis** 561 **discussion** 348, 353, 359, 360, 372, 374, 451, 493, 497, 588 **point** 380 **section** 366 **speech** 506, 517
- servare** 273.169 **to take care** 580
- siccitas** 68.17; 71.111; 111.108, 112 **dryness** 387, 389, 438
- siccus** 111.113 **dry** 439
- signare** 90.4; 110.80; 165.194; 222.181 **to describe** 424 **to draw** 475 **to impress** 516 **to individuate** 438
- signatio** 100.81 **implication** 431
- significare** 4.41; 5.58, 21; 8.81, 10; 10.41; 27.147, 152; 54.68, 75; 58.194; 159.1; 231.122 **to alert to the fact** 471 **to indicate** 344, 346, 347, 359, 377, 380 **to show** 346
- significatio** 27.143; 52.300; 53.36; 55.87; 57.146; 108.8; 117.276; 118.14; 119.33; 170.37; 182.97, 98, 106; 216.192; 223.195, 204, 214; 225.251 **defining feature** 489 **evidence** 378, 379, 436, 442, 444, 479, 516 **implication** 512 **indication** 359, 376, 377, 443, 488, 517
- signum** 49.227; 53.50; 102.135; 103.159, 160; 104.211; 112.119, 122; 116.250; 143.153;

sillogismus**solidus**

- 146.219; 183.123; 231.122; 232.149; 233.180, 182, 185; 234.198; 236.271; 238.34, 36; 241.117; 243.146 **defining feature** 374, 432-434, 439, 442, 521-523, 525, 526, 528, 529 **indication** 377, 488 **sign** 461, 462
- sillogismus** 106.245, 254, 263; 292.2, 6, 7; 293.16, 31; 294.49; 301.2, 5, 6, 9, 10; 302.22, 23, 36; 309.228; 314.3, 10; 315.36; 316.56; 317.84; 318.134; 322.3; 325.94, 3; 329.4; 331.3; 334.2; 336.1, 3; 337.35 **deduction** 593-595, 600, 601, 606, 609-613, 615, 616, 618, 621, 623, 625, 627 **sylllogism** 435
- sillogizare** 106.265; 308.196, 201; 319.3 **to carry out a deduction/to deduce** 605, 615 **to form a syllogism** 435
- similis/similiter** *frequently recurring* (3-9, 14, 19, 21-23, 26, 37, 38, 42-44, 49, 51, 61-63, 65-68, 72, 73, 78, 79, 87, 90, 92, 96-105, 108, 110, 111, 115-119, 123, 128, 134, 136, 139, 141, 145, 147, 148, 150, 155, 157, 158, 160-162, 164, 165, 172, 173, 175, 177, 178, 181, 182, 185, 192, 193, 198, 199, 203, 206-213, 215, 216, 221-223, 225, 227, 228, 231, 232, 234-240, 249, 252, 259, 261, 263, 265-267, 269, 274, 280-282, 286-289, 291-293, 295, 296, 299-301, 304, 306, 309, 311, 313, 318-321, 324, 329, 332, 335, 337) **alike/likewise, identical, similar/similarly**
- similitudo** 98.22, 28, 30-32, 36; 101.122; 102.130; 111.104; 117.297; 208.268; 296.6; 306.152; 311.294; 313.53, 60; 318.136, 139; 319.143; 321.74, 76; 325.89, 90, 92; 327.40; 329.100, 107; 331.49; 333.71; 334.72; 336.64, 66 **being alike** 615 **identity** 609, 613, 619 **resemblance** 443 **similarity** 429, 430, 432, 438, 506, 597, 604, 608, 609, 613, 618, 621, 622, 624-626
- simitas** 211.60; 212.72; 231.137 **flatness** 508, 509, 522
- sinapis** 299.70 **mustard** 598
- singillatim** 299.90 **discretely** 599
- singularis/singulariter** 64.79; 65.89, 108; 177.252; 296.50; 297.24 **individual** 597 **separate/separately** 384, 385, 484 **single** 596
- singulus** 292.222, 225, 226; 301.129, 8; 305.120, 121; 324.75; 328.71, 73; 331.2; 334.2; 336.8 **each/every one/thing** 593, 623, 625 **individual** 618, 620 **particular** 600 **single** 627 **specific** 603
- situari** 23.25 **to be located** 356
- situs** *frequently recurring* (6, 11, 12, 14, 16, 17, 19-21, 35, 36, 38-41, 49, 50, 53, 55-57, 70, 71, 73, 79-82, 87, 93, 97-99, 110, 111, 114, 120, 126, 128, 129, 139, 140, 142, 144, 146-148, 150-156, 159, 160, 162-164, 166, 169, 170, 175, 176, 180, 186, 187, 190, 194-202, 206, 210-213, 216, 222, 223, 240, 255, 275, 287, 290, 292, 294, 295, 298, 302-304, 310-312, 314-320, 322, 323, 325-327, 330, 332-335) **case, disposition/spatial disposition, location, situation**
- sol** 6.29, 50; 7.56; 9.22; 52.1, 2; 65.112; 66.120, 121; 115.239; 204.144, 145; 208.257; 292.10, 11; 300.118; 304.96; 309.224; 313.31, 46; 324.74; 327.58; 328.65, 89 **sun** 345-347, 376, 385, 442, 503, 506, 594, 600, 606, 609, 617, 620
- soliditas** 290.175, 207; 295.39, 40, 41; 299.72; 312.22; 317.110; 318.116; 324.65; 325.4; 327.54; 329.110; 331.46; 333.59; 336.55, 57 **opacity** 592, 596, 598, 608, 612, 617, 618, 620, 621, 622, 624, 626
- solidus** 291.206, 207; 295.43; 312.25, 27, 28; 318.114; 321.57, 59; 324.70, 71; 326.32; 327.53, 54, 57, 63, 64; 331.46; 333.61; 336.59 **opaque** 593, 608, 612, 615, 617, 619,

spatium**strictificare**

620, 622, 624, 626

spatium *frequently recurring* (14, 47, 73, 74, 96, 120, 125, 126, 130, 131, 139, 144-153, 168, 169, 175-181, 184, 189, 190, 195, 197-199, 246, 271, 272, 289, 315, 316) **gap, interval, space**

specialitas/specialiter 229.64, 81; 234.197, 210, 213 **being of a kind/general type** 520, 523

species 96.192; 102.125, 128, 129; 208.269; 225.271; 226.274, 275, 279; 228.36, 41, 51, 52, 55; 229.58, 59, 70, 74; 230.86, 99, 100; 233.188; 234.198, 215-217, 220, 221; 235.243, 244; 236.266, 275; 237.279-282; 285.200; 297.14; 298.59; 300.113, 116; 313.43; 318.125, 128, 131, 137, 140; 321.70, 72, 75, 78; 325.84, 86; 329.101, 105; 331.47; 333.66 **beauty** 609, 613, 615, 618, 621, 622, 624 **general type** 523-525 **kind** 432, 506, 518-521, 523, 524, 588, 597-599, 615 **species** 518

speciosus 318.129; 329.99 **beautiful** 613, 621

speculum 3.5, 7, 8; 141.98 **mirror** 343, 459

spera 12.28, 30, 33, 35, 44, 50, 52; 13.65, 77; 14.97, 100, 102; 15.122, 124, 131, 133, 134, 136; 16.148, 165, 169; 17.180, 184, 187, 189; 19.255; 69.52; 83.115; 84.119, 121; 88.241; 246.19; 255.250; 304.92; 319.17 **sphere** 348-352, 388, 420, 423, 561, 568, 602, 614

spericitas 69.38; 84.122 **curvature** 388, 420

spericus 12.53; 15.121, 127; 16.144, 152, 155, 164; 17.194, 198; 18.206; 19.251; 42.17; 68.19; 69.27, 37, 51; 70.70, 73, 84; 83.114; 84.121; 88.241; 89.295; 90.2; 92.66, 71; 93.84, 93, 104, 107; 326.20 **circular** 369 **spherical** 349-352, 387-389, 420, 423-427, 619

spiritus 86.198 **spirit** 422

spiritus visibilis 13.85; 70.55; 112.125 **visual spirit** 349, 388, 439

spissitudo 4.44; 12.46; 15.128; 50.269; 51.272, 273, 275, 278; 64.88; 65.95; 69.35; 78.172, 174; 88.257, 259, 260, 263; 111.94; 202.96, 102; 204.132, 134; 208.251, 254; 209.296; 236.260; 238.21; 289.134, 138, 142, 146; 290.176; 291.210; 299.77 **consistency** 349 **density** 524 **haziness** 591, 593, 599 **opacity** 375, 384, 385, 388, 394, 423, 438, 502, 503, 506, 526, 591, 592 **thickness** 344, 350, 507

spissus 68.19; 69.25, 26, 42; 73.12; 78.160, 164; 202.97; 203.116; 207.235; 289.129, 142 **dense** 506 **hazy** 591 **opaque** 388, 390, 503 **thick** 387

splendor 3.6 **flooding of light** 343

spoliatus 49.223, 226 **naked** 374

statuere 251.118; 306.146; 310.250; 312.23; 318.123; 327.44, 53 **to occupy** 565 **to place** 604, 608, 613, 619, 620 **to set up** 606

status 246.30; 254.217; 262.135, 139; 264.200; 265.222; 267.270; 275.208; 276.235; 279.27 **case** 572 **condition** 575 **disposition/position** 581, 582 **situation** 567, 572, 574, 584

stella 5.1, 5, 6; 47.165; 65.109, 110, 113-115, 117, 118; 73.29; 205.185; 207.229-232, 238, 241; 208.264, 266; 246.23-25, 27; 294.42; 297.35; 302.31; 310.244, 255, 257-259, 268 **star** 344, 372, 385, 391, 504-506, 562, 595, 597, 601, 606, 607

stella erratica 302.33; 310.266 **planet** 601, 607

strabo 335.28 **squint** 625

strictificare 167.247 **to narrow** 477

strictura**tabula**

- strictura** 300.99 **narrowness** 599
strictus 60.235; 132.136; 156.235; 192.95, 100, 103; 212.89; 300.102, 103 **conver-**
ging 469 **narrow** 381, 453, 495, 599 **thin** 509
subduplus 308.212 **half** 605
subiacere 308.201 **to affect** 605
subripere 331.5 **to snatch away** 623
substantia 235.249; 294.11 **that within which something inheres** 524
subtendere 250.94; 282.137; 283.140; 284.182 **to subtend** 564, 586, 587
subtilis 5.9, 10, 12, 15; 6.26, 43; 8.2¹, 6; 38.195; 52.22; 69.34, 39; 70.57; 87.209; 117.291;
141.83; 180.27; 206.196, 199, 202; 208.256; 209.276, 288, 294; 217.30-32, 40, 43;
218.46, 49, 52; 220.115; 224.238; 238.22; 260.102; 275.205; 277.268; 283.149, 158;
284.189; 287.78, 82, 85, 88, 92; 288.100, 101, 105, 114; 289.130, 131, 135, 140, 145,
147; 300.106; 312.9; 321.72 **careful** 512 **fine** 599 **narrow** 507 **sheer** 591
slow 581 **small/tiny** 344, 346, 506, 512, 587 **subtle** 344-346, 376, 388, 422,
443, 459, 486, 505, 508, 512-514, 517, 526, 571, 586, 587, 590, 591, 615 **thin** 506,
507, 608
subtilitas 210.33; 212.75, 77 **being subtle** 508 **narrowness** 509
sufficere 167.233; 231.117; 238.17, 19; 337.16 **to need only** 526 **to suffice** 476, 521,
627
sumere 146.230; 298.51; 301.12; 313.52; 314.19; 325.86, 92; 329.108; 331.3, 10 **to**
base 598, 609, 618, 621 **to take** 462, 600, 610
supercilium 209.275, 287; 231.138 **eyebrow** 506, 507, 522
superficies *frequently recurring* (6, 12, 13, 15-43, 45-47, 49-52, 61, 69-71, 73-96, 112,
113, 119-121, 123-125, 139, 141, 144-166, 168, 170, 173, 174, 180, 184-192, 196,
199-202, 218, 232, 238, 240, 248-252, 255-259, 261, 264, 265, 269, 274, 282, 283,
302-304, 306, 308, 319, 321, 323, 325) **plane, surface**
superfluitas 303.70; 307.160; 312.29 **excess** 602, 608 **inordinateness** 604
superfluus 46.139; 48.197; 311.280; 313.53 **excessive** 607, 609 **superfluous** 372,
373
superhabundantia 312.22 **excess** 608
superponere 15.126; 16.150, 152; 53.32; 68.4; 72.133, 135; 74.32, 45; 187.247; 257.292,
12; 258.43; 263.167, 171; 264.204; 265.212, 214; 277.269; 280.59; 295.40; 327.50
to close over 390 **to coincide with** 491, 574 **to cover** 351 **to extend over** 387
to place at/behind/upon 391, 574, 584, 596, 619 **to position over/up to** 350, 582
to superimpose 376, 569, 570, 573
supponere 336.4 **to adduce** 627
sustentare 136.229; 143.148; 164.163; 166.223 **to base upon** 461, 476 **to de-**
pend 455, 475
sustentatio 151.74; 166.220; 226.292; 227.3, 5 **basis** 466, 518 **dependence** 476, 519
- tabula** 263.176, 186, 188; 264.189, 191, 194-196, 199, 200, 204, 206, 207, 209; 265.215,
217, 220, 229-230, 232, 236; 266.254, 256, 259; 270.80, 81; 271.91; 272.125; 273.166,
168, 170; 274.180-182, 186, 188, 191; 275.206, 215, 225; 276.238; 277.269-271, 279;

taciturnitas**terminus**

- 278.294, 16; 280.58, 59, 63, 64, 70, 74, 75, 78, 80; 281.86, 88, 93, 95-97, 106; 309.232; 320.30; 332.29 **plank** 606, 614, 623 **plaque** 573-575, 578-585
- taciturnitas** 207.244 **reserve** 506
- tactus** 55.106; 86.195, 197 **touch** 378, 422
- tangere** 19.257; 23.27; 264.189, 190, 208 **to be in contact/make contact** 353, 356
to touch 573, 574
- tarditas** 198.274 **slowness** 198
- tela** 7.74; 11.1, 7; 12.36; 13.60; 68.16; 69.36, 47, 50 **membrane** 346, 348, 349, 387, 388 **tunic** 348
- temperamentum** 290.169, 174, 179, 182, 184, 186; 291.192, 198, 202, 208, 209, 213; 292.219, 223, 227, 230, 232; 293.24, 30; 294.47; 295.25, 38, 42; 296.47, 60; 297.17; 298.39, 56, 61; 299.72; 300.110; 302.26; 307.175; 310.264; 314.1, 22; 319.146, 13; 320.26; 325.1; 329.2; 331.1 **moderation** 596, 598, 614, 621, 623 **range of moderation** 592-597, 599, 601, 605, 607, 609, 610, 613, 618
- temperantia** 290.167, 171; 291.196; 293.25, 33; 294.16; 295.17, 30, 32, 37; 298.38, 50; 299.68, 78; 302.35, 38; 307.172; 311.298; 314.15, 17; 317.108; 318.124; 319.1; 322.83, 1; 323.35; 329.112; 334.74, 14 **being moderate** 594, 599 **being ordinate** 608, 610 **moderation** 598, 610, 612, 613, 616, 617, 621, 625 **range of moderation** 592, 594-596, 598, 601, 604, 616, 625
- temperare** 72.137 **to mitigate** 390
- temperatus** 6.28, 39; 52.10; 69.28; 294.12; 298.60; 299.79; 303.62; 304.98; 305.123, 125; 306.143, 153; 307.166; 308.188, 190, 192, 205; 309.234; 311.298; 314.6, 18; 319.5; 320.48; 322.5, 10; 325.95; 326.32; 329.7; 330.20, 29, 33; 331.53; 334.19; 335.44, 46; 336.12; 337.13, 14, 22, 23 **efficient** 387 **moderate** 345, 376, 593, 598, 599, 602-606, 608-610, 614-616, 618, 619, 621-623, 625-627 **ordinate** 605
- tempus** *frequently recurring* (3, 5, 10, 23, 24, 30-32, 35, 36, 48, 56, 58, 59, 71, 74, 79, 96, 98, 101, 103, 104, 106, 107, 110, 113, 118-125, 127, 143, 174, 177, 197-199, 223, 224, 230-239, 243, 247, 285, 286, 289-291, 296, 300, 310, 331-334, 337) **time**
- tendere** 158.273 **to curve away** 470
- tenebra** 313.37, 39, 41; 318.117, 123; 321.60, 67, 68; 324.72, 76; 328.65, 77, 81, 88, 91; 331.44; 333.65; 336.63 **darkness** 609, 612, 613, 615, 617, 618, 620-622, 624, 626
- tenebrositas** 316.66 **darkened area** 611
- tenebrosus** 294.10; 295.29; 296.46, 57; 309.218; 312.24; 313.32; 316.65, 68; 318.118; 328.67, 68, 89 **dark** 606, 608, 609, 611, 612, 620 **shadowy** 595, 596
- tenuitas** 13.73; 210.33; 212.74; 323.41 **delicateness** 509 **fineness** 508 **fluidity** 349 **thinness** 617
- tenuis** 12.30; 13.61, 71; 68.17; 288.124, 126; 323.45 **faint** 591 **fine** 349 **serous** 349 **thin** 348, 387, 617
- terminalis** 305.114, 119, 123; 307.181 **terminal** 603, 605
- terminus** 139.21, 25, 26; 144.179; 145.196; 153.136; 155.202, 205; 156.209; 160.39, 43, 46; 161.59, 61, 70, 71, 75, 79, 80, 82; 164.148, 149; 169.294-296, 301, 11; 170.24, 33; 184.151-153; 188.281; 193.127; 286.51; 322.83; 332.21 **boundary** 457, 461, 469, 472, 478, 479, 489 **edge** 462, 467, 473, 495 **extremity** 472, 474, 492 **limit** 589, 616 **outer edge** 472, 473 **side** 623

terra**tunica**

- terra** 5.9; 42.14-16; 47.167; 132.121, 128; 133.142, 143; 135.220; 173.110, 112-114, 117-121, 123, 125, 128, 134; 174.142, 147, 151, 154, 156, 158, 162, 166; 175.169, 171, 184, 185, 195; 176.201, 204, 216, 219, 222, 225, 227; 177.233, 248, 249, 254; 178.262, 263, 265, 271, 272, 275, 276; 179.11; 180.30; 246.28; 306.155; 315.52, 54; 316.61; 320.28; 329.9; 330.11; 331.9 **earth** 369, 373, 455, 481, 482, 484 **ground** 344, 453, 481-486, 562, 604, 611, 614, 621, 623
- tersitudo** 201.60, 71; 202.76, 92 **polish** 501, 502
- tersus** 3.5; 6.25, 34, 42; 52.3; 201.60, 61; 287.93 **polished** 343, 345, 376, 501, 590 **smooth** 345
- testari** 55.91 **to testify** 378
- textura** 13.61 **texture** 249
- tinctura** 44.75; 58.183; 59.215; 62.298; 67.170, 173-175; 119.36; 263.183 **color** 380, 386, 444, 573 **dye** 370, 383
- tingere** 57.166; 58.182, 192, 195, 200; 59.214 **to tint** 380, 381
- tortuositas** 208.260 **complicated windings** 506
- tortuosus** 42.13 **winding** 369
- tractatus** 38.199, 200; 49.228; 78.184; 79.6, 16, 1²; 80.25; 81.42; 84.135; 244.176; 245.1²; 246.38; 247.43, 1, 17; 253.183; 285.3, 14 **book** 366, 374, 394, 417, 418, 420, 529, 561-563, 566, 588
- transfere** 187.235; 252.143 **to shift** 491, 565
- transire** 16.145, 147, 158, 160, 167; 17.191, 192, 199, 200; 18.209, 210, 213, 215, 217, 223, 226, 227, 229, 232; 20.279, 295; 21.2, 3, 11, 20, 22, 24; 23.34; 27.159, 162; 28.190; 30.242, 243; 31.259, 262, 266, 273, 277; 40.252; 41.287; 56.133; 57.154, 160; 68.7, 8; 80.10, 13, 16, 20; 91.33; 93.106; 146.226; 163.125; 170.41; 179.1, 5, 6; 186.220; 198.280; 199.287, 288; 220.112; 238.17, 19; 254.223; 255.235, 236, 253; 258.26; 273.149; 293.36; 299.88; 300.111; 327.63 **to fall** 462 **to flow by** 594 **to pass by/over/through** 351-356, 359-362, 368, 379, 387, 417, 418, 425, 426, 479, 485, 490, 499, 500, 514, 526, 567-569, 580, 599, 620 **to scan** 474
- transitus** 29.199; 51.273; 83.93; 174.159; 239.42; 317.112; 318.115; 328.90; 333.60 **course** 482 **passage** 526, 612, 620 **passing through** 360, 375, 419, 612, 624
- translucens** 27.147 **transparent** 359
- transmutabilis** 253.190; 254.221, 223, 224; 258.28 **affected** 567 **variant** 567, 569
- transmutare** 253.184; 254.218; 273.155, 157 **to change** 566, 567, 580
- transmutatio** 273.157 **change** 580
- triangulus** 250.92; 293.14 **triangle** 564, 594
- tristitia** 111.105 **sadness** 438
- triticum** 299.70 **wheat** 598
- trocus** 119.35, 36, 39, 53, 57; 120.63, 68, 69, 78, 79; 289.159, 160; 333.43-45; 335.39, 40 **top** 444, 445, 591, 624, 626
- tumor** 304.93 **bulge** 602
- tunica** 11.6, 23; 12.41; 13.67-69, 80; 14.110; 18.233, 234; 19.250, 259, 262, 267; 20.269; 21.2, 8, 10, 13, 14, 21, 23, 24; 22.32, 33; 23.25, 34, 37, 44; 26.128, 131; 27.143, 144, 148, 161; 28.179; 29.227; 30.231, 239, 242; 31.262, 266; 33.33; 35.93, 94; 43.29; 49.220; 50.251, 257; 56.124; 57.170; 59.210; 68.1, 3, 18; 69.30; 70.70, 80; 71.88, 107,

turbidus**uvea**

- 109, 111-113; 80.11, 15, 17; 253.186 **tunic** 348-350, 353-356, 358-361, 363, 369, 374, 375, 379-381, 387-389, 417, 418, 566
- turbidus** 8.4²; 9.13, 25; 289.129; 328.85, 86; 329.94 **cloudy** 621 **dull** 346, 347 **foggy** 591 **muddy** 620 **roiled** 620
- turpis** 208.257, 273; 209.277; 212.90; 215.162, 165, 166; 329.94 **ugly** 506, 507, 509, 511 **unappealing** 621
- turpitude** 111.95; 206.195, 196; 208.272; 209.275, 285, 297; 215.154, 163, 166, 167 **disfigurement** 505 **ugliness** 438, 506, 507, 511
- turris** 329.6; 330.10; 331.5-7, 9 **tower** 621, 623
- ultimum/ultimus sentiens** 52.15, 19, 25; 53.34, 48; 54.55-57, 62, 63, 66, 81; 55.84, 88, 106; 56.117; 70.58; 81.46, 53; 84.140, 144; 86.193, 195, 196; 87.220; 88.263; 89.268; 95.162; 112.121, 130, 134, 137; 113.162, 173; 114.187; 121.104; 124.183; 253.194 **final sensor** 376-379, 388, 418, 421-423, 428, 439, 440, 445, 447, 567
- ultimus sensor** 53.38, 39 **final sensor** 377
- umbra** 4.49; 5.10; 7.53, 57, 66; 9.33; 10.35; 62.15, 17; 63.27, 35, 40; 111.94; 117.291, 294; 199.6, 8-10; 204.136-139, 141, 146, 150, 151; 208.254, 255, 258, 261; 293.15; 300.105; 309.225; 312.4, 6, 29; 313.32, 34; 318.117-119, 130; 321.60, 62-64; 324.63, 72; 325.81, 83; 327.58, 61, 64; 328.69, 73, 77, 80, 81, 84, 85, 87, 91; 330.40; 331.43; 333.62, 64; 336.60, 61 **shading** 443 **shadow** 344, 345, 347, 383, 438, 500, 503, 504, 506, 594, 599, 606, 608, 609, 612, 613, 615, 617, 618, 620-622, 624, 626
- umbrosus** 327.60 **shadowy** 620
- unio** 316.67 **(continuity)** 611
- unire** 55.102 **to unite** 378
- unitas** 295.22, 29; 309.241; 333.49 **blending** 595 **uniform blend** 634 **unity** 606
- universalis** 104.186; 106.249, 251; 108.23; 229.85; 234.205; 297.11; 301.12 **general** 433 **major** 435, 436 **universal** 520, 523, 597, 600 *see also* **forma universalis**
- universalitas** 238.37 **general nature** 526
- universaliter** 223.195; 247.18; 248.30; 283.158 **in a general way** 563 **generally** 516, 563, 587
- universum** 251.136 **every** 565
- uti** 107.276; 108.4, 12, 25; 176.215 **to avail oneself of** 483 **to exert** 436 **to use** 435, 436
- utilitas** 13.83; 68.5; 72.141 **function** 387, 390 **straight-line connection** 349
- uva** 12.36 **grape** 348
- uvea** 12.36, 37, 40, 44, 54; 13.62, 66, 67, 71, 74, 75, 81; 14.92, 100, 102; 15.122, 124, 125, 127, 131, 132, 134, 136, 138, 140, 141; 16.143, 150, 157-159, 162, 163, 165, 166, 169, 171, 173; 17.179, 181, 184, 187, 189, 192, 199; 18.204, 213, 224, 225, 227-230, 232, 233, 235; 19.236, 241, 244, 250, 260; 23.35; 26.133, 138; 27.140; 31.273, 274, 277; 40.248; 41.287; 68.5-7, 19; 73.31; 80.13, 21, 23 **uvea** 348-353, 356, 358, 359, 362, 368, 387, 391, 418

vacuitas**verus**

- vacuitas** 132.137; 159.297; 192.99; 321.66 **gap** 495 **hollow** 471 **space** 453, 615
vadere 332.19 **to oscillate** 623
varietas 290.190 **type** 592
vas 9.19; 317.113; 318.115; 323.39; 327.55; 328.92; 329.94-96, 99, 100 **glass** 612, 617, 620, 621 **vessel** 347
velocitas 71.117; 103.173; 106.247; 107.279, 292; 109.45, 46; 123.159; 136.250; 137.257; 187.246; 198.274, 280; 199.286; 227.18; 235.236; 310.267 **ease [of motion]** 390 **quickness/speed/swiftness** 390, 433, 435-437, 446, 456, 491, 499, 519, 524, 607
velociter 71.111; 104.204; 107.273 **quickly** 389, 434, 435
velox 72.134; 103.177; 107.298; 120.79; 187.245; 232.167; 237.280, 282, 284; 238.10, 30; 289.148, 152, 158; 300.112; 310.262, 265; 324.51; 330.28; 332.30 **fast/quick/swift** 390, 433, 436, 491, 525, 526, 591, 599, 607, 617, 622, 623 **vigorous** 445
verbum 104.193, 196-198; 105.213, 224; 108.13; 170.48; 210.10; 211.60; 231.124; 237.287; 239.47; 273.163; 289.151; 301.13; 304.82; 336.10 **example/instance** 434, 436, 479, 507, 508, 521, 525, 526, 591, 600, 602, 627 **word** 433, 434, 580
verificare 6.44; 49.231; 94.140; 138.283; 225.246; 259.61, 71; 260.79, 85; 261.115; 290.166; 298.52; 323.37 **to define** 570, 571, 592 **to determine/to determine correctly** 572, 617 **to perceive: clearly/distinctly** 345, 427, 598 **to verify** 374, 456, 517
verificatio 186.199 **determination** 490
veritas 105.226; 106.254, 260, 266; 107.282, 284, 288; 110.74; 141.73; 157.265; 164.168; 177.246; 183.133; 188.277; 193.111; 221.143; 227.24; 231.116; 242.135; 245.8²; 266.240, 248; 271.87, 89, 114; 272.118, 121; 290.167, 181; 292.228, 229; 296.59; 297.15; 298.37, 47; 299.89; 300.98; 301.121; 302.32; 303.45, 65; 305.100, 128; 306.131, 138; 307.180; 315.40; 320.47; 322.13; 327.61; 329.8; 331.7 **accuracy** 515 **actuality** 459, 470, 475, 484, 492, 519, 521, 528, 561, 575, 578, 579, 592, 593, 597, 600-605, 610, 615, 616, 621, 623 **correctness** 598 **reality** 495 **truth** 434, 435, 488, 596, 599 **veracity** 438
verticalis 77.126 **[direct]** 393
verticatio 27.139; 32.293, 299, 4; 33.28; 34.63, 76; 35.86, 107, 109; 36.118, 125, 127, 136; 40.237, 242, 254, 261, 263, 265, 266; 41.268, 271, 272, 283, 294; 42.298, 299, 7, 9, 19, 21, 24; 43.31, 35, 43; 46.143, 146; 47.154; 48.208; 49.217, 239; 50.243, 256, 259; 51.288; 56.132, 141; 57.144, 162, 163, 165; 60.257; 61.273, 274, 276, 280, 281, 283, 285; 65.100, 115; 66.128, 130, 136, 137, 139, 140; 71.92, 94, 99, 101; 79.7, 2²; 80.29; 81.51; 85.152, 153, 156, 158, 161; 87.211, 213, 215, 226; 88.251; 112.143; 113.156; 140.57, 58, 63, 65; 141.67, 68, 71, 72, 85, 87, 89, 90, 97; 142.102, 104, 110, 112, 113, 115, 120; 143.133; 147.246; 168.283-285, 287; 169.294, 295, 299, 10, 15; 170.33; 171.57; 174.152, 164; 175.175, 177, 178, 180-182; 219.80; 247.2; 248.41; 264.203; 274.179, 182, 183; 275.216; 279.19 **alignment** 580 **direction** 458-460 **line/line of radiation/radial line** 359, 362-365, 367-370, 372, 374-376, 379, 380, 382, 385, 389, 417, 418, 421-423, 439, 458-460, 463, 478, 479, 482, 562, 563, 574, 580 **line-of-sight** 386 **path** 362, 440 **radial link** 375 **ray** 513
verus/vere 3.14; 38.197; 47.162; 48.210; 49.232; 66.138; 67.163; 72.120; 105.216, 217, 222, 226; 107.283, 286, 289; 109.39; 130.76, 78, 79, 81, 82; 131.83, 84, 86, 89, 94, 96, 98, 101, 103, 105, 108, 111; 134.176, 196; 135.205; 137.259; 138.287, 8; 140.37; 142.119;

vespertinus

vis

- 144.161; 148.287; 151.83; 153.128; 184.135; 186.201; 190.42; 191.46, 48; 193.108, 110; 217.37, 39; 218.49, 50, 53, 66, 67; 219.75; 220.126, 128; 221.142; 223.199; 224.240, 245; 225.246; 228.40; 240.68, 72, 87; 241.118, 119; 246.14, 16; 271.112; 272.133, 140, 142; 273.147; 276.255; 277.260; 283.160; 285.24; 286.34, 36, 46, 47, 49, 51, 54; 287.61, 64, 67, 72, 74, 91, 94; 288.96, 98, 106, 117, 120, 123, 127; 289.131, 134, 138, 141, 143, 150; 300.99; 301.12; 308.193, 202, 206; 309.214; 311.283; 323.41; 336.56 **absolute** 617 **accurate** 515 **actual/actually** 493, 579, 580, 605, 626 **correct/correctly** 452, 454, 456, 460, 464, 466, 490, 493, 495, 516, 582, 587-591 **evident** 599 **exact** 457 **proper/properly** 366, 386, 387, 512, 513, 515, 517, 519, 527, 528 **real/really** 437, 561, 579, 607 **true** 372, 374, 390, 434, 436, 456, 458, 461, 467, 488, 600
- vespertinus** 328.66 **evening** 620
- videre** *frequently recurring* (5-7, 9, 22, 24, 25, 47, 53, 101, 102, 104, 105, 109, 118, 128, 130, 132, 133, 135, 142, 151, 159, 165, 172, 180, 200-203, 205, 221, 223, 228, 232, 234, 245, 246, 248, 267-273, 275, 276, 278-281, 290-305, 307-326, 328, 330-333, 335, 336) **to look at, to observe, to see, to view**
- vigor** 243.166 **strength** 529
- vigorescere** 7.62 **to intensify** 345
- villositas** 208.246 **shagginess** 506
- vincere** 62.297, 10; 63.45; 65.93; 328.85 **to overcome** 620 **to overwhelm** 382, 384, 385
- vinosus** 8.2² **wine-red** 346
- vinum** 9.19; 11.18; 317.111, 113; 318.114; 327.55, 57; 328.75; 329.94, 97, 102, 106 **wine** 347, 348, 612, 620, 621
- viridale** 207.235 **vegetation** 506
- viridarium** 4.44; 206.191 **garden** 344, 505
- viridificatio** 99.47, 48 **greening** 430
- viridis** 12.29; 67.172; 99.40, 41; 206.189; 208.273; 236.258; 301.119 **green** 348, 386, 430, 442, 504, 506, 524, 600
- viriditas** 99.42-44, 46-48, 50; 117.278; 231.138; 236.255-257, 259, 264 **greenness** 430, 442, 522, 524
- viror** 4.47, 50, 51 **green** 344
- virtus** 51.281; 73.9; 76.103, 113; 85.162, 166, 167; 87.207; 100.93; 103.163, 164; 109.50; 174.138 **capacity** 375, 390, 393, 421 **faculty** 376, 435, 437, 481 **power** 393, 422, 431, 447
- virtus distinctiva** *frequently recurring* (100, 103-107, 109, 111-115, 127-129, 135-137, 140-143, 145, 153-156, 166-172, 174-178, 180, 183, 185, 188-190, 194, 214, 220, 222, 227, 231, 239, 284) **faculty of discrimination**
- virtus sensibilis** 69.43; 70.56; 85.145; 124.180; 248.31 **sensitive faculty** 388 **sensitive power** 388, 563
- virtus sensitiva** 52.15, 18; 76.112; 88.262; 96.167; 112.125, 131, 136, 138; 113.159; 114.191 **sensitive power** 393, 421, 423, 439, 440 **sensitive faculty** 376, 428, 440
- virtus visibilis** 14.90 **the power of seeing** 350
- vis** 335.36, 37 **power** 626

visibile**ymaginabilis**

- visibile** *frequently recurring* (4, 5, 24, 26, 50, 52, 66, 67, 71, 72, 79, 96, 109, 117, 129-131, 134, 135, 138, 139, 141, 144, 147, 152, 156, 159, 163, 167, 170, 172, 173, 176, 178-180, 182-184, 191, 193-195, 197, 223, 229, 231-233, 240, 243, 245, 246, 252, 285, 286, 288) **object/visible object** *see also* **res visa, res visibilis, visum**
- visibilis** 100.90; 104.203, 206; 107.272, 278; 109.47; 111.98, 116; 121.91; 335.36, 37 **visible** 421, 434, 435, 437, 438, 445 **visual** 626 *see also* **spiritus visibilis**
- visio** 10.18; 19.248; 23.45, 46; 25.93; 26.125, 126, 127, 131, 138; 28.186, 188; 36.134; 43.30, 46; 46.124; 47.162, 168, 172; 48.181, 198; 49.222, 231, 234; 52.24; 54.68; 55.89-91; 68.2; 70.69; 73.30; 74.48, 51; 75.63, 64; 76.121, 123; 79.1, 6; 81.58; 82.89; 97.205-209; 101.111; 107.276; 126.256, 257, 259, 262, 263; 127.265, 269, 274, 278; 128.10; 129.25, 38; 135.203; 140.38, 46, 53, 55; 142.117, 119; 154.172, 175; 179.17; 185.168, 171; 186.199; 200.18; 217.21; 221.133, 135; 227.10, 19; 228.34; 232.163, 165; 238.33; 240.82; 241.108, 123; 242.124, 127, 129, 131, 132, 136-138, 140-142, 144, 145; 243.148, 156, 169; 244.175; 248.38; 271.94; 278.13; 280.56; 282.123, 129 **seeing/sight** 431, 449, 450, 454, 458, 460, 486, 500, 512, 519, 527, 528 **view** 458 **vision** 348, 353, 356-360, 365, 369, 370, 372-374, 377, 378, 387, 388, 391-393, 417-419, 429, 449, 450, 451, 468, 515, 522, 526, 528, 529, 563, 578, 583, 584, 586 **visual perception** 435, 490 **visual process** 376, 489
- visum** *frequently recurring* (24, 53-55, 65, 70, 76, 128, 129, 199, 246-253, 255, 257-263, 268-273, 276, 277, 280, 282-289, 298, 305, 321, 330) **visible object, what is seen**
- visus** *frequently recurring* (3-6, 8-10, 19-53, 55-86, 89, 93, 94, 96-102, 109-111, 113-121, 123-206, 209, 213-223, 225-228, 230-243, 245-248, 251-263, 266-270, 276, 277, 279, 281-296, 298-301, 303-308, 310-317, 319-325, 327-329, 331-337) **center of sight, eye, faculty of sight, focus, line-of-sight, sight, viewpoint, vision, visual faculty**
- vitare** 166.231 **to do without** 476
- vitreus** 13.60, 78, 79; 83.100, 103, 106; 85.162, 165, 167, 169, 171, 173; 86.178, 186, 187, 194, 200; 87.208, 211, 230, 236; 88.237, 246, 250; 89.271, 277, 294; 90.3, 4, 11, 15, 18, 19; 91.34, 36, 37, 40, 44, 46, 48; 92.55, 62, 66, 68, 70-72, 76, 77, 79, 81, 82; 93.83, 86, 89, 92, 94, 96, 100, 102, 106, 109, 112; 94.115, 128; 317.113; 318.115; 323.40; 327.60; 329.96 **glass** 612, 617, 620, 621 **vitreous/vitreous humor** 349, 420-427
- vitrum** 13.59; 299.79, 81; 317.111, 112; 323.40, 42; 327.50, 57 **glass** 349, 599, 612, 617, 619, 620
- vocabulum** 104.192 **term** 433
- vocare** 42.27; 48.207; 106.258; 254.224; 258.36; 274.182 **to call** 369, 374, 435, 580 **to refer to** 567, 570
- volvare** 317.94; 332.40; 335.34, 40-42 **to revolve** 612, 624, 626 **to spin around** 626
- vox** 141.79-81, 83, 84, 86-92 **sound** 459
- ydemptitas** 260.100; 306.156; 310.251; 311.271; 317.86 **identity** 612 **sameness** 571, 604, 606, 607
- ymaginabilis** 33.48, 49; 50.244; 73.8; 248.38; 249.53 **capable of being imagined** 363, 390, 563 **imaginary** 363

ymaginare**ysoperimetrus**

ymaginare/ymaginari 17.183; 31.279; 33.51; 48.206, 210; 49.218; 50.250; 90.2, 5, 9; 137.265, 267; 138.282; 142.107; 169.300, 2, 6; 170.26-28, 32, 33; 172.90; 174.149, 160; 175.176, 179; 177.233; 188.259; 223.200, 202, 207, 211; 227.8; 253.178, 195, 197; 254.208, 209, 215, 226; 255.227; 284.178 **to conceive** 364, 374 **to imagine** 352, 363, 374, 375, 424, 456, 459, 478, 480, 482, 484, 491, 519, 566, 567, 587 **to suppose** 362

ymaginatio 140.44; 170.34; 172.82, 83, 84; 173.130; 177.239, 240; 182.89; 187.255; 190.36; 217.20; 222.181, 189; 223.195, 197, 206, 212, 216, 218; 224.239; 225.249, 250, 263, 265; 226.287, 290, 292, 297, 300; 227.2, 10, 13, 14, 16; 233.174, 176, 178 **conceptual process** 479 **imagination** 458, 481, 484, 487, 491, 493, 512, 516-519, 522 **imagining** 480, 491

ymago 300.105; 311.281 **depiction** 607 **silhouette** 599

ysoperimetrus 69.32 **having the same circumference** 388

**ENGLISH-LATIN
GLOSSARY**

ENGLISH-LATIN GLOSSARY

| | |
|--|--|
| a little bit/not very much | modicum |
| aberration | immoderatio |
| absence | privatio |
| absent | absens |
| absolute | verus |
| abu qalamun | alburalmon (<i>see also</i> amilialmon) |
| abutment | coniunctio |
| to accept | recipere |
| acceptance | receptio |
| to accomplish | complere, facere |
| account | distinctio |
| to account for | complere |
| accuracy | veritas |
| accurate | verus |
| accurate determination | certificatio, certitudo |
| accurately/correctly/precisely determined | certificatus |
| accustomed | assuetus |
| to achieve | complere |
| acquaintance | cognitio, scientia |
| to acquire | adquirere, habere, recipere |
| actual | proprius, verus |
| actuality | veritas |
| acuity | fortitudo |
| to add | addere |
| additional amount | augmentatio |
| to adduce | proponere, superponere |
| to affect | immutare, operari, subiacere |
| affected | transmutabilis |
| to affix/attach | applicare, componere, consolidare |
| to aggregate | aggregare |
| to agree | convenire |
| agreement | convenientia |
| air | aer |
| albugineous | albugineus |
| to alert to the fact | significare |
| alignment | verticatio |
| alike | similis |
| to ally with | coniungere |
| almond shape | amigdaleitas |

almond shaped amigdalatus
almond tree amigdalus
to alter alterare
alteration immutatio
aluerach *see* firefly
amilialmon amialmon (*see also* abu qalamun)
amount quantitas
analysis sermo
analytic procedure divisio
to analyze distinguere
anatomist anatomicus
angle angulus
animal animal
ant formica
anterior anterior
aperture foramen
apparent apparens
to appear apparere
appearance apparens, apparentia
to apply invenire
to apprehend adquirere, cognoscere, comprehendere, intellegere
to apprehend before precognoscere
apprehensible comprehensivus
apprehension adquisitio, cognitio, comprehensio, intuitio
approach appropinquatio
to approach appropinquare
appropriate proprius
aranea aranea
arc arcus
arching arcualitas
area locus, pars
area around/encircled circuitus
to argue ratiocinare
argument/logical argument argumentatio, argumentum
to arise/arise as a perception apparere, contingere, crescere, evenire, oriri, procedere
arising crementum
arm brachium
to arouse inducere, ingerere
to arrange/arrange properly ordinare
arrangement compositio, congregatio, dispositio, ordinatio, ordo
arrival perventio, perventus
to arrive/arrive at extendere, invenire, pervenire
as a whole collocatus
to ascribe assignare
ascribing/ascription assignatio

- ass** asinus
to assimilate assimilare, assimilare, communicare, confiteri
assimilation assimilatio, collatio, communicatio
to assume existimare, iudicare, putare, reputare
at rest immotus
attachment consolidatio
to attenuate debilitare
attenuated debilis
to attest attestari
attractive/comely pulcher
attractiveness pulcritudo
to attribute ascribere
to avail oneself of uti
axis axis, collum
azure lazuleus
- back** posterius
barely modice
base basis
to base/base upon sumere, sustentare
to base a conclusion/ perception on concludere
based on mere visual impression fantasticus
based on supposition opinabilis
basis dispositio, radix, sustentatio
basis for conclusion argumentum
to be a function of (a combination) componere
to be accepted/established/given quiescere
to be affected pati
to be apparent/clear/evident/manifest/revealed/visible apparere, patere
to be apprehended apparere
to be based upon componere
to be clarified/explained patere
to be compatible convenire
to be constituted/disposed appropriare, parare, preparare
to be contiguous coniungere, contingere, continuare
to be continually presented iterare
to be continuous continuare
to be currently in view preesse
to be different diversare
to be divisible dividere
to be earlier/previous precedere
to be endowed with habere
to be ensconced quiescere
to be exposed to view apparere
to be hidden/imperceptible/inapparent/invisible/obscured/unclear/

unseen latere
to be high/above/stand above elevare, eminere
to be identical convenire
to be in contact/make contact tangere
to be in line with respicere
to be inordinate egredi
to be insensible/invisible abscondere
to be larger excedere
to be left remanere
to be like assimilare
to be located situari
to be luminous illuminare
to be maintained remanere
to be manifold dividere
to be naturally constituted naturari
to be obligated debere
to be oblique declinare, inclinare, obliquare
to be opposite respicere
to be part of a set/a subtype collocare
to be placed/lie against/upon applicare, existere
to be present/exist existere, preesse
to be prominent eminere
to be removed recedere
to be retained remanere
to be right in front of obicere
to be seen apparere
to be sensitive sentire
to be shown patere
to be small/tiny diminuere
to be specific appropriare
to be successive continuare
to be susceptible to recipere
to be transformed admittere
to be without carere
to be/remain at rest/fixed/immobile/stationary/steady/still quiescere
to bear/hang upon dependere
beautiful formosus, speciosus
beauty pulcritudo, species
to become less distinct diminuere
becoming ensconced quiescentia
to begin incipere
beginning principium
behind posterior
being accustomed to assuetudo
being affirmed affirmatio
being alike similitudo

being an animal animalitas
being deep-set profunditas
being distilled reductio
being ensconced quies
being equal equalitas
being false falsitas
being few paucitas
being fixed/implanted fixio, quies
being flat planities
being identical convenientia
being immobile/motionless/stationary/still/stopped quies
being impressed impressio
being measured collatio
being moderate/ordinate mediocritas, temperantia
being normal assuetudo
being of a certain kind quiditas
being of a kind/general type specialitas
being of another kind diversus
being placed/being put against/opposite oppositio
being toward mediocritas
being unequal inequalitas
to believe credere
to belong to appropriare
bench scannum
bend/bending giratio, obliquatio
to bend declinare, girare
beneficence benignitas
bird avis
to bisect dividere
black niger
blackness nigredo
to blanket with effundere
blemish macula
blended confusus, mixtus
blending unitas
to block cooperire, occultare, opilare, privare, resistere
blocking occultatio
boat navis
bodily corporalis
body corporeitas, corpus, pectus, res
book liber, tractatus
bottom fundus
boundary finis, terminus
bowl scutella
brain cerebrum
breadth amplitudo, latitudo, latus

brevity/shortness brevitās, parvitas
bridge (of nose) cornu
brief/short brevis, modicus, parvus, paucus
brief period instans
briefly instantē
bright acutus, clarus, lucidus
to brighten clarescere
brightness scintillatio
to bring about complere, invehere
to bring back into focus revertere
to bring back to reducere
to bring near/to appropinquare
to bring out extrahere
brown fuscitas
bulbous prominens
bulbousness prominentia
bulge eminentia, gibbositas, tumor
bulging gibbus

to call appellare, vocare
candle candela
capable of being imagined ymaginabilis
capable of being suffered passibilis
capable of retaining retentibilis
capacity virtus
capacity to transmit light diafonitas
cardinal precept magnum
careful subtilis
to carry/carry with deferre, gerere, includere
to carry out a deduction sillogizare
to carry out a process iterare
to carry out an experiment experimentare
carrying out adquisitio
carrying out a task operatio
case dispositio, situs, status
to cast a shadow obumbrare
cause causa
to cause/cause to arise/cause to end up causare, efficere, facere, inducere,
 invehere, procreare
to cause to cease/disappear destruere
to cause to deteriorate corrumpere
to cause to stand erigere
cavity concavitas, concavum
celestial celestis
center/centerpoint centrum, medius

center of sight/center of the eye centrum, centrum visus, visus
certainty certificatio, certitudo
to certify certificare
change ablatio, diversitas, excessus, immutatio, mutatio, transmutatio
to change/suffer change alterare, diversare, immutare, mutare, transmutare
changeable mutabilis
characteristic intentio, proprietas, res
to characterize appropriare
charming nature dulcedo
cheek gena
child puer
childhood pueritas
choice electio
to choose eligere
circle circulus
circle of attachment circulus consolidationis
circle of intersection circulus sectionis
circular circularis, rotundus, spericus
circularity rotunditas
circumference circumferentia, rotunditas
to circumscribe continere
circumstance conditio, dispositio
city civitas
to claim before/earlier predicere
clarity/clearness certificatio, claritas, manifestatio
clear clarus, manifestus, mundus, planus
close/near propinquus
to close claudere
to close over superponere
close succession continuitas
closeness/nearness propinquitas
closure clausio
cloth pannus
cloud nubis, nubula
cloudy turbidus
to cluster together coniungere
to coexist aggregare
coexistence concursus
to coincide/coincide with respicere, superponere
to coincide nearly appropinquare
coincidence applicatio
coincidental continuus
collating collatio
color color, tinctura
to color colorare
coloring coloratio

combination adiunctio, compositio, congregatio, coniunctio
to combine adunare, componere, congregare, coniungere
to come pervenire
to come about evenire
to come back revertere
to come first precedere
to come out exire
commingling confusio
common communis
common axis axis communis
common nerve (optic chiasma) nervus communis
common section differentia communis
comparing/comparison collatio, consideratio, proportio, respectus
to complement complere
to complete complere
complicated windings tortuositas
to compose/comprise admiscere, componere
composite/composition compositio
to comprehend continere
to compress congregare
compression congregatio
concave concavus
concave part/concavity concavitas
concavity of the bone concavum ossis (*see also eyesocket*)
to conceive ymaginari
conceptual process ymaginatio
to conclude aggregare, concludere, existimare
conclusion conclusio, fides
condition dispositio, natura, qualitas, status
to conduce to iuvare
cone piramis
cone of radiation piramis radialis
configuration figuratio
to confirm affirmare
to confirm/determine experimentally experimentare
to conform convenire
to confuse admiscere
confusion admixtio
to conjoin aggregare, componere, coniungere, consolidare
conjoining/conjunction compositio, coniunctio, convenientia
to connect coniungere, consolidare, continuare
to conserve conservare
to consider considerare
considerable extraneus, longus, magnus
consideration consideratio
to consist of componere, continere

consistency spissitudo
consistent/constant consimilis
to constrain retinere
to construct facere
contact contactus
to contain continere
contiguity coniunctio, contiguatio
contiguous/having contiguity contiguus
continuation extensio
to continue/continue on durare, elongare, extendere, prolongare
to continue by pertransire, procedere
to continue to be preesse
continuing outward processus
continuity continuatio, continuitas
continuous continuus
to contract congregare
to converge appropinquare, concurrere
convergence aggregatio, appropinquatio
converging strictus
convex convexus
convexity convexio, convexitas
conviction fides
cornea cornea
corner angulus
corporeity corporeitas
correct rectus, verus
correctness veritas
to correspond convenire, respondere, respicere
correspondence consimilitudo
corresponding consimilis
to corroborate certificare
to count numerare
to counter contradicere
course transitus
to cover continere, cooperire, superponere
crack fissura
crass densus, grossus
to create efficere, facere, operari
to create/have/make an effect contingere, operari
creator operator
crooked curvus
cross-section dyiameter
crystal cristallus
crystalline lens *see* **glacialis**
cubit cubitum
to cull out eligere

curvature/curve arcualitas, arcuitas, curvitas, deviatio, incurvatio, spericitas
to curve incurvare
to curve away tendere
curved arcualis, curvus, rotundus
custom consuetudo
customary assuetus
to cut abscidere, distinguere, secare
cylindrical columpnatus

to damage corrumpere
dark (adj.) obscurus, tenebrosus
dark/darkening/darkness fuscus, nigredo, obscuratio, obscuritas, obumbratio, tenebra
to darken obscurare
darkened area tenebrositas
day dies
dazzle/dazzling light scintillatio
to deal with incedere
dearth paucitas
to deceive decipere
deception deceptio
decipherable intelligibilis
to decorate depingere
decrease in distance appropinquatio
decrease in size/diminution diminutio
to decrease/diminish/lessen diminuere
to deduce arguere, sillogizare
deduction/deductive process/reasoning argumentatio, argumentum, ratio, sillogismus
to deem putare, reputare
deep fortis, profundus
deficiency/insufficiency debilitas, parvitas
to define appropriare, determinare, distinguere, figurare, verificare
defining proprius
defining feature significatio, signum
definite certificatus, indubitabilis
definition diffinitio
to deform deformare
degeneration corruptio
deliberation consideratio
delicateness tenuitas
to delight in delectare
to delineate figurare
to demand indigere
to demarcate/mark off/out distinguere, secare

- demonstration** demonstratio
dense spissus
density spissitudo
to depend/depend upon premittere, sustentare
dependence sustentatio
to depict pingere
depiction pictura, ymago
to depress deprimere
depressed profundus
depression depressio, profunditas
depth profunditas, profundum
to derive adquirere, componere
to describe/describe before/earlier asserere, distinguere, figurare, narrare, predicare, signare
design lineatio, pictura
to design pingere, preparare
to designate ordinare
designed picturatus
to destroy destruere
destruction destructio
to detail dividere
determinant causa
determinate/determined certificabilis, certificatus, notus
determinate perception certitudo
determinateness certificatio
determination distinctio, verificatio
to determine/determine accurately/correctly/precisely affirmare, certificare, determinare, distinguere, verificare
to determine size mensurare
to develop contingere
development crementum, crescentia, distinctio
diagonal/diameter dyiameter
to differ diversare, diversificare
difference differentia, dissimilitudo, diversitas, excessus, excrementum, inequalitas
different dissimilis, diversus
to differentiate distinguere, diversificare
differentiating faculty distinctio
differentiation distinctio
digit digitus
to dim eclipsare
dimension dimensio
direct/directly facing directus, rectus, verticalis
direct contact applicatio
direct focus directio
to direct dirigere, ponere

directed conversus
direction verticatio
directly facing disposition directio
directness rectitudo
disagreement diversitas
to disappear aufere, latere, recedere
disappearance destructio, latentia, latitatio, occultatio
to discern comprehendere, distinguere
discernment discretio, distinctio
discontinuity discretio, separatio
discrepancy diversitas
discrete discretus
discretely singillatim
to discuss narrare, predicere
discussion divisio, sermo
disease egritudo, infirmitas
to disfigure deformare, deturpare
disfigurement deformitas, turpitude
to disjoin/divide/subdivide distinguere, dividere
disjoined discretus
disjunction distinctio, divisio, separatio
disk rota
disparate remotus
to displace aufere, declinare
displacement obliquatio
disposition dispositio, preparatio, situs, status
disproportionate assimetrus
to disrupt cassare, ledere
disruption destructio, lesio
dissimilar dissimilis
dissimilarity dissimilitudo, diversitas
distance distantia, elongatio, longitudo, remotio
distant remotus
distinct certificatus
distinction differentia, distinctio, divisio
distinctness certificatio
to distinguish distinguere
distinguishing notabilis
distorted monstruosus
to distress angustiare
disturbed state immoderantia
divergence pyramidalitas, pyramidatio
to divert obliquare
dividing communis
division distinctio, divisio
to do facere

to do without vitare
doubled duplex
to draw extrahere, scribere, signare
to draw away extrahere
to draw upon aggregare
drawing pictura
to drop/drop (a line) elevare, exire, extendere
dropped to erectus
dry siccus
dryness siccitas
dull turbidus
dullness debilitas
duration duratio
dusky obscurus
dust pulvis
to dwindle carere
dye tinctura

each/every thing singulus
earth terra
ease of motion velocitas
easily moved levis
edge extremitas, finis, latitudo, terminus
effect immutatio, operatio, passio
efficient temperatus
effort labor
egg white albumen
to elevate/lift/raise elevare
elevation preminetia, prominentia
to emanate emittere, exire
to emerge crescere
to emit exire
to encircle circulari
to enclose/form an enclosure continere, distinguere
to encompass continere, respicere
to encounter invenire
end/endpoint extremitas, finis
to endow dare
engraving sculptura
to enlarge ampliare, extendere
to entail indigere
to enter intrare
entertainer ioculator
to enumerate determinare, enumerare, narrare
to envelop continere

equal consimilis
equality equalitas, equivalentia
equivalent consimilis
to erect elevare, erigere
erroneous erroneus
error error
to escape/escape notice latere, preterire
essential essentialis
essential nature quiditas
estimate/estimation estimatio
to estimate existimare
etching incisura, sculptura
to evaluate considerare, intueri
evaluation consideratio, inductio
evening vespertinus
evenness directio, ordinatio
every universum
evidence significatio
evident manifestus, planus, verus
exact verus
to examine aspicere, considerare, inducere, inspicere, intueri
examination consideratio, inspectio, intuitus
example/instance dispositio, exemplum, verbum
to exceed addere, egredi, excedere
exceeding additio
to except deficere
excess augmentum, excessus, excrementum, superfluitas, superhabundantia
excessive extraneus, superfluus
excessiveness extraneitas
to exert uti
to exist preesse
to exist along with admiscere
to expand amplificare, dilatare
expanded/expanding pyramidalis
expanding amplificatio
experience experimentatio
to experience invenire
experiment/experimental confirmation/experimentation consideratio, experimentatio, experimentum
experimenter experimentator
to explain determinare
to explain before/earlier predicere
explanation divisio, expositio
to expose/expound exponere
to extend augmentare, continuare, elongare, exire, extendere, penetrare,

procedere
to extend between interiacere
to extend over superponere
extension continuatio, extensio
extent amplitudo, capacitas, longitudo, magnitudo, quantitas
external influence extrinsecus
to extinguish destruere
extramission exitus
extreme (adj.) magnus
extreme/extremity extremitas, terminus
eye/eyeball oculus, pupilla, visus
eyebrow supercilium
eyelash cilium
eyelid palpebra
eyesocket/socket concavitas, concavum ossis, os

fabric pannus
face facies
to face/face directly opponere
to face obliquely obliquare
facing facialis, oppositus, rectus
facing disposition/orientation/position oppositio
fact dispositio
factor radix
faculty virtus
faculty of discrimination distinctio, virtus distinctiva
faculty of sight visus
fading recessus
to fail to meet carere
faint debilis, tenuis
faintness debilitas
to fall cadere, incidere, transire
to fall outside egredi, pertransire
to fall short recedere
to fall to efficere
to fall under (a subdivision) dividere
falling outside/outside of egressio, evagatio
false falsus
familiar assuetus
familiarity consuetudo
far/far away longe, remotus
fast/quick/swift festinus, velox
to fasten applicare
fat pinguedo
to fatigue fatigare

fatness grossitudo
feature intentio, nota, pars, res
to feel pati, sentire
few paucus
fiber filum
fiery igneus
figure figura
to fill/fill by expansion extendere, implere
final judgment conclusio
final perception conclusio
final sensor ultimus/ultimum sentiens, ultimus sensor
to find invenire
fine minutus, subtilis, tenuis
fineness tenuitas
finger digitus
to finish complere
finite finitus
fire ignis
firefly aluerach, noctiluca
firm retentiva
firmness retentio
first glance aspectus
first moment principium
to fit into intrare
fitting together applicatio
to fix/fix upon figere, inspicere
fixed immobilis
flame flamma
flank latus
flaring/funneling outward declinatio, piramidalitas, piramidatio
flat planus
flatness planities, planitudo, simitas
flattening compressio
flex/flexing declinatio, giratio, incurvatio
to flex declinare, girare
to flood ascendere
flooding of light splendor
flow fluxus
to flow/flow by fluere, transire
flower flos
fluid fluxibilis, humidus
fluidity tenuitas
fly musca
focus intuitio, oppositio, visus
to focus/focus upon certificare, dirigere, figere, inspicere, intendere, intueri
foggy turbidus

to follow incedere, peragere, percurrere
forehead frons
forgetting oblivio
form apparentia, forma, genus
to form componere, consolidare, continere, contingere, efficere, facere, figurare, formare
to form a syllogism sillogizare
to form a whole congregare
fortuitous casualis
freckled lentiginosus
frequency frequentatio
front facies, pectus
to fulfill facere
function utilitas
to function accordingly appropriare
funnel rameh
funnel shaped pyramidalis

to gain adquirere
gap distinctio, fissura, spatium, vacuitas
garden ortus, viridarium
gauge mensura
to gauge considerare, existimare, mensurare
gauging consideratio
gaze pupilla
general generalis, universalis
general nature universalitas
general type species
generally/in general/on the whole generaliter, universaliter
to generate generare
to get invenire, recipere
to get farther away elongare
to get larger intendere
glacialis (crystalline lens) glacialis
glance inspectio
to glance at/glimpse inspicere, intueri
glass (adj.) vitreus
glass cristallus, vas, vitrum
glimpse aspectus
to glitter micare
to go through an analytic procedure dividere
to go through steps iterare
to go unseen latere
goblet ciphus
goodness bonitas

grape uva
grasp adquisitio
to grasp adquiescere, adquirere, comprehendere, deprehendere, intellegere
to grasp with certainty certificare
grassy segetalis
gravity (of demeanor) gravitas
great magnus
greatness maioritas
green viridis, viror
greening viridificatio
greenness viriditas
grey glaucus
to grind to pieces frustare
ground/ground level facies terre, terra
grove nemus
to grow crescere

habit consuetudo
hair capillus
half subduplus
hand manus
to happen contingere, evenire
to hark back revertere
to harm/hurt dolere, ledere, nocere
harmful residue nocumentum
harmony consonoritas
to have/possess habere
to have to indigere
having a modicum modicum
having reached perventio, perventus
having texture asperus
having the same circumference ysoperimetrus
having to indigentia
haziness spissitudo
hazy spissus
head caput
health salus, sanitas
hearing auditus
heavens celum
height elevatio, erectio, preminentia
hidden occultus
to hide cooperire, occultare
hiding occultatio
to hinder impedire
to hold custodire

- to hold in place** retinere
to hold snugly includere
hollow (adj.) obticus, profundus
hollow concavitas, concavum, vacuitas
horn cornu
horse equus
human/human being homo
humor humor
- ice** glacies
identical consimilis, similis
identity similitudo, ydemptitas
illogical falsus
to illuminate/shine upon ascendere, illuminare, oriri
illuminated luminosus
illumination illuminatio, lumen
illusion deceptio
imaginary intellectualis, ymaginabilis
imagination ymaginatio
to imagine ymaginari
imagining ymaginatio
immobile immobilis, immotus
immobility quies
impairment nocumentum
to impede prohibere
imperceptibility/insensibility/invisibility occultatio
imperceptible imperceptibilis
to implant/plant figere
implication signatio, significatio
to impress figere, figurare, imprimere, infigere, instituere, signare
impression figuratio, intentio, intuitio
to impute existimare, iudicare
in tight order punctatim
inclination/slant declinatio, obliquatio
to incline/be inclined/incline toward appropinquare, declinare, inclinare, obliquare
inclined/slanted/sloping declinabilis, obliquus
to include continere
inconclusive incertus
inconspicuous occultus
increase augmentatio, excrementum
to increase addere, augmentare, crescere
indefinite/indistinct dubitabilis
indefiniteness latentia
indentation profundatio, profunditas

- indented** profundus
indeterminate incertus
indeterminateness incertitudo
to indicate significare
indication significatio, signum
indistinct perception incertitudo
individual (adj.) individualis, individuus, particularis, singularis, singulus
individual individuum
individual nature individualitas, individuitas, individuum
individuality distinctio
to individuate distinguere, separare, signare
to induce inducere, ingerere, invehere
induction inductio
inequality inequalitas
inferential process ratio
infinite infinitus
infinity infinitum
infirmity infirmitas
injury occasio
inner/inner surface anterieus, interius, intrinsecus
inordinate evagatus, extraneus, immoderatus
inordinateness immoderamen, immoderantia, immoderatio, superfluitas
inside interius
to inspect intueri
inspection/visual inspection intuitio
instance dispositio
instant hora, instans
instrument instrumentum
intellect intellectus
intellectual grasp notitia
to intend intendere
intense fortis, purus
to intensify intendere, vigorescere
intensity fortitudo
to interfere impedire
interference impedimentum
interior interius
to interpose/be interposed intercidere, interponere
to interpret concludere
to interrupt abscidere, abscindere, secare
interruption abscisio
to intersect abscidere, abscindere, concurrere, coniungere, secare
to intersect obliquely declinare
intersection/intersection-point concursus, coniunctio, sectio
interstice foramen
interval distantia, spatium

to intervene/intervene between intercidere, interiacere, interponere, mediare

intervening medius

to investigate considerare, inquirere

investigation consideratio, inductio

invisible invisibilis, occultus

invisibility absconsio, latentia, occultatio

inward projection fundatio, profundatio

issue questio

to issue exire

jar doleum

to join concurrere, coniungere, consolidare, continuare, copulare

joining aggregatio, coniunctio

joy alacritas

judge/one who judges iudex

to judge distinguere, existimare, iudicare, putare, reputare

judgment argumentatio, estimatio, iudicium, ratio, reputatio

juncture concursus, divisio

to jut out eminere

juxtaposition compositio, congregatio, coniugatio

to keep conservare, custodire, retinere

to keep moist humefacere

to keep on durare

to keep together congregare

kind/like/sort genus, modus, ordo, qualitas, species

to know cognoscere, intellegere

knowledge cognitio, scientia

known notus

lack privatio

to lack carere

lamp lampas

large magnus, remotus

later posterius

laughter risus

to lay out/list distinguere, enumerare

to lay snugly applicare

to lead/lead to efficere, facere, inducere

leaf folium

to leak out resudare

to leave recedere

legible legibilis
length amplitudo, extensio, longitudo, longum
lentic lenticula
letter littera
to lie existere
to lie at continere
to lie beside/to the side of declinare
to lie between interiacere
to lie far from elongare
to lie in front of antecedere
to lie in line with opponere
to lie near propinquare
to lie opposite/directly opposite opponere
to lie upon cadere
to lift away aufere
ligature continuatio
light lumen, lux
to light illuminare
lightness levitas
limit finis, meta, terminus
line linea, lineatio, verticatio
line of radiation verticatio
line-of-sight radius, verticatio, visus
to line up ordinare
lineament lineatio
to linger remanere
to link continuare
lip labium
to list numerare
little paucus
location locus, situs
locomotion motus localis
to lodge infigere
logic ratio
long longus, remotus
look aspectus
to look/look at aspicere, considerare, inspicere, intueri, videre
to look as apparere
loosely textured rarus
to lose discernibility/visibility latere
to lower demittere
luminous lucidus, luminosus
luxuriant lotus
lying apart/away/beyond remotus
lying at the front/in front of antecedens, anterior
lying between interpositio
lying in direct line with directus

magnitude magnitudo, mensura, quantitas
to maintain custodire, durare
to maintain/mention before/earlier predicere
major universalis
to make/make up componere, facere
to make certain preservare
to make clear/evident/manifest/perceptible aperire, apparere, manifestare
to make determinate/sure certificare
to make disappear occultare
to make into efficere
to make more intense augmentare
to make out comprehendere
to make proportionate proportionare
to make vanish abicere, aufere
making out comprehensio
man/mankind homo
manner/means modus, qualitas
mark nota
marked notabilis
to mask abscondere
mass corporeitas
matching consimilis
mathematician mathematicus
mathematics mathesis
matter res
to mean intendere
meaning intentio
measure/measurement mensura, mensuratio
to measure mensurare
to mediate mediare
medical medicinalis
medical science ars medicinalis, medicina
to meet adunare, aggregare, cadere, concurrere, coniungere, existere
to meet as a whole congregare
member membrum
membrane tela
memory memoria
mere visual impression fantasia
middle/midpoint medius
Milky Way galaxia
mind mens
to mingle/mix admiscere
mingling/mixing admixtio, mixtura
minimal modicus
minute minutus

- mirror** speculum
misty pruinus
to mitigate temperare
mixed mixtus
mode modus
moderate mediocris, moderatus, modicus, temperatus
moderation moderatio, temperamentum, temperantia
moist humidus
moistness/moisture humiditas
moment hora
moon luna
morning matutinus
moth papilio
motion/movement motio, motus
motionless immotus
mountain mons
mouth os
to move movere, mutare
to move away elongare, incedere
much magnus
muddy turbidus
mule mulus
muscle lacertus
mustard sinapis
- naked** spoliatus
narrow modicus, strictus, subtilis
to narrow constringere, strictificare
narrowing angustum
narrowness strictura, subtilitas
natural naturalis, proprius
natural philosopher naturalis
nature/nature of a thing diffinitio, genus, natura, proprietas, qualitas
nearness appropinquatio
necessity/need indigentia
neck collum
to need indigere
to need only sufficere
needle acus
nerve nervus
night nox
normal mediocris
nose nasus
not the same diversus
not to apprehend/determine/know/notice ignorare

not to be exposed to carere
not to stand destruere
notch concavitas
to notice aspicere
noticeable manifestus, notabilis
notion intentio, notitia
number numerus

object res, visibile
oblique/obliquely facing obliquus
obliquely facing disposition obliquatio
obliquity declinatio, obliquatio
oblong longus, oblongus
to obscure occultare
to observe videre
observer aspiciens, inspiciens
to obstruct cooperire, opilare
obstruction impedimentum, opilatio
to obviate excludere
obvious manifestus, planus
obviousness manifestatio
to occlude cooperire, occultare
occluded occultus
to occupy statuere
to occur cadere, contingere, evenire
occurrence perventus
of two kinds bipartitus
opacity densitas, soliditas, spissitudo
opaque densus, obscurus, solidus, spissus
to open aperire
to open into pertransire
opening apertio, foramen
opposite contrarius, econversus, oppositus
optic chiasma *see* **common nerve**
order ordinatio
to order/order properly ordinare
ordinary assuetus
ordinate moderatus, temperatus
ordinateness moderamen
organ membrum, res
orientation dispositio
origin principium
to originate exire, oriri
orthogonal perpendicularis, rectus
orthogonally ortogonaliter

- to oscillate** vadere
other extraneus
outer/outside exterius, manifestus
outer edge extremitas, terminus
outer surface exterior, manifestum
outline lineatio
to outshine eclipsare
outward projection preminentia, prominentia
oval oblongus
to overcome vincere
to overlap penetrare
overshadowing occultatio
to overwhelm vincere
own proprius
- pain** dolor
painful dolorosus
to paint depingere, inficere, intingere, pingere
painting pictura
paired duplus
palm's-breadth palma
parallel equidistans
parchment pargamentum
part pars
particular particularis, proprius, singulus
particular form forma particularis
to pass beyond/by/out of/over/through exire, intrare, pertransire, transire
passage extensio, penetratio, pertransitus, transitus
passing/passing over motus, pertransitus
passing beyond recessus
passing through pertransitus, transitus
passion passio
path verticatio
pattern ordinatio
peak cacumen
pear tree pirus
pearl margarita
peg individuum
to penetrate penetrare
to perceive comprehendere, cognoscere, percipere
to perceive accurately/clearly/distinctly/precisely certificare, comprehendere, distinguere, verificare
perceived apparens
perceived with accuracy/precision certificatus
perceiving comprehensio, perceptio

- perceptible** comprehensibilis, perceptibilis
perception/visual perception apparentia, comprehensio, intuitio, perceptio, visio
permanent fixus
perpendicular orthogonal, perpendicular
to persist existere, remanere
person homo
perspicacity discretio
pertinent proprius
petal folium
phenomenon dispositio, res
physical realm natura
picture pictura
pistachio fisticus
place locus
to place/position/put applicare, disponere, ponere, preponere, statuere
to place against continuare
to place at/behind/upon superponere
to place before opponere
to place between interponere, opponere
placement applicatio
plain planum
plane planus, superficies
planet stella erratica
plank tabula
plant herba
plaque tabula
point punctum
point (of discussion) sermo
to point out narrare, predicere
pointed punctatus
polish tersitudo
polished politus, tersus
polygonal lateratus
portion pars
position dispositio, status
to position over/up to superponere
posterior posterior
to pour ponere
power virtus, vis
power of seeing virtus visibilis
to precede precedere
to preclude excludere
premise propositio
to prepare preparare
to present evenire, redere

to preserve conservare
presupposition antecedens
to prevent negare, prohibere
previous antecedens
principle propositio
procedure/logical procedure argumentum, operatio, ratio
to proceed (in argument) arguere
process of visual scrutiny/visual scrutiny intuitio, intuitus
to produce efficere, facere, generare, inducere, ingerere, invehere, procreare, redere
producer causa
to project exire, procedere
to project upon incidere
to prolong prolongare
prominence/protrusion prominentia
prominent prominens
to promise promittere
to prompt affirmare, inducere
to propagate extendere
proper proprius, verus
property intentio, proprietas, res
propinquity propinquitas
proponent ponens
proportion dispositio, proportio
proportional/proportionate proportionalis
proportionality/proportionateness proportionalitas
proposition propositio
to protect conservare
protruding prominens
protrusion eminentia
to provide the means/means of recognition appropriare, mediare
providence bonitas, preparatio
proximity appropinquatio
pure mundus, purus
to put together componere, congregare

quadrilateral quadratus
quadruped quadrupes
to qualify appropriare
quality proprietas, qualitas, res
quantity quantitas
question questio

radial breaking reflexio

radial line linea radialis, verticatio
radial link verticatio
to radiate descendere, dirigere, exire, extendere
radius medietas dyametri, semidyameter
raised prominens
range/range of moderation latitudo, temperamentum, temperantia
to range respicere
rare rarus
ratio proportio
ray radialis, radius, verticatio
to reach evenire, extendere, invenire, pervenire
to reach a conclusion distinguere, intellegere
to reach to cadere
to read legere
real verus
reality veritas
to realize cognoscere, complere, evenire, intellegere, percipere, scire
rear posterior
reason/reasoning causa, ratio
to recall/remember meminire, memorare, rememorare
to recede elongare, recedere
receding elongatio, recessus
to receive recipere
reception receptio
recognition cognitio, scientia
to recognize cognoscere, iudicare, precognoscere
to recount narrare
rectangular oblongus
rectilinear rectus
rectilinearity rectitudo
to recur iterare, redere, revertere
recurrence/reiteration/repetition frequentatio, iteratio
red rubeus
redness rubedo, rubor
to reduce to dividere
to refer to vocare
to reflect reflectere
reflection conversio, reflexio
to refocus recedere
to refract obliquare, reflectere
refraction obliquatio, reflexio
regard respectus
to reinforce invalescere
to reject dimittere
to relate appropriare, proportionare
relation/relationship proportio, relatio

to rely upon indigere
to remain/remain fixed existere, quiescere, remanere
remaining the same immotus
remembering/remembrance memoratio, rememoratio
remote remotus
remoteness remotio
removal ablatio, recessus
to remove abstulere, aufere, destruere, elongare, separare
to render ingerere, redere
to render imperceptible/inapparent/invisible abscondere, occultare
to render ugly deformare
to renew renovare
to repeat/repeat steps frequentare, iterare
repeated experience frequentatia
to replace/reposition revertere
to represent exprimere
representation expressio
to require exigere, indigere
resemblance assimilatio, similitudo
to resemble assimilare
reserve taciturnitas
respect dispositio, proportio, respectus
to respond respondere
rest quies
to restore reducere, revertere
result dispositio
to retain habere
to return/return to redere, reducere, revertere
to reveal exponere, manifestare
revealed manifestus
reversal conversio
reversed conversus
to revert back revertere
revolution revolutio
to revolve volvere
right rectus
rigidity retentio
river flumen
riverbank littus
robust fortis
roiled turbidus
room domus
rose roseus
rose-red roseaceus, roseus
rotary/rotating circularis
rotation giratio, revolutio

- rough** asperus
roughness asperitas, attritio
round/rounded circularis, rotundus
roundness rotunditas
routine assuetus
row ordo
- sadness** tristitia
same communis, consimilis
sameness ydemptitas
to say before/earlier predicere
scan/careful scan intuitio, intuitus
to scan aspicere, movere, transire
scanning/scanning process motus
scarce paucus
sclera consolidativa
screen coopertorium
to screen cooperire
to scrutinize considerare, intueri
scrutiny/close scrutiny inductio, intuitio, intuitus, iudicium
section pars, sermo
to see aspicere, considerare, inspicere, invenire, percipere, videre
seed granum
to seek quesere
to seem apparere
seen apparens
select proprius
sense sensus, sentiens
to sense sentire
sensing sentiens
sensing/sensitive agent/organ sentiens
sensitive sentiens
sensitive faculty/power virtus sensibilis, virtus sensitiva
sensitivity sensus
sensor sentiens
separate remotus, singularis
to separate disiungere, distinguere, dividere, separare
separation discretio, distantia, distinctio, divisio, remotio, separatio
serous tenuis
to set aside abstulere
to set before/forth proponere
to set up disponere, statuere
to shade obumbrare
shading/shadow umbra
shadowing effect diminutio

shadowy tenebrosus, umbrosus
shagginess villositas
shape figura, forma, ordinatio
sharply different remotus
sheer rarus, subtilis
sheet folium
to shield cooperire
shielding body coopertorium
to shift/shift away alterare, aufere, declinare, mutare, recedere, transfere
to shift back revertere
to shine/shine over/through/upon apparere, cadere, descendere, exire, extendere, fulgere, incidere, oriri, pertransire, scintillare
to shine brightly/brilliantly scintillare
shortfall defectus
to show/show forth/through/up apparere, demonstrare, determinare, egredi, erumpere, manifestare, ostendere, predicere, prestare, significare
showing apparens
to shrink constringere
side dimensio, facies, finis, latitudo, latus, terminus
sight aspectus, visio, visus
sign signum
significant/sizeable/substantial magnus
silhouette ymago
similar consimilis, similis
similarity assimilatio, consimilitudo, similitudo
to simulate assimilare
single singularis, singulus
situation dispositio, intentio, situs, status
size magnitudo, maioritas, mensura, quantitas
skew diversitas
sky celum
sky-blue celestis
to slant declinare
slenderness/slimness gracilitas
slight modicus, parvus
slim gracilis
slope obliquatio
slow subtilis
slowly modice
slowness tarditas
small/tiny minutus, modicus, parvulus, parvus, subtilis
small/tiny feature/part minutia, particula
smallness diminutio, minoritas, parvitas
smoke fumus
smooth lenis, planus, tersus
smoothness lenitas, planities

to snatch away subripere
snow nix
solid densus
someone homo
something harmful nocumentum
somewhat/to some extent modicus
soot fuligo
soul anima, animus
sound vox
soundness sanitas
source causa, principium
space spatium, vacuitas
to span respicere
spatial disposition situs
species species
specific particularis, proprius, singulus
to specify determinare, distinguere
speech sermo
speed/quickness/swiftness festinatio, velocitas
sphere sphaera
spherical sphaericus
spider web aranea
to spin/spin around circumgirare, girare, volvere
spirit spiritus
split divisio
to split dividere
spot macula, particula, punctum
square quadrangulus, quadratio, quadratus
squint strabo
to squint adunare
standing upright erectus
star stella
stare aspectus
to stare/stare at aspicere, inspicere, intueri
state dispositio
stationary immotus
to stay remanere
stick baculum, lignum
stone lapis
to stop cessare, quiescere
straight rectus
straight outward direction oppositio
straight-line connection utilitas
straightness rectitudo
to stream from/into descendere, exire
strength fortitudo, vigor

to strike cadere, incidere, percutere
strip scrotula
strong fortis
structure compositio
subject res
subject to debate dubitabilis
subject to deception fallibilis
to subsume collocare
to subtend cadere, continere, respicere, subtendere
subtle subtilis
to suffer dolere, habere, pati
to suffer/undergo an effect pati
suffering an effect receptio
to suffice sufficere
to suit convenire
to summarize aggregare, coacervare
sun sol
superfluous superfluous
to superimpose superponere
to suppose ponere, premittere, putare, reputare, ymaginari
surface facies, superficies
to surround circumdare, continere, continuare
syllogism syllogismus

to take recipere, sumere
to take away divertere
to take care preservare, servare
to take for/to take to be credere, putare, reputare
to take into account cadere, inducere
to take place accordingly appropriare
to teach instruere
tear/tear duct lacrima
tenuous minutus
term vocabulum
term of comparison respectus
terminal terminalis
test probatio
to test experimentare
to testify testari
texture asperitas, textura
that which is responsible causa
that within which something inheres substantia
thick corpulentus, grossus, spissus
thickness grossitudo, spissitudo
thin rarus, strictus, subtilis, tenuis

thing individuum, res
to think putare, reputare
thinness tenuitas
thought cognitio
thread filum
threshold mediocritas
time dispositio, hora, tempus
to the side obliquus
to tinge/tint colorare, intingere, tingere
to tire fatigare
top trocus
touch tactus
to touch applicare, concurrere, contingere, tangere
to touch on incedere
toughness fortitudo
tower turris
tracing sculptura
to transform alterare, facere, immutare
transformation mutatio
transmission reditio
to transmit defere, redere
transparency diafonitas, raritas
transparent diafonus, rarus, translucens
to traverse pertransire
tree arbor
triangle triangulus
true verus
true reckoning rectitudo
truth veritas
to try experimentare, intendere, probare
tunic tela, tunica
to turn aside declinare
twilight crepusculum
type varietas

ugliness deformitas, feditas, turpitude
ugly fedus, turpis
ultimate (noun) finis
unappealing turpis
unchanged immotus
unconscious occultus
to understand intellegere
understanding intellectus
unequal inequalis
unfamiliar extraneus

uniform consimilis
uniform blend unitas
uniformity consimilitudo, equalitas
union adunatio, congregatio
to unite adunare, unire
unity unitas
universal universalis
universal form forma universalis
upright posture/stance erectio
upward anterior
to use uti
useless otiosus
utensil instrumentum
utter immensus
uvea uvea

vanishing debilitas
variable/various/varying diversus
variant transmutabilis
variation diversitas
to vary alterare, diversare, diversificare, diversitare
vegetation viridale
veracity veritas
to verify affirmare, verificare
vertex caput, conus
vessel vas
vicinity circuitus
view inspectio, visio
to view inspicere, videre
viewer aspiciens, inspiciens
viewpoint visus
vigorous velox
visible apparens, visibilis
visible characteristic/feature/property res visibilis
visible object res, res visa, res visibilis, visibile, visum
vision visio, visus
visual pyramidalis, visibilis
visual axis axis, axis radialis
visual cone pyramis radialis
visual faculty visum
visual perception visio
visual process visio
visual spirit spiritus visibilis
vitreous/vitreous humor vitreus

vividness fortitudo

wall paries

water aqua

water cress nasturtium

wax cera

way dispositio, modus, qualitas

weak debilis

weakening/weakness debilitas

to wear off aufere

weeping fletus

wellspring incrementum, principium

what is seen visum

wheat triticum

wheel rota

white albus

whiteness albedo

width amplitudo, latitudo

wild marjoram origanum

winding tortuosus

window fenestra, foramen

wine vinum

wine-red vinosus

to wipe away abstergere

wood lignum

wooden ligneus

wool lana

woolen laneus

word dictio, lectio, pars, verbum

wrinkle ruga

to write scribere

writer scriptor

writing scriptura

yellow citrinus

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GENERAL INDEX

- abstraction/abstractive cognition** lxxxix, xcvi, xcvi, ciii, cxlix (n. 323)
- abu qalamun** 396 (n. 16), 554 (n. 176) *See also* **alburalmun, amilialmon, chameleon** *below*. *See also* **alburalmun, amilialmon** *in Latin-English Index*.
- accident/accidental property** lxxxvii, lxxxviii, 537 (n. 32), 557 (n. 200).
- accidental light** cxxxiv (nn. 156, 159), 541 (n. 68) *See also* **lumen** *below and in Latin-English Index*.
- accurate visual determination** lxxviii *See also* **certificatio, certitudo** *in Latin-English Index*.
- act/activity/actuality** xviii, xxvi, xxvii, xxxvi, lv, lxiv, lxxxv, xc, xcvi, cix, cx, cxv, cxxvii (n. 67), cxxviii (n. 87), cxxix (n. 100), cxxxi (n. 130), cxxxii (n. 137), cxliii (n. 263), cxlvii (n. 309), cxlviii (n. 310), clxxv, 404 (n. 58), 408 (n. 85), 409 (n. 90), 538 (n. 42), 540 (n. 60), 557 (n. 206)
- active/agent intellect** cxxxi (n. 130), cxlvii (n. 309), cxlviii (n. 310)
- active power** lxxxv, cxliii (n. 263)
- aesthetic harmony/proportionality** lxxvii, cxii, 555 (nn. 178, 179, 181) *See also* **consonoritas, proportionalitas** *in Latin-English Index*.
- to affect/be affected sensibly** xxvii, lv, lvi, lxiv, cxiii, cxxx (n. 108), cxxxv (n. 165), 395 (n. 5), 398 (n. 26) *See also* **immutare, operari, pati, subiacere** *in Latin-English Index*.
- afterimage** lvi, cxxv (n. 165), 395 (nn. 4, 5), 411 (n. 108),
- Ahmad ibn Isa** l, lii, cxxxiii (nn. 152, 153), 407 (n. 78), 409 (n. 89)
- air** xxvi, xl, xli, xliv, xlviii, liv, lv, lvii, lxiii, lxxiii, lxxvii, ci, cii, cxxx (nn. 114, 115), cxxxiv (n. 162), cxlix (n. 325), 395 (nn. 2, 7), 403 (n. 54), 404 (n. 59), 408 (n. 81), 542 (n. 75), 553 (n. 163), 637 (n. 55), 639 (nn. 81, 82) *See also* **aer** *in Latin-English Index*.
- aisthesis koine** xxvii *See also* **common sense** *below*.
- Alberti, Leon Battista** cvii, cviii, cl (nn. 335, 336), cli (nn. 338, 340, 348), clii (n. 356)
- Albertus Magnus** cxlv (n. 281)
- albugineous/albuminoid/aqueous humor** xxxix, lviii, cxxx (n. 107), cxxxii (n. 139), cxxv (n. 170), 399 (nn. 30, 31), 403 (n. 53), 406 (n. 68) *See also* **albugineus** *in Latin-English Index*.
- alburalmun** 396 (n. 16), 554 (n. 176) *See also* **abu qalamun** *above and amilialmon, chameleon* *below*. *See also* **alburalmun, amilialmon** *in Latin-English Index*.
- Alhazen's Problem** cxxii (n. 21), cxlv (n. 280)
- to alter** xxvii, xxxix, xli, cxxx (n. 114) *See also* **alterare** *in Latin-English Index*.
- alteration** xxxix, xli, cxxviii (n. 87), cxxix (n. 89), cxxx (n. 114), 542 (n. 75) *See also* **immutatio** *in Latin-English Index*.

aluerach See **firefly** *below*.

amilialmon 554 (n. 176) See also **abu qalamun**, **alburalmon** *above* and **chameleon** *below*. See also **alburalmon**, **amilialmon** in *Latin-English Index*.

amphiblestroeides xxxvii See also **retina** *below*.

anatomist xxv See also **anathomicus** in *Latin-English Index*.

Anaxagoras 410 (n. 97)

angle See **visual angle** *below*.

animal xlvi, lxxxviii, cxxxix (n. 216) See also **animal** in *Latin-English Index*.

animal pneuma/spirit xlviii, 400 (n. 32) See also *pneuma psychikon* *below*.

Anthemius of Tralles I, cxxxiii (n. 147)

apperception xxviii, lxxii, lxxx, lxxxvii

to apprehend / to grasp perceptually or intellectually xxvii, xxviii, xxix, xxxi, xxxiii, lxxv, xciii, xcvi, xcix, cii, ciii, cviii, cxxxi (n. 130), cxxviii (n. 87), 409 (nn. 88, 90), 537 (n. 31), 539 (nn. 50, 51), 541 (n. 64), 556 (n. 194) **adquiescere, adquirere, adquisitio, certificare, cognoscere, comprehendere, deprehendere, intellegere**

aqueous humor See **albugineous humor** *above*.

Aquinas See **Thomas Aquinas** *below*.

aranea lviii, cxxxv (170), 398 (n. 30), 399 (n. 31), 400 (n. 34), 412 (n. 125) See also **aranea** in *Latin-English Index*

Aristotle/Aristotelian xvi, xxv-xxix, xxxi, xxxvii, xl, xli, xliii-xlvii, lvi, lvii, lxii, lxxii, lxxviii-lxxx, lxxxv, lxxxvii, lxxxix, xciv, xcix, c, cx, cxii, cxx, cxxvii (nn. 65-67, 69, 70, 72, 73), cxxviii (n. 87), cxxx (n. 114), cxxxi (n. 127), cxxxii (n. 144), cxxxv (n. 167), cxxxix (nn. 216, 220, 221), cxli (nn. 240, 241), cxlii (nn. 243, 252), cxliv (n. 267), cxlv (n. 281), cxlvi (n. 296), cxlvii (nn. 297, 309), 396 (n. 17), 402 (n. 48), 408 (n. 81), 409 (n. 90), 410 (nn. 95, 98), 412 (n. 121), 414 (n. 142), 538 (n. 42), 539 (nn. 45, 50), 540 (nn. 55, 56, 60), 542 (n. 75), 543 (n. 80), 546 (n. 104), 553 (n. 157), 556 (nn. 193, 194), 557 (n. 203)

artistic naturalism civ, cv, cix, cx, cl (n. 328)

to assimilate an effect xxvi, xxvii, xli, cxxxviii (n. 211), 545 (n. 95) See also **assimilare, assimilare, communicare, confiteri** in *Latin-English Index*.

assimilation lxx, lxxiii, cx, cxxxviii (n. 210), 538 (n. 40) See also **assimilatio, collatio, communicatio** in *Latin-English Index*.

astrological influences xliii (n. 262)

atomism/atomists cxxvii (n. 66), cxxviii (n. 88), cxlviii (n. 313), 397 (n. 17)

Averroes lxxxi, cxxxi (n. 130), cxxxiii (n. 144), cxlii (n. 243), cxlvii (n. 309)

Avicenna xlv, lii, lxxxi, lxxxvi, lxxxviii, cxxxi (nn. 130, 131), cxxxiii (n. 144), cxli (n. 241), cxlii (n. 243), cxliv (nn. 267, 270, 277), cxlvii (n. 309), 395 (n. 2), 402 (n. 50)

axis See **common axis, visual axis** *below*.

Azhar Mosque xv

Bacon, Roger xi, xx, lvi, lxxxi-lxxxiii, lxxxv-xci, xciv-xcvii, cix, cxiii, cxvi, cxxiii (n. 33), cxliii (nn. 261, 262, 264), cxliv (nn. 265-268, 275), cxlvi (n. 287), 295 (n. 2), 397 (n. 20), 400 (n. 34), 408 (n. 85), 534 (n. 19), 540 (n. 55), 542 (n. 75)

Baghdad xlv, xlvii, cxx (n. 6), cxxxii (n. 135)

- Bartholomeus Anglicus** xx, cxxiii (n. 32)
Basra xv
al-Battani cxlii (n. 243)
al-Bayhaqi, Ali ibn Zayd xv
to be ensconced in the soul lxiv, lxxi, cxxxviii (n. 211), 539 (n. 54), 541 (nn. 65, 66) *See also quiescere in Latin-English Index.*
beauty (as a visible intention) liii, lxiii, lxvi, lxvii, lxxvii, cix, cxi, cxii, cxxxvii (nn. 194, 198), clxxv, 541 (n. 60), 543-544 (nn. 168-172, 174), 555 (nn. 177, 179, 180, 182, 184) *See also pulcritudo, species in Latin-English Index.*
binocular image-fusion xxxiv, xlii, lxxiv, lxxv, cxxxvi (n. 180), 410 (n. 99), 632 (n. 17)
binocular vision xviii, xxix, lxviii, lxxiii, lxxvi, lxxviii, cxxxvi (n. 180), cxxxviii (n. 205), 410 (n. 99), 629 (n. 7), 632 (n. 18)
Blasius of Parma xciv
bodiliness/corporeity (as a visible intention) lxii, lxiii, lxviii, cxxviii (n. 89), cxxxvi (n. 184), clxxv, 540 (nn. 59, 60) *See also corporeitas, corpus in Latin-English Index.*
Boethius cxx (n. 9), cxlii (n. 243)
Borghini, Raffaele cxi
boundary/limit xxxi, xxxii, cxxviii (n. 89), 413 (n. 132), 414 (n. 142), 546 (n. 104), 547 (n. 113), 553 (n. 163) *See also finis, terminus in Latin-English Index.*
brain xviii, xxvi, xxxvii-xli, xliii, xlvi, xlviii, lvii, lviii, lxi, lxii, lxix, lxxii, lxxix, lxxxvi-lxxxviii, xcvi, c, ci, cxxxii (n. 137), cxxxv (n. 171), cxxxix (nn. 218, 219), cxliv (nn. 265, 268), clxxvii, 397 (n. 21), 400 (nn. 31, 32), 405 (n. 64), 413 (n. 127), 556 (n. 194) *See also cerebrum in Latin-English Index.*
brightness xxxii, ciii, cxxviii (n. 85), 412 (n. 121), 537 (n. 37) *See also scintillatio in Latin-English Index.*
Brunelleschi, Filippo cvi-cix, clii (n. 354)
Brunellus 636 (n. 53)
brute sensation xxviii, lxii, lxxii, lxxvii, lxxviii, lxxxvi, cxxxvi (n. 182), cxl (nn. 230, 233), 409 (n. 90), 537 (n. 34), 539 (n. 51), 540 (n. 56), 542 (n. 77), 556 (n. 194)
Buridan, Jean xciv
burning mirrors xix, xxxvi, l, cviii *See also concave mirrors below.*
- catoptrics** xxxv, xxxvi, lxxiii
center of sight xxviii, xxxiv, cix, cxxii (n. 21), 535 (n. 23), 540 (n. 58), 546 (nn. 106, 107), 548 (nn. 119, 121), 549 (nn. 126, 131), 550 (n. 136), 552 (nn. 151, 154) *See also centrum, centrum visus, visus in Latin-English Index.*
cerebral ventricles xl, xlvi, xlviii, lviii, lxxix, cxxxii (n. 137), 400 (n. 32), 410 (n. 98)
certification xviii, liii, lxviii, lxix, lxxi, cx, cxxxviii (n. 203), 537 (n. 29), 543 (n. 84), 551 (n. 143), 553 (n. 156), 555 (n. 187), 556 (n. 190) *See also certificatio, certitudo in Latin-English Index.*

characteristic *See* **defining feature, visible characteristic, visible intention below**

chiaroscuro cv, cviii, cxi, cl (n. 335), 638 (n. 67)

chiton choroeides xxxvii, lvii, 398 (n. 24) *See also* **choroid tunic below**.

chiton keratoeides xxxix *See also* **cornea below**.

chiton skleros xxxviii, 397 (n. 22) *See also* **sclera below**.

choroid tunic xxxvii-xxxix, xlviii, 398 (n. 24),

Cicero cxlii (n. 243)

circle of attachment 401 (n. 36) *See also* **circulus consolidationis in Latin-English Index**.

circle of intersection 401 (n. 36) *See also* **circulus sectionis in Latin-English Index**.

chameleon 396 (n. 16) *See also* **abu qalamun, alburalmun, amilialmun above**.

Clagett, Marshall xcix, cxxiii (n. 31)

close visual scrutiny xli, lxxviii, lxx-lxxii, lxxv, cxxxviii (n. 203), cxxxix (n. 214), cxl (n. 233), 543 (n. 84), 557 (n. 204) *See also* **inductio, intuitio, intuitus, iudicium in Latin-English Index**.

cogitativa lxxxvi *See also* **reason below**.

cogito argument cii, civ

color xviii, xxvi-xxix, xxxi, xxxiii, xxxvii, xxxix-xli, xliii, xlviii, liii-lvii, lxi-lxiii, lxvi, lxxviii, lxx, lxxii, lxxxvi-lxxxviii, cii-civ, cx-cxii, cxiv, cxv, cxvii, cxxv (n. 52), cxxvii (nn. 66, 68), cxxviii (nn. 85, 87, 89), cxxx (n. 114), cxxxiv (nn. 160, 161), cxxxv (n. 165), cxl (n. 230), cliii-cliv (n. 375), clxxv, 395 (nn. 4, 5), 396-397 (n. 14, 16-18), 398 (n. 26), 402 (n. 48), 403 (nn. 52, 54), 404 (n. 59), 405 (n. 67), 409 (n. 90), 410 (nn. 96, 97), 411 (nn. 105, 106, 108, 110, 112, 115), 412 (nn. 121, 123), 413 (n. 126), 414 (n. 142), 537 (n. 37), 540 (n. 60), 541 (nn. 64, 66, 68, 69), 542 (nn. 71-73, 75, 77), 550 (n. 136), 553 (nn. 163, 165), 556 (n. 194), 557 (n. 203), 637 (n. 59), 638 (n. 67), 639 (nn. 85, 86) **as objective quality** xxvi, xxxi, cxxvii (n. 66), cxxviii (n. 87), 396 (n. 17), 411 (n. 115), 553 (n. 163) **as per se visible** xxxvii, liii, lxii **as proper object of sight** xxvi, xxxi, xxxvii, xl, xli, xliii, xlviii, lvi, lxii, lxxii, cxxvii (n. 66), cxl (n. 230), 409 (n. 90) **as subjective effect** xxxi, cii-civ, 396 (n. 17) *See also* **color, tinctura in Latin-English Index**.

color-perspective xxxiii, 550 (n. 136), 638 (n. 67), 639 (n. 86)

common axis xxxiii, xxxiv, lxix, lxxiii-lxxv, cxxxviii (nn. 207, 208), clxxx (n. 17), 631 (n. 16), 632 (n. 18) *See also* **axis communis in Latin-English Index**.

common nerve lxix, cviii, 397 (n. 21), 534 (n. 19), 539 (n. 48), 542 (n. 76), 556 (n. 194), 631 (nn. 16, 17), 632 (n. 19-21) *See also* **optic chiasma below. See also nervus communis in Latin-English Index**.

common sense / sensibility xxvii, xxviii, xlv, xlvi, lxxii, lxxxvi, lxxxix, cx, cxxvii (n. 70), cxlix (n. 320), 410 (n. 98), 538 (n. 42), 556 (n. 194)

common sensibles xxvii, xxviii, xli, lxxii, cxxvii (n. 70), cxxviii (n. 87), 540 (n. 60)

comparison / correlation *See* **perceptual comparison / correlation below**.

comprehensio solo sensu lxii, lxxii, lxxxvi, 409 (n. 90), 540 (n. 56) *See* **brute**

- sensation** *above*.
- concave lenses** xci-xciii
- concave mirrors** xix. xxxvi, xcvi, cv, cix, cxliii (n. 261), cxlv (280), cl (n. 331)
- concavity** xxxiii, 547 (n. 111), 638 (n. 67)
- conceptual impression/representation** xxvii, xxviii, lxxii,
- conclusion** *See perceptual conclusion below*.
- cone** *See visual cone below*.
- cone of radiation** lxi, lxviii, lxxx, xci, xcii, cxxxv (n. 178), cli (n. 340), 405 (n. 66), 535 (n. 23), 546 (n. 106) *See also piramis radialis in Latin-English Index*.
- conjunctiva** xxxviii, xxxix, xlviii, 397 (n. 22), 400 (n. 34)
- consistency** lv, lxiii, 398 (n. 26), 404 (n. 59) *See also spissitudo in Latin-English Index*.
- consolidativa** 397 (n. 22), 399 (nn. 30, 31), 400 (nn. 33, 34) *See also sclera below*.
See also consolidativa in Latin-English Index.
- Constantine the African** cxli (n. 241)
- continuity (as a visible intention)** lxii, lxviii, lxxv, cxi (n. 226), clxxv *See also continuatio, continuitas in Latin-English Index*.
- convex lenses** xci-xciii
- convex mirrors** xxxv, xxxvi, xcvi, civ, cxlv (n. 280), cl (n. 329)
- convexity** xxxiii, 547 (nn. 110, 111), 638 (n. 67) *See also convexio, convexitas in Latin-English Index*.
- cornea** xxvii, xxxviii-xl, xlviii, lvii-lx, lxxiv, lxxv, cxxxii (n. 139), cxxxiv (n. 157), cxxxv (nn. 169, 171, 173, 175), 398 (nn. 25, 29), 399 (nn. 30, 31), 400 (n. 34), 405 (n. 68), 406 (n. 69), 407 (nn. 71, 75), 410 (n. 101), 536 (n. 26) *See also cornea in Latin-English Index*.
- corporeity** *See bodiliness above*.
- creator** cxxxvii (n. 198) *See also operator in Latin-English Index*.
- cross-section** lxx, cxxxviii (n. 209), 637 (n. 59) *See also dyiameter in Latin-English Index*.
- crystal** lv, 639 (n. 79) *See also cristallus in Latin-English Index*.
- crystalline humor** xxxvii, xxxviii, xlvii, xlviii, cxxx (n. 108) *See also glacial humor below*.
- crystalline lens** xxxvii-xli, xlviii, xlix, lviii, lxxxviii, lxxxix, xci-xciii, cxvii, cxlix (n. 320), 398 (n. 28), 402 (n. 42), 403 (n. 53), 531 (n. 13) *See also glacialis in Latin-English Index*.
- darkness (as a visible intention)** liv, lxiii, cxxviii (n. 85), clxxv, 412 (n. 121), 537 (n. 37), 541 (n. 60), 553 (nn. 165-167) *See also fuscus, nigredo, obscuratio, obscuritas, obumbratio, tenebra in Latin-English Index*.
- daylight** lvi
- dazzle/dazzling brightness** xxxi, 396 (n. 14), 537 (n. 37) *See also scintillatio in Latin-English Index*.
- deduction/deductive process** lxiii, lxiv, lxviii, lxxvii, lxxviii, lxxxvi, xcvi, cxxxvi (nn. 184, 185), cxxxvii (n. 201), cxi (nn. 232, 233), clxxv, 548 (n. 116), 551 (n. 144), 556 (n. 194), 636 (n. 48) *See also arguere, argumentatio, argu-*

- mentum, ratio, sillogismus, sillogizare** *in Latin-English Index.*
- defining feature** lxx-lxxii, cxxxix (n. 213), 409 (n. 90), 546 (n. 103), 553 (n. 163), 557 (n. 204) *See also* **significatio, signum** *in Latin-English Index.*
- Democritus** 408 (n. 81)
- density** *See* **optical density** *below.* *See also* **spissitudo** *in Latin-English Index.*
- depiction** *See* **visual depiction** *below.*
- Descartes, René** lxxxiv, ci-civ, cxviii, cxliii (n. 259), cxlix (nn. 325-327), cliii (n. 375)
- difference (as a visible intention)** lxiii, lxviii, clxxv, 537 (n. 36) *See also* **dis-similitudo, diversitas** *in Latin-English Index.*
- differentiation** *See* **perceptual differentiation** *below.*
- Diocles** 1
- Diophantus** xliv, cxxxi (n. 127)
- dioptrics** xxxv, xxxvi, lxxiii
- diplopia** xviii, xxxiii-xxxvi, xliii, lxxiii-lxxvi, lxxviii, cxxix (nn. 97, 99), cxxx (n. 121), 410 (n. 101), 636 (n. 48)
- direct (unimpeded) vision** xviii, xxxv, lxxiii, xcv, xcvi, 629 (n. 1)
- direction/directionality** 404 (n. 63), 531 (n. 1), 540 (n. 58), 545 (n. 102), 546 (n. 104), 548 (n. 126) *See also* **verticatio** *in Latin-English Index.*
- directional privilege** xxxii
- directly facing disposition** xxx, lxix, lxxiii, lxxv, cxxxviii (n. 205), 540 (n. 58), 546 (n. 107), 550 (n. 135), 632 (n. 18) *See* **directio, opponere, oppositio** *in Latin-English Index.*
- discontinuity** *See* **separation** *below.*
- discrimination** *See* **perceptual discrimination** *below.*
- dissimilarity** *See* **difference** *above.*
- distance (as a visible intention)** xxxii, xxxiii, xli, xlviii, lxii, lxiv-lxvi, lxxviii, xcvi, cxxxvi (nn. 186, 189), cxxxvii (nn. 190, 192), cxli (n. 238), clxxv, 543 (nn. 84, 86-88), 544 (n. 90), 545 (nn. 92, 93, 95, 98, 102), 549 (n. 132), 550 (nn. 137, 141), 552 (n. 151), 639 (n. 82) *See also* **remoteness** *below.* *See also* **distantia, elongatio, longitudo, remotio** *in Latin-English Index.*
- to distinguish through perception** lxiii, lxxxvi, cxxxix (n. 215) *See also* **dis-tinguere** *in Latin-English Index.*
- divine illumination** lxxxv, cxlvii (n. 309), cxlviii (n. 310)
- Domenico de Clavasio** xciv
- double vision** *See* **diplopia** *above.*
- Duns Scotus** cxlviii (n. 311)
- dura mater** xxxvii, xxxviii, lvii, 397 (n. 21), 398 (n. 29), 400 (n. 31)
- Dürer, Albrecht** cviii
- earth** cxlix (n. 325), cliii (n. 372), 407 (n. 77) *See also* **terra** *in Latin-English Index.*
- Eastwood, Bruce** xlix, cvi
- Edgerton, Samuel** cv, cix
- effect** *See* **perceptual/visual effect** *below.*
- empirical perspective** cv
- empiricism** xxxvi, xliii, xlv, lii, cxiii, cxv, cxvi, 539 (n. 45), 540 (n. 55), 550

- (n. 133)
- equal-angles law of reflection** xcv, cxv
- Erasistratus** xliii
- essence/essential nature** xxvii, lxxviii, lxxxvii, lxxxviii, xcvi, cxxxix (n. 216), 538 (n. 44) *See also* **quiditas** in *Latin-English Index*.
- essential light** liii, cxxxiv (n. 156), 395 (n. 2), 541 (n. 68) *See also* **lux** below and in *Latin-English Index*.
- estimation** *See* **perceptual estimation** below.
- estimative faculty/faculty of estimation (estimativa)** xlvi, lxxxvi
- Euclid/Euclidean** xvi, xxv, xxvi, xxviii, xxix, xxxi, xxxii, xxxvi, xl, xlv, xlix, l, li, lxi, lxvi, lxxx, xc, xci, ciii, cvii, cviii, cxii, cxxvi (n. 64), cxxvii (nn. 74-76), cxxviii (nn. 78, 79), cxxix (nn. 92, 98), cxxxiii (nn. 144, 152), cxli (n. 240), cxlv (nn. 281, 284, 285), 401 (n. 35), 405 (n. 66), 407 (n. 78), 408 (nn. 82, 87), 409 (n. 89), 531 (nn. 8, 14), 539 (nn. 40, 49), 548 (nn. 118, 121), 550 (n. 143)
- Eugene of Sicily, emir** cxx (n. 11), cxli (n. 240)
- experiment/experimental verification** xxxvi, lii, lxxvi, cxv, cxvi, cxl (nn. 227, 228), 403 (n. 55), 404 (n. 60), 545 (n. 92), 633 (n. 25) *See also* **consideratio, experimentatio, experimentum** in *Latin-English Index*.
- extramission/extramissionist** xl, xliii, l, xc, cviii, cxiii, cxiv, cxxxii (n. 144), cxlv (n. 281), 408 (n. 85), 543 (n. 81), 551 (n. 147) *See also* **exitus** in *Latin-English Index*.
- eye/eyeball** *See* **ocular anatomy and physiology** below. *See also* **oculus, pupilla, visus** in *Latin-English Index*.
- eyeglass** cv, cxliii (n. 261), cl (n. 333)
- eyelid** lxiv, 408 (n. 80) *See also* **palpebra** in *Latin-English Index*.
- eyesocket/socket** xxxvii-xxxix, lvii, lviii, lxix, lxxiv, 397 (n. 21) *See also* **concavitas, concavum ossis, os** in *Latin-English Index*.
- Eyck, Jan van** civ
- to face directly/directly facing disposition** lxix, lxxiii, cxxxviii (n. 205), 540 (n. 58), 546 (n. 107), 550 (n. 135) *See also* **opponere, oppositio** in *Latin-English Index*.
- faculty of discrimination** lxiii, lxiv, lxviii, cxxxvi (n. 183), 538 (nn. 40, 42), 541 (nn. 64, 66), 548 (n. 126), 549 (n. 131), 556 (n. 194) *See also* **distinctio, virtus distinctiva** in *Latin-English Index*.
- faculty of imagination** *See* **imagination** below.
- faculty of memory** *See* **memory** below.
- faculty of reason** *See* **reason** below.
- faculty of vision** *See* **visual faculty** below.
- fantasia/fantasy/phantasia** xxvii, xlv, xlvi, lxxxvi, cx, 557 (n. 206) *See also* **imagination** below.
- al-Farabi** lii, cxxxi (n. 130)
- al-Farisi, Kamal al-Din** xix, cxxii (n. 18), cxxiii (n. 27)
- farsightedness** *See* **presbyopia** below.
- Fatimids** xv

to feel/to sense/sense/feeling/sensation xxvi-xxviii, xxx-xxxiii, xxxvii, xl, xli, xliii, xlv, xlvi, xlviii, lx, lxii, lxiii, lxxii, lxxxvi, lxxxvii, lxxxix, xcvi, ci, ciii, civ, cx, cxi, cxxviii (nn. 77, 87, 89), cxxxvii (n. 201), cxxxix (n. 221), cl (n. 327), 395 (n. 3), 403 (n. 53), 405 (n. 64), 407 (n. 75), 409 (nn. 88, 90), 410 (nn. 95, 96), 411 (n. 108), 412 (n. 120), 413 (n. 127), 531 (n. 12), 535 (n. 22), 537 (n. 34), 542 (n. 73), 545 (nn. 92, 101), 548 (n. 126), 549 (n. 132), 550 (nn. 137, 141), 551 (n. 144), 552 (nn. 151, 154), 556 (nn. 193, 196), 636 (n. 45) *See also* **passio, pati, sensus, sentiens, sentire** in *Latin-English Index*.

figure *See* **shape** *below*.

final sensor lxii, lxiii, lxxi-lxxiii, lxxxvi, cxxxvi (nn. 180, 181), cxxxix (nn. 218, 219), cxliv (n. 265), 410 (nn. 98, 101), 538 (n. 42), 541 (n. 64), 542 (n. 76), 543 (n. 77), 545 (n. 101), 556 (n. 194) *See also* **ultimus/ultimum sentiens, ultimus sensor** in *Latin-English Index*.

firefly lvi, cxxxv (n. 165), 396 (n. 12), 637 (n. 54) *See also* **aluerach, noctiluca** in *Latin-English Index*.

first glance *See* **vision at first glance** *below*.

to fix *See* **to impress** *below*.

focus *See* **radial focus, visual focus** *below*.

to focus/focus upon *See* **visual focus** *below*.

form x, xiii (n. 4), xlvi, li, liii-lvi, lx-lxiii, lxvii, lxx-lxxv, lxxx, lxxxvi-lxxxviii, xcvi, xcvi, cviii, cxxxvi (nn. 180, 185), cxxxviii (nn. 204, 209-212), cxxxix (nn. 215, 216, 219, 220), cxl (nn. 231, 233), cxliv (nn. 266, 272), cxlvii (n. 309), 402 (n. 51), 404-405 (n. 64), 405 (nn. 67, 68), 407 (n. 75), 410 (n. 96), 411 (nn. 105, 110, 112, 115), 412 (n. 120), 531 (nn. 1, 8, 11), 532-534 (n. 15), 534 (nn. 17-19), 535 (n. 21), 536 (n. 26), 539 (n. 48), 541 (nn. 64, 65), 545 (nn. 95, 100), 549 (n. 126), 553 (n. 156), 555 (n. 179), 556 (nn. 190, 192-194, 197), 557 (n. 206), 631 (n. 17), 632 (nn. 19, 20), 633 (n. 21), 636 (n. 42), 637 (n. 59), 638 (n. 70) *See also* **particular form, primary form, secondary form, universal form** *below*. *See also* **apparentia, forma** in *Latin-English Index*.

Futhitos l

Galen xxv, xxvi, xxxvii, xxxix-xliv, xlvi-xlix, lvi-lx, lxxviii-lxxx, cxxvi (n. 62), cxxix (nn. 100, 103), cxxx (nn. 108, 114, 115, 119, 121), cxxxii (nn. 138, 139), cxxxv (nn. 167, 171), cxxxvi (n. 180), 397 (nn. 21, 22), 398 (nn. 24, 27, 28), 400 (n. 32), 402 (nn. 48, 50), 403 (n. 53), 407 (n. 78), 409 (n. 89), 410 (n. 99), 413 (nn. 127, 128), 629 (n. 7)

Galilei, Galileo xciii, cxlvi (nn. 292, 293), cxlvii (n. 297)

gaze 633 (n. 25) *See also* **pupilla** in *Latin-English Index*.

Gerard of Cremona ix, xx, xxi, cxxiv (n. 36), cxxxiii (n. 149), cxli (nn. 240, 241)

al-Ghazali lxxxi, cxxxi (n. 130), cxli (n. 241)

Ghiberti, Lorenzo lxxxiii, cvi, clx

Giotto civ, cv, cl (n. 328)

glacial humor/glacial sphere/glacialis lviii-lxi, cxxxv (nn. 170, 173), cxxxvi (n. 180), cxxxviii (n. 204), 398 (nn. 26-29), 399 (n. 31), 401 (nn. 36-38), 402 (nn. 40, 42), 403 (nn. 53, 57), 405 (nn. 64, 67, 68), 406 (nn. 69, 70), 407 (nn. 71, 73, 75, 79), 409 (n. 92), 410 (nn. 96, 101), 411 (n. 108), 412 (nn. 120, 123, 125),

413 (nn. 125, 126), 414 (n. 140), 531-534 (nn. 9, 12, 13, 15), 534 (n. 18), 535 (nn. 21, 24, 25), 536 (nn. 26, 27, 29), 542 (nn. 72, 75), 545 (n. 100), 548 (n. 113), 549 (n. 126), 553 (n. 156), 637 (n. 59) *See also* **glacialis** *in Latin-English Index*.
glass xxxvi, xxxvii, cxxix (n. 103), cl (n. 333), 398 (n. 28), 403 (n. 54), 537 (n. 37),
See also **eyeglass** *above* and **looking-glass** *below*. *See also* **cristallus, vas, vitreus, vitrum** *in Latin-English Index*.
governing faculty xliv, 410 (nn. 98, 101)
to grasp *See* **to apprehend** *above*.
Grosseteste, Robert cxxiii (n. 33), cxlii (n. 242), cxlv (nn. 281, 282)
Gundissalinus, Domenicus xcvi, cxli (n. 241)

al-Hakim xv, cxix (n. 6),
harmony *See* **aesthetic harmony** *above*.
Harun ar-Rashid xlv
hegemonikon xxxix, xlv *See also* **governing faculty** *above* and **ruling principle** *below*.
Henry of Langenstein xciv
Hero of Alexandria l, 409 (n. 87)
Herophilus xliii
Hippocrates xliii
Holbein, Hans the Younger civ
horopter 545 (n. 93), 629 (n. 7)
horse lxx, lxxii, lxxvii, lxxxvi, xcvi, 409 (n. 90), 545 (n. 95), 555 (n. 187), 557 (n. 206) *See also* **equus** *in Latin-English Index*.
House of Wisdom xlv, xlv, xlvii
human/man lxx-lxxii, lxxxvi, lxxxvii, xcvi, xcvi, cx, cxi, cxxxix (n. 216), cxlvii (n. 297), 538 (n. 44), 543 (n. 84), 550 (n. 133), 551 (n. 145), 554 (n. 168), 557 (n. 200) *See also* **homo** *in Latin-English Index*.
Hunayn ibn Ishaq xxvi, xlv, xlvii-xlix, lii, lvii-lx, lxxxi, xciii, cxxxii (nn. 135, 137, 138), cxxxv (nn. 171, 175), cxl (n. 236), cxli (n. 241), cxlvii (n. 296), 397 (n. 21), 398 (n. 28), 402 (nn. 42, 45, 50), 403 (n. 53), 412 (n. 124), 413 (n. 128)
Huygens, Christiaan cxviii, cxxii (n. 21), cxlv (n. 280)
hydatoides xxxix *See* **albugineus humor** *above*.
hyaloides xxxvii *See* **vitreous humor** *below*.

Ibn Abi Usaybi a xv, xvi, xxv, cxix (nn. 1, 3, 5), cxx (nn. 6, 7)
Ibn al-Haytham: Abu Ali al-Hasan ibn al-Hasan xxi, cxix (n. 1), cxx (nn. 6, 7), cxxiii (n. 30), cxxv (n. 45) **abu Ali Muhammed ibn al-Hasan** cxix (n. 1), cxx (nn. 6, 7), cxxiii (n. 30)
Ibn al-Nadim cxxxiii (n. 147)
Ibn al-Qifti, Jamal al-Din xv, xvi, cxix (nn. 1, 3, 4), cxx (n. 7)
Ibn Mu adh *See* **al-Jayyani** *below*.
Ibn Rushd *See* **Averroes** *above*.

Ibn Sahl l, lii, cxxxiii (n. 153)

Ibn Sina See **Avicenna** *above*.

to illuminate/shine upon xviii, xxvi, xli, xlviii, lv, lvi, lxiii, lxxxvi, cxiv, cxxviii (n. 89), cxxxiv (n. 159), 395 (n. 5), 398 (n. 26), 405 (n. 65), 410 (n. 97), 411 (nn. 109, 112, 115), 543 (n. 86) See also **ascendere, illuminare, oriri** in *Latin-English Index*.

illuminated See **luminous** *below*.

illumination xxx, xli, xlii, l, liv, lxxvi, 395 (nn. 5, 7), 397 (n. 17), 412 (n. 121), 535 (n. 22), 555 (n. 165) See also **divine illumination** *above*. See also **illuminatio, lumen** in *Latin-English Index*.

illusion See **visual deception** *below*.

illusionism xxxiii, cv, 638 (n. 67)

image/visual image x, xviii, xxvii, xxxi, xxxiii, xxxv, xxxix, xlii, xliii, l, liii, lx-lxii, lxxv, lxxviii, lxxxiv, xcii, xciv, xcvi, c, ci, civ-cvi, cviii, cxi, cxxix (n. 97), cxxxvi (n. 179), cxxxix (n. 221), cxl (n. 227), cxlix (n. 323), cl (n. 329), 401 (n. 37), 406 (n. 69), 407 (nn. 73, 75, 79), 409 (n. 92), 410 (nn. 96, 98, 101), 632 (nn. 20, 21), 633 (nn. 22, 26), 634 (nn. 28, 29), 635 (n. 35), 636 (n. 48), 639 (n. 81) See also **real image, retinal image, virtual image** *below*.

image-fusion See **binocular image-fusion** *above*.

image-inversion cvi, 531 (n. 9)

imagination xxvii, xxviii, xlv, xlvi, lxiv, lxxii, lxxxvi, lxxxix, ci, cx, cxxxii (n. 137), cxxxvi (n. 185), cxxxviii (n. 211), cxxxix (n. 220), cxl (n. 231), 538 (n. 42), 539 (n. 48), 557 (nn. 193, 194, 196), 556 (n. 206), 636 (n. 45) See also **ymaginatio** in *Latin-English Index*.

to impress sensibly or perceptibly lxxiii-lxxv, 534 (n. 18), 635 (n. 37), 637 (n. 59) See also **figere, figurare, imprimere, infigere, instituere, signare** in *Latin-English Index*.

impression See **sensible impression** *below*.

incidental sensibles xxvii, xxix

indistinct perception lxxvi, 403 (n. 51), 407 (n. 75), 632 (n. 19) See also **incertitudo** in *Latin-English Index*.

individual/particular form lxx-lxxii, lxxxvi, lxxxvii, cxxxviii (n. 212), cxxxix (n. 215), cxl (n. 231), 556 (nn. 196, 198) See also **forma particularis** in *Latin-English Index*.

induction xxxvi, xlvi, lii, lxxxix, cx, cxv, cxvi, cxxxi (n. 130), cxlvii (n. 309), 408 (n. 80), 539 (nn. 45, 49, 50) See also **inductio** in *Latin-English Index*.

instrumentalism/positivism xciv, xcix, cxxix (n. 98), cxlvii (n. 297), cxlviii (n. 316)

intellect/intellectual awareness/intellectual functions xxviii, xlv, lxxxi, lxxxviii, lxxxix, xcv, xcvi-xcix, cx, cxxxi (n. 130), cxli (n. 241), cxlvii (n. 309), cxlviii (nn. 309, 310), clxxv, 400 (n. 32), 538 (nn. 39, 44), 539 (nn. 49, 51, 54), 540 (n. 55), 555 (n. 185), 556 (n. 194), 636 (n. 48) See also **intellectus** in *Latin-English Index*.

intention See **visible intention** *below*.

intentional species See **species** *below*.

intentionality lxxxviii, lxxxix, 538 (n. 43)

intuition/intuitive cognition xxviii, xxxii, lxiv, lxv, xcvi, xcix, ciii, civ, 408 (n. 80), 409 (n. 88), 543 (n. 81), 549 (n. 132)

iris xxxix, 398 (n. 25)

James of Venice cxli (nn. 240, 241)

al-Jayyani, ibn Mu adh xx, xxiii, clv, clvii-clxii, clxvii, clxxi, clxxix (nn. 2, 5)

Johannitius lxxxi *See also* **Hunayn ibn Ishaq** *above*.

John of Seville cxli (n. 241)

Jordanus of Nemore cxxiii (n. 31)

judgment *See* **perceptual conclusion** *below*.

kalam xvi

Kamal al-Din *See* **al-Farisi** *above*.

Kepler, Johan xi, lxxxiv, c, ci, civ, cxiii, cxvii, cxviii, cxliii (n. 256), cxlix (n. 323), 411 (n. 110)

keratoeides xxxix *See also* **cornea** *above*.

kind *See* **type** *below*.

al-Kindi, Yaq ub xxvi, xlv, xlvii, l-lii, lvii, lxxxi, xc, cxxxi (n. 130), cxxxiii (nn. 144, 150-152), cxxxiv (n. 157), cxxxv (nn. 167, 171), cxli (n. 241), cxlii (nn. 242, 243), cxliii (n. 262), cxlv (nn. 281, 284), 407 (n. 78)

krystalloides *See* **crystalline humor** *above*.

lens *See* **concave lenses, convex lenses, crystalline lens** *above*.

Leonardo da Vinci lxxxiii, cv, cvi, cxi, cli (nn. 338, 340, 342), clii (n. 354), 402 (n. 42)

light xvi-xix, xxvi, xxix-xxxi, xxxv-xxxvii, xli, xliii, l, liii-lvii, lxii, lxiii, lxvi, lxviii, lxxiii, lxxvii, lxxxi-lxxxvii, lxxxix, xci, xciii-xcv, ci-cv, cviii, cx, cxii-cxvii, cxxv (n. 52), cxxvii (nn. 65, 67), cxxviii (nn. 87, 89), cxxxii (n. 139), cxxxiv (nn. 156, 158, 159, 161, 162), cxxxv (n. 165), cxxxvii (n. 194), cxl (n. 230), cxlii (n. 242), cxliii (nn. 259, 264), cxlviii (n. 313), cxlix (n. 326), clii (n. 355), cliii-cliv (n. 375), clxxv, 395 (nn. 2-5, 7), 396 (nn. 9, 13, 16, 17), 397 (n. 18), 398 (n. 26), 402 (nn. 48, 49), 403 (nn. 52, 54, 55, 57), 404 (nn. 58-60, 64), 405 (n. 67), 407 (n. 77), 408 (n. 81), 409 (n. 90), 410 (n. 96), 411 (nn. 105, 108-110, 115), 412 (nn. 120, 123), 413 (n. 126), 414 (nn. 134, 140, 141), 537 (nn. 32, 37), 540 (n. 59), 541 (nn. 64, 69), 542-543 (nn. 73-78), 553 (nn. 159, 164, 166, 167), 556 (n. 194), 636 (n. 48), 637 (n. 59), 638 (n. 67), 639 (n. 85) **as mediating agent** xxvi, xxxi, xxxvii, lvii, lxvi, cxv, cxxxiv (n. 161), 402 (n. 48), **as objective quality** liii, lvi, lxxxv, cii, 395 (n. 2), 411 (n. 115), 537 (n. 32) **as per se visible** lvii, lxii, cxv, 402 (n. 48) **as subjective effect** cii-civ *See also* **accidental light, essential light** *above* and **primary light, secondary light, sunlight** *below*. *See also* **lumen, lux** *in Latin-English Index*.

light metaphysics lxxxi

light- or color-radiation/ray xviii, xxxvi, liii, liv, lvi, lx, lxxiii, lxxviii, lxxx, lxxxv, lxxxix, xci-xciii, ciii, cviii, cix, cxiv, cxvii, cxxv (n. 52), cxxxiv (nn. 156, 157), cxliii (n. 264), cli (n. 340), 402 (n. 49), 404 (n. 57), 405 (n. 64), 407 (n. 77), 408 (n. 85), 542 (nn. 74, 75), 637 (n. 59)

limit See **boundary** *above* and **perceptual threshold** *below*.

Lindberg, David xi, xxi, lxxxiv, xciv, c, cxlii (n. 244), cxliii (n. 262), clxxix (n. 1)

line-of-sight lxv, lxviii, xcii, 542 (n. 76), 545 (n. 93), 552 (n. 154), 637 (n. 57) See also **radius**, **verticatio**, **visus** in *Latin-English Index*.

linear perspective cvi-cix, cxi, cxii, cli (n. 340), clii (n. 355)

Lippi, Fra Filippo cix

location See **place** *below*.

locomotion cxxix (n. 89), 553 (n. 157) See also **motus localis** in *Latin-English Index*.

logical premise 539 (nn. 50, 52), 541 (n. 65) See also **propositio** in *Latin-English Index*.

logical proposition 539 (n. 49), 541 (n. 65) See also **propositio** in *Latin-English Index*.

logistikon xxvii See also **reason** *below*.

to look / look at xlii, lxxv, xcii, xcvi, cxxx (n. 119) See also **aspicere**, **considerare**, **inspicere**, **intueri**, **videre** in *Latin-English Index*.

looking glass cv

luminosity / luminous xviii, xxxi, li, liii, liv, lvi, lx, lxvi, lxxxv, lxxxviii, cxiv, cxxviii (n. 85), cxxxiv (nn. 157, 158), 395 (n. 2), 396 (n. 13), 403-404 (n. 57), 405 (n. 65), 537 (n. 32), 541 (n. 68) See also **lucidus**, **luminosus**, **lux** in *Latin-English Index*.

lumen liv, lxxxv, cxxxiv (n. 156), cxliii (n. 264), 395 (n. 2), 541 (n. 68), 542 (n. 74)

lux liv, lxxxv, cxxxiv (nn. 156, 158), cxliii (n. 264), clii (n. 356), 395 (n. 2), 403 (n. 57), 541 (n. 68)

magnitude See **size** *below*.

Maier, Anneliese xcix, cxlix (n. 319)

al-Ma mun xliv

ma na cxliv (n. 277)

manazara / manazir / manzar xix, cxxiv (n. 43)

Manetti, Antonio cvi, cli (nn. 343, 344)

al-Mansur xliv

mathematician xxv, l, lii, cxiv, cxlv (280), 407 (n. 78) See also **mathematicus** in *Latin-English Index*.

Mauroluco, Francesco lxxxiii, xci-xciii, c, cv, cxliii (n. 255), cxlvi (nn. 287-289), cxlix (n. 320), cl (n. 333)

medicine / medical science xvi, xxv, xlvii, xlix, lii, xciii, cxlvii (n. 296), 402 (n. 42) See also **ars medicinalis**, **medicina** in *Latin-English Index*.

membrane xxxvii, xxxviii, 397 (nn. 21, 22), 398 (n. 29), 399 (n. 31), 412 (n. 125) See also **tela** in *Latin-English Index*.

memory xli, lxiii, lxv, lxx, lxxi, cx, cxxxviii (n. 209), 539 (n. 48), 541 (n. 67), 556 (n. 193) See also **memoria** in *Latin-English Index*.

Michelangelo civ, cl (n. 328)

Milky Way 554 (n. 174)

mind cii, civ, 539 (nn. 48, 54), 556 (n. 194) See also **mens** in *Latin-English Index*.

mirrors cv See also **concave mirrors**, **convex mirrors** *above* and **plane mirrors**

below. See also speculum in Latin-English Index.

mnemonic engraving 556 (n. 193)

Moon Illusion xvi, cxx (n. 12), cxxi (n. 13), cxxii (n. 22), 544 (n. 88)

motion/movement (as a visible intention) xxvii, xxviii, xxx, xxxv, xxxvi, xlvi, xlvi, lviii, lxiii, lxviii, cxxviii (n. 77), cxxix (n. 96), cxxxii (n. 137), clxxv, 400 (n. 33), 413 (n. 132), 542 (nn. 72, 76), 552 (nn. 150-154), 553 (nn. 156, 157), 555 (n. 185), 636 (n. 46), 638 (n. 74) *See also motio, motus in Latin-English Index.*

mule lxxii, lxxvii, 555 (n. 187) *See also mulus in Latin-English Index.*

multiplication of species lxxxv-lxxxix, xcix, cix, cxliii (n. 264), 408 (n. 85), 534 (n. 19)

muscle xxxviii, xxxix, lviii, cli (n. 338) *See also lacertus in Latin-English Index.*

myopia xci, xcii, cv

naked sense 409 (n. 90)

natural philosopher/natural philosophy xxv, xlv, xlvii, lii, lxxviii, lxxxi, lxxxiv, xciv, xcix *See also naturalis in Latin-English Index.*

nearsightedness *See myopia above.*

Neoplatonism xlv, lxxxi, cxxvi (n. 65)

nerve/optic nerve xxxvii, xxxviii, xl, xlii, xlv, xlviii, lvii-lix, lxi, lxii, lxix, lxxiv, lxxxvi, xci, xcii, c, cxxx (n. 108), cxxxv (nn. 169, 171, 172), cxxxvi (n. 180), cxlix (n. 320), clxxvii, 397 (n. 21), 398 (n. 25), 399-400 (n. 31), 401 (nn. 36, 37), 402 (n. 41), 407 (n. 73), 410 (nn. 96, 100), 412 (n. 123), 534 (nn. 17, 19)

Newton, Isaac lxxix, cxvii, cxviii, cliii (n. 375)

Nicholas of Autrecourt xcvi, cxlviii (n. 311, 313)

night lxviii *See also nox in Latin-English Index.*

notion lxiii-lxv, lxx, lxxi, cxxxviii (nn. 210, 211), cxl (nn. 231, 233), 540 (n. 55), 541 (n. 65) *See also intentio, notitia in Latin-English Index.*

number (as a visible intention) lxiii, 554 (n. 174) *See also numerus in Latin-English Index.*

obliquity/obliquely facing disposition xxxii, lxix, lxxv, lxxvii, cxxxvii (n. 192), cxl (n. 225), 540 (n. 58), 545 (n. 97), 546 (n. 107), 548 (nn. 119, 122), 550 (n. 135) *See obliquare, obliquatio in Latin-English Index.*

Ockham *See William of Ockham below.*

Ockham's Razor 408 (n. 85)

ocular anatomy and physiology: according to Alhacen lvii-lx according to Galen xxxvii-xl according to Hunayn ibn Ishaq xlvii-xlix

ocular humor *See albugineous humor and crystalline humor above and vitreous humor below.*

ocular tunic xxxvii-xxxix, xlvii, xlviii, lvii, lviii, lxxix, cxxxv (nn. 169, 175), 397 (nn. 21, 22), 398 (nn. 24, 29, 30), 400 (nn. 31, 34), 403 (n. 53) *See also choroid tunic, conjunctiva above and sclera, uvea below. See also tela, tunica in Latin-English Index.*

oculogyral illusion cxvi, 636 (n. 48), 639 (n. 87)

ooeides xxxix *See albugineus humor above.*

- opacity (as a visible intention)** xxxi, liv, lv, lxiii, lxviii, lxxiii, cxv, cxxxiv (nn. 159, 161, 162), cxxxvii (n. 201), clxxv, 395 (n. 7), 398 (n. 26), 404 (n. 59), 413 (n. 126), 414 (n. 142), 540 (n. 59), 541 (n. 60) *See also* **densitas, soliditas, spissitudo** in *Latin-English Index*.
- optic chiasma** *see* **common nerve**
- optical density** xviii, cxliii (n. 259), 404 (n. 59), 532 (n. 15), 639 (n. 81)
- optic nerve** *See* **nerve** *above*.
- Oresme, Nicole** xciv
- orientation** *See* **spatial disposition** *below*.
- pain of initial visual impression** xxxi, lxii, ciii, cxxxvi (n. 181), 395 (n. 3), 410 (n. 97), 535 (n. 22) *See also* **dolor** in *Latin-English Index*.
- painting** xxxiii, civ, cv, cix, cxi, cxii, cli (n. 338), clii (n. 354), 638 (n. 67) *See also* **pictura** in *Latin-English Index*.
- Panofsky, Erwin** cxxxvii (n. 193), clii (n. 360), 554 (n. 168)
- particular form** *See* **individual form** *above*.
- passion** *See* **pain** *above*.
- passive power** lxxxv, cxliii (n. 263)
- Pecham, John** xi, xx, xxi, lxxxii, lxxxiii, lxxxix, xci, cvi, cxlvi (n. 287), cli (n. 340), 400 (n. 34)
- Pélerin, Jean** *See* **Viator** *below*.
- perceptible quality** xli, lxii, lxiii, cii-civ, cxxvii (n. 66), 538 (n. 43) *See also* **proprietas, qualitas, res** in *Latin-English Index*.
- perceptual comparison / correlation** lxiii, lxvi, lxviii, lxx, lxxi, lxxiii, cx, cxxxvi (n. 184), cxxxvii (n. 190), 538 (nn. 39, 40), 541 (n. 66), 549 (n. 131), 550 (n. 137) *See also* **collatio, comparatio, consideratio, proportio, respectus** in *Latin-English Index*.
- perceptual conclusion / judgment** lxii, lxvii, lxxxvi, cx, cxi, cxlix (n. 320), 413 (n. 131), 540 (n. 56), 554 (n. 168), 556 (n. 194) *See also* **argumentatio, conclusio, estimatio, iudicium, ratio, reputatio** in *Latin-English Index*.
- perceptual determination** xxviii, xxxii, lxiii-lxv, lxviii, lxx-lxxii, lxxxvi, civ, cxxxvi (n. 189), cxxxvii (n. 192), 538 (n. 40), 543 (nn. 84, 87, 88), 545 (n. 101), 546 (n. 104), 547 (n. 111), 548 (nn. 121, 126), 550 (nn. 136, 137, 141), 556 (n. 190), 636 (n. 42) *See also* **affirmare, certificare, determinare, distinctio, distinguere, verificare, verificatio** in *Latin-English Index*.
- perceptual differentiation** cxxxvi (n. 183), 538 (n. 40), 542 (n. 73), 556 (n. 194), 557 (n. 204) *See also* **distinctio** in *Latin-English Index*.
- perceptual discrimination** lxiii, cx, cxxxvi (nn. 184, 185), cxxxix (n. 218), cxl (n. 233)
- perceptual / visual effect** xviii, xxvi, xxvii, xxx, xxxi, xxxiii, xxxvi, xliii, liv, lvi, lxiv, ci, 395 (n. 4), 396 (n. 9), 411 (n. 108), 537 (n. 37) *See also* **immutatio, operatio, passio** in *Latin-English Index*.
- perceptual estimation** lxv, cxxxvi (n. 189), 409 (n. 88) *See also* **existimare, estimatio** in *Latin-English Index*.
- perceptual recognition** xlvi, lxiv, lxv, lxxi, lxxvi-lxxviii, lxxxvi, cx, cxxxvi

- (n. 189), cxxvii (n. 191), cxxxix (nn. 213-215), cxi (nn. 231, 233), 409 (n. 90), 556 (n. 198) *See also* **cognitio, cognoscere, scientia, intellegere** in *Latin-English Index*.
- perceptual thresholds/limits** liii, xxxii, lxv, lxxvi, lxxvii, clxviii, 396 (n. 13), 414 (n. 140), 543 (nn. 86, 87), 548 (nn. 120, 121) *See also* **mediocris, mediocritas, moderamen, moderatio, moderatus, modicus, temperamentum, temperantia, temperatus** in *Latin-English Index*.
- perspective** *See* **color-perspective** and **linear perspective** above.
- perspectiva** lxxxii, xciv, cix, cxxiv-cxxv (n. 44), cxlv (n. 283)
- Perspectivist theory/theoreticians** xi, lxxxii-lxxxiv, lxxxix-xcii, xciv-ci, ciii, civ, cvi, cviii-cx, cxii, cxvii, cxlii (n. 252), cxliii (n. 264), cxlvi (n. 287), cxlix (n. 323), cli (n. 340), 542 (n. 75)
- Peter Aureol** xcvi, cxlviii (n. 311)
- Peter of Limoges** lxxxii, xcv, cxlvii (n. 303)
- pia mater** xxxvii, xxxviii, lvii, 397 (n. 21), 398 (n. 29), 400 (n. 31)
- picture** lxxxix, 555 (n. 182)
- Piero della Francesca** cviii
- place** lxxiii, cxxviii (n. 87), cxxix (n. 89), 540 (nn. 58, 60), 545 (n. 102), 546 (n. 104) *See also* **locus** in *Latin-English Index*.
- plane of refraction** 407 (n. 74)
- plane mirrors** xxxvi, xcv, xcvi
- Plato** xliii, xliv, xlvii, lxxxi, cix, cx, cxxvii (nn. 65, 66), cxxviii (n. 88), cxxx (n. 115), 397 (n. 17), 413 (n. 128), 539 (n. 45), 540 (n. 55)
- Pliny** cxlii (n. 243)
- pneuma psychikon** xl, xlviii, cxxv (n. 171), 400 (n. 32)
- psychic/animal/pneuma/spirit** xl, xli, xlvi, xlviii, cxxx (n. 108), cxxxii (n. 137), 400 (n. 32) *See also* **visual pneuma** and **vital pneuma** below.
- polish/polished** cv, cxxviii (n. 85), 396 (n. 9), 553 (n. 161) *See also* **politus, tersitudo, tersus** in *Latin-English Index*.
- Porta, Giambattista della** lxxxiii, cxliii (n. 255)
- position** xxviii, xli, ciii *See also* **dispositio** in *Latin-English Index*.
- potency/potential** xxvi, lvi
- potential intellect** cxxxi (n. 130)
- power** xxx, xxxi, l, li, liv, lvi, lviii, lxxxv, lxxxviii, xcvi, cxi, cxxxiv (n. 160), cxliii (nn. 262, 263), 404 (n. 59), 407 (n. 77), 408 (n. 81), 534 (n. 19) *See also* **virtus, vis** in *Latin-English Index*.
- Powers, Richard** cxiii, cxvii
- premise** *See* **logical premise** above.
- presbyopia** xci, xcii, cv
- previous acquaintance/knowledge** *See* **perceptual recognition** above.
- primary form** 411 (n. 115)
- primary light** liv, cxxxiv (n. 159)
- primary qualities** civ
- primary visible** xxxi, lxxii
- Proclus** 531 (n. 14)
- proportionality** *See* **aesthetic harmony** above.

proposition *See logical proposition above.*

Pseudo-Euclid lxxx

Ptolemy xvi, xix, xxv, xxvi, xxix-xxxvii, xl, xlii-xliv, xlix-li, lvi-lviii, lxi, lxiv, lxvi, lxxii, lxxiii, lxxviii-lxxx, lxxxix-xci, cvii, cviii, cxiv, cxvi, cxx-cxxi (nn. 11, 12), cxxii (n. 17), cxxviii (nn. 87, 88), cxxix (nn. 97-99), cxxxi (n. 125), cxxxiii (n. 151), cxxxv (n. 167), cxxxvii (n. 192), cxxxviii (n. 207), cxli (n. 227), cxli (n. 240), cxlii (n. 243), cxlv (nn. 282-285), cxlvi (n. 296), cxlvii (n. 297), cliii (n. 373), 396 (n. 17), 402 (n. 48), 404 (n. 64), 405 (n. 66), 407 (nn. 77, 78), 408 (nn. 82, 85), 409 (nn. 89, 90), 410 (nn. 97-99, 101), 413 (n. 132), 535 (nn. 22, 23), 537 (n. 30), 540 (n. 60), 541 (n. 71), 544 (n. 88), 545 (nn. 92, 93), 546 (n. 106), 548 (n. 119), 549 (n. 132), 551 (n. 147), 552 (nn. 151, 153, 154), 555 (n. 182), 629 (n. 7), 631 (n. 16), 632 (n. 21), 633 (nn. 23, 26), 636 (n. 48), 638 (nn. 64, 67), 639 (n. 87)

punctiform radiation li, lx, lxxx, cxxxiv (n. 158)

pupil xxx, xxxix, xlii, xlviii, lviii, lix, lxxvi, cix, cxxxv (n. 169), 398 (nn. 25, 27), 399 (n. 31), 401 (n. 37), 401 (n. 41), 412 (nn. 123, 124), 413 (n. 132)

quality *See perceptible quality above.*

radial breaking xxxv, cviii *See also reflexio in Latin-English Index.*

radial correspondence lxxiv, lxxv, cxxxix (n. 224), 629 (n. 5), 630 (n. 8) *See also consimilitudo in Latin-English Index.*

radial line/link xxviii, xxix, liv, 531 (nn. 1, 9), 545 (nn. 100, 101), 550 (n. 141), 629 (n. 1) *See also linea radialis, verticatio in Latin-English Index.*

to radiate xl, liii, lv, lvi, lx, lxxxv, lxxxvii, xc, 402 (n. 51), 403 (n. 54), 404 (n. 64), 411 (n. 115), 414 (n. 141), 541 (n. 68) *See also descendere, dirigere, exire, extendere in Latin-English Index.*

radiation/ray *See light- and color-radiation above and visual radiation below. See also radialis, radius, verticatio in Latin-English Index.*

rainbow xix, xxxvi, xciv, cxxiii (n. 27), cxxvii (n. 73), 412 (n. 121)

Ramus, Petrus xxiii, cxxv (n. 49)

Rashed, Roshdi xlv, cxix (n. 1), cxx (n. 6), cxxi (n. 16)

ray-analysis (geometrical optics) xvii, xxviii, xxxiii, xxxvi, xxxvii, xc, xci, c, cviii, cix, cxxxii (n. 144), cxlv (n. 282),

al-Razi/Razes lii, lxxxi, cxli (n. 241)

real image c, ci

realism cxxix (n. 98), 396 (n. 17)

reason/faculty of reason xxvii, xxviii, xlvi, lxxxvi, lxxxix, cx, cxlvii (n. 297), 537 (n. 39) *See also ratio in Latin-English Index.*

recognition *See perceptual recognition above.*

reflection/reflectivity xviii, xxvii, xxxv, xxxvi, l, liv, lxxiii, lxxxix, xciii, xcv, cxv, cxxii (n. 21), cxxix (n. 99), cxxxiv (n. 159), cxliii (n. 261), cxlv (n. 280), 396 (nn. 9, 16), 402 (n. 49), 404 (nn. 59, 61), 553 (n. 161), 629 (n. 1) *See also conversio, reflexio in Latin-English Index.*

refraction/refractivity xviii, xxxv, xxxvi, l, lv, lx, lxi, lxxiii, lxxxiv, lxxxix, xc, xciii, xcv, c, cix, cxxi (n. 12), cxxix (n. 99), cxxxiv (n. 163), cxxxv (n. 178),

- cxxxvi (nn. 180, 181), cxxxviii (n. 204), cxliii (nn. 260, 261), cxlv (n. 282),
 cxlvi (n. 287), 396 (n. 16), 403 (n. 55), 404 (nn. 59-62), 405-406 (nn. 68-70), 407
 (nn. 71, 74), 408 (n. 81), 412 (n. 120), 531 (n. 12), 532-534 (n. 15), 534 (n. 19),
 535 (n. 21), 537 (n. 30), 545 (n. 100), 629 (n. 1), 639 (nn. 81, 85) *See also obli-*
quatio, reflexio in *Latin-English Index*.
- remoteness** lxiii, lxiv, cxxxvi (n. 186), 540 (n. 57), 545 (n. 102) *See also remotio*
in Latin-English Index.
- representation/representational form** xxvii, xlv, xlvi, liii, lxi, lxiii, lxx-lxxii,
 lxxxiv, xcvi, xcvii, cx, cxi, cxxxv (n. 178), cxl (n. 231), 403 (n. 52), 540 (n. 55)
- res cogitans/res extensa** cii
- rest (as a visible intention)** xxvii, xxviii, lxiii, lxviii, cxxviii (n. 87), clxxv, 540
 (n. 60) *See also quies* in *Latin-English Index*.
- rete mirabile/retiform plexus** xl, xlviii
- retina/retiform plexus** xxxvii, xxxviii, xl, xlviii, lviii, lxxix, lxxxiv, c, ci, cxvii,
 399 (n. 30), 400 (n. 34),
- retinal image** c, cxlix (n. 323)
- Risner, Friedrich** x, xi, xxi-xxiii, lxxxiii, cxxiv (nn. 37, 38), cxxv (nn. 46, 49, 55),
 clv, clx-clxii, clxxi, 404 (n. 61)
- roughness (as a visible intention)** lxiii, lxviii, clxxv, 553 (n. 159) *See also asperi-*
tas in *Latin-English Index*.
- ruling principle** xxxix, xl, xliii
- Sabra, A. I.** x, xix, xxi, cxx (n. 6), cxxi (n. 15), cxxii (n. 17), cxxiii (n. 27), cxxiv
 (n. 43), cxxxiii (n. 152), 395 (n. 2), 396-397 (nn. 16, 17, 22), 398 (n. 28), 407
 (n. 78), 410 (n. 97), 412 (n. 121), 538 (n. 41), 540 (n. 60), 542 (n. 75), 551
 (n. 147), 554 (nn. 168, 175), 555 (n. 177)
- scan** *See visual scan below*.
- sclera** xxxviii, xxxix, xlviii, lvii-lix, cxxxv (n. 169), cxxxvii (n. 198), 397 (n. 22),
 398 (n. 29), 399 (nn. 30, 31), 400 (n. 34), 413 (n. 131), 554 (n. 168) *See also*
consolidativa in *Latin-English Index*.
- scrutiny** *See close visual scrutiny above*.
- secondary form** 411 (n. 115), 414 (n. 141)
- secondary light** liv, cxxxiv (n. 159)
- secondary qualities** civ
- secondary visibles** lxxii, cxxviii (n. 87)
- Seneca** cxlii (n. 243)
- sensible/perceptible impression** xviii, xxvii, xxviii, xxx, xxxi, xxxvii, xl, xli,
 xlv, xlvi, xlviii, xlix, liii, lx-lxii, lxviii-lxxii, lxxv, lxxx, lxxxiv, cii, cxxvii
 (n. 69), cxxxv (n. 178), cxxxvi (n. 181), cxxxviii (n. 209), cxxxix (n. 220), cxl
 (n. 226), cxlix (n. 327), 395 (nn. 4, 5), 398 (n. 26), 403 (nn. 51, 52), 405 (n. 68),
 407 (n. 75), 414 (n. 140), 536 (n. 29), 537 (n. 30), 540 (nn. 55, 56), 556 (nn. 193,
 197), 557 (n. 206), 629 (n. 7), 632 (n. 18), 638 (n. 70) *See also figuratio, im-*
pressio, intentio, intuitio in *Latin-English Index*.
- sensitive capacity/faculty/power** xxxix, xl, liii, lx, lxxxviii, 400 (n. 32), 405
 (n. 64), 409 (n. 90), 538 (n. 42), 543 (n. 87), 545 (n. 101), 550 (n. 135), 556
 (n. 194) *See also virtus, virtus sensibilis, virtus sensitiva, vis* in *Latin-*

English Index.

separation (as a visible intention) lxiii, lxviii, clxxv, 552 (n. 149), 553 (n. 160), 555 (n. 185) *See also* **discretio, separatio** in *Latin-English Index*.

shadow (as a visible intention) lxiii, clxxv, 541 (n. 60), 553 (n. 166) *See also* **umbra** in *Latin-English Index*.

shape (as a visible intention) xxvii, xxviii, xxxii, xxxiii, xli, xlviii, liii, lxii, lxviii, lxxiii, lxxvii, lxxxviii, ciii, cvii, cxxvii (n. 75), cxxviii (n. 87), cxxix (n. 89), clxxv, 409 (n. 90), 537 (n. 31), 540 (n. 60), 553 (n. 168), 555 (n. 185), 556 (n. 194), 638 (n. 67) *See also* **figura, forma, ordinatio** in *Latin-English Index*.

sign lxxi, cxxxix (n. 213), cxl (n. 233), 409 (n. 90), 538 (n. 43), 546 (n. 103) *See also* **signum** in *Latin-English Index*.

similarity (as a visible intention) lxiii, lxviii, 537 (n. 36) *See also* **consimilitudo, similitudo** in *Latin-English Index*.

size (as a visible intention) xxvii, xxviii, xxxii, xxxiii, xxxv, xli, xlviii, liii, lxii-lxviii, lxx, lxxiii, lxxvii, lxxviii, ciii, cvii, cxxviii (n. 87), cxxix (n. 89), cxxxvii (nn. 190-192, 194), cxlix (n. 325), clxxv, 396 (n. 13), 409 (n. 90), 414 (n. 140), 537 (n. 31), 540 (nn. 57, 60), 543 (nn. 79, 84, 86, 87), 544 (n. 88), 545 (nn. 95, 102), 548 (nn. 118) *See also* **magnitudo, mensura, quantitas**

size-distance invariance lxvi, cxxxvii (n. 191), 548 (n. 121)

slant/slope *See obliquity above.*

smoothness (as a visible intention) lxiii, lxvi, lxviii, cxxxvii (n. 194), clxxv, 396 (n. 9), 553 (n. 162) *See also* **lenitas, planities** in *Latin-English Index*.

soul xxvii, xlv, xlv, lxiv, lxxii, lxxxvi, xcv, xcvi, cx, cxxxi (n. 130), cxxxix (n. 218), cxli (n. 241), cxlviii (n. 310), 534 (n. 19), 539 (n. 48), 540 (n. 54), 541 (nn. 65, 66), 556 (nn. 194, 195) *See also* **anima, animus** in *Latin-English Index*.

spatial disposition (as a visible intention) lxii, lxiii, lxviii, lxix, lxxvi, ciii, clxxv, 409 (n. 88), 531 (n. 1), 545 (nn. 97, 102), 549 (n. 131), 553 (n. 157) *See also* **situs** in *Latin-English Index*.

species/intentional species x, xiii (n. 4), lxxxv-xc, xcvi-xcix, ci, civ, cxliv (nn. 275, 278), cxlix (nn. 320, 323), 395 (n. 2), 408 (n. 85), 534 (n. 19) *See also* **species** in *Latin-English Index*.

spirit *See visual spirit below.*

Stoics/Stoicism xliii, xlv, xlv

substance xxxi, lxxxvii, lxxxviii, cii, cxxviii (n. 89), 557 (n. 203)

Summers, David cix-cxii

sun/sunlight xvi, xli, liii, lxii, cxiii, 395 (nn. 2, 7), 403 (n. 54), 411 (n. 115), 542 (n. 74), 543 (n. 78), 547 (n. 109), 557 (n. 205) *See also* **sol** in *Latin-English Index*.

sura x, cxliv (n. 272)

syllogism/to syllogize lxxiii, cx, cxxxvi (n. 184), clxxv, 539 (nn. 50, 52), 636 (n. 48) *See also* **sillogizare, sillogismus** in *Latin-English Index*.

Thabit ibn Qurra cxlii (n. 243)

Theodoric of Frieberg xciv, cxxiii (n. 27)

Thomas Aquinas xcvi

threshold *See* **perceptual threshold** *above*.

Tideus l, lxxxi, xc, cxxxiii (n. 149), cxlv (n. 284)

time (as a factor in perception) xxxv, lv, lxxi-lxxiii, lxxvii, cxxxix (n. 215) *See also* **dispositio, hora, tempus** *in Latin-English Index*.

top cxvi, 541 (n. 70) *See also* **trocus** *in Latin-English Index*.

touch xxvii, xxviii, xxxiii, xli, xlv, xlviii, 409 (n. 88), 410 (n. 97), 543 (n. 81) *See also* **tactus** *in Latin-English Index*.

transmission of visible/visual effects xxxi, xli, liii-lv, lxi, lxii, lxxxiv, lxxxv, xciv, cii, cxiv, cxxvii (n. 68), cxxx (n. 114), cxxxiv (n. 162), cxxxvi (nn. 180, 181), cxliii (n. 259), cxlviii (n. 313), 395 (n. 7), 404 (n. 59), 410 (nn. 96, 98), 542 (n. 75) *See also* **reditio** *in Latin-English Index*.

transparency xxvi, liv-lvi, lx, lxiii, lxviii, lxxxvi, cxxx (n. 107), cxxxii (n. 139), cxxxiv (nn. 156, 162), cxxxv (n. 165), cxxxvi (n. 187), cxxxvii (n. 201), clxxv, 398 (nn. 26, 28), 403 (n. 54), 404 (n. 59), 408 (n. 81), 411 (n. 105), 537 (n. 37), 541 (nn. 60, 69), 553 (nn. 163, 165), 637 (n. 55), 639 (nn. 80, 82) *See also* **diafonitas, raritas** *in Latin-English Index*.

tunic *See* **ocular tunic** *above*.

type/kind lxii, lxx-lxxii, lxxvii, lxxxvi, lxxxvii, 409 (n. 90), 538 (n. 43), 539 (n. 44), 543 (n. 78), 556 (n. 196) *See also* **genus, qualitas, quiditas, specialitas, species, varietas** *in Latin-English Index*.

ugliness (as a visible intention) liii, lxiii, lxvi, lxvii, cxxxvii (n. 194), clxxv, 541 (n. 60), 555 (n. 184) *See also* **deformitas, feditas, turpitude** *in Latin-English Index*.

Umayyads xlv

universal as object of cognition xlvi, lxxii, lxxxviii, xcvi, cxxxi (n. 130), cxxxix (n. 216), cxlvii (n. 309), 540 (n. 55)

universal form lxx-lxxii, lxxxvii, cxxxviii (n. 212), cxxxix (nn. 215, 216), cxi (n. 231), cxliv (n. 266), 540 (n. 55), 541 (n. 65), 556 (nn. 193, 196) *See also* **forma universalis** *in Latin-English Index*.

Utarid ibn Muhammed cxxxiii (n. 147)

uvea xlviii, lvii-lix, cxxxv (n. 169), 398-400 (nn. 24, 29-31), 400 (n. 34), 401 (nn. 36-38), 402 (n. 40), 412 (nn. 123, 124) *See also* **uvea** *in Latin-English Index*.

Vasari, Giorgio civ

veridical perception xxix, liii, lxxiii, xcv, xcvi, ciii, cxi

Viator cviii, cix, clii (n. 356)

view/to view xxix, xxx, xxxiii, xxxiv, xlii, xliii, lxviii, lxxv, xcii, xcv, cv-cvii, cxii, cxiv, cxxvii (n. 76), cxxxvii (n. 191), cxxxviii (n. 208), cl (n. 329), 396 (n. 13), 403 (n. 57), 408 (n. 80), 540 (nn. 57, 58), 541 (n. 64), 543 (n. 87), 544 (n. 91), 547 (n. 111), 548 (n. 122), 549 (n. 130), 550 (nn. 135, 141), 551 (n. 143), 553 (n. 161), 557 (n. 206), 632 (n. 18), 636 (n. 48), 639 (n. 81) *See also* **inspectio, inspicere, intueri, videre, visio** *in Latin-English Index*.

virtual image cxlix (n. 323)

visible characteristic/feature/property xxxi, lxii, lxviii, lxx, lxxxvii, ciii, cxxviii

(nn. 87, 89), 537 (n. 31), 540 (n. 60), 542 (n. 73), 553 (n. 162), 554 (nn. 168, 169)
See also **res visibilis** in *Latin-English Index*.

visible intention lxii, lxiii, lxvi, lxviii, lxxi, lxxii, lxxvii, lxxxvi, lxxxix, ciii, cxxxvi
 (nn. 182, 183), cxxxviii (n. 203), cxl (n. 232), cxliv (n. 277), clxxv, clxxvi, 540
 (n. 60), 553 (n. 162) *See also* **beauty, continuity, corporeity, darkness, difference, discontinuity, distance, motion, number, opacity, rest, roughness, shadow, shape, similarity, size, smoothness, spatial disposition, transparency, ugliness** *above*. *See also* **intentio** in *Latin-English Index*.

visible object xviii, xxviii, xxxi, xxxiv, lxi, lxvii, lxxiv, xcii, cviii, cxiv, cxxvii
 (n. 74), cxxviii (n. 89), cxxix (n. 96), cxlv (n. 280), clxxx (n. 17), 407 (n. 71),
 408 (n. 80), 535 (n. 23), 537 (n. 31), 541 (n. 65), 543 (n. 87), 546 (n. 107), 631
 (n. 12), 632 (n. 21), 635 (n. 36) *See also* **res, res visa, res visibilis, visibile, visum** in *Latin-English Index*.

visible radiation *See* **light-radiation**

vision at first glance lxxi, cxxxix (n. 214) *See also* **aspectus** in *Latin-English Index*.

visual clarity/acuity xxviii-xxx, lxviii, lxix, lxx, lxxv, lxxviii, cxi, cxxviii (nn. 78,
 79), 397 (n. 17), 403 (n. 57), 405 (n. 64), 536 (n. 29), 630 (n. 8), 632 (nn. 18, 19)

visual angle xxviii, xxix, xxxii, xxxiii, lxv, lxvi, cxxvii (n. 76), cxxvii (n. 190),
 548 (nn. 118, 119, 121, 126), 549 (n. 131), 550 (nn. 135, 137), 551 (n. 146), 636
 (n. 48), 637 (n. 59)

visual axis xxix, xxx, xxxiv, lxii, cvii, cviii, cxxviii (n. 79), cxxviii (nn. 204, 205,
 207, 208), cxl (n. 227), clxxx (n. 17), 400 (n. 31), 401 (n. 36), 402 (n. 41), 535
 (nn. 23-25), 536 (nn. 26, 27), 537 (n. 29), 546 (n. 107), 550-551 (n. 143), 556
 (n. 192), 630-631 (n. 12), 631 (n. 16), 632 (n. 18), 633-634 (nn. 26, 27), 634
 (nn. 28, 29), 635 (n. 36) *See also* **axis, axis radialis** in *Latin-English Index*.

visual cone xxviii-xxx, xxxiii, xxxiv, xxxvi, xlii, li, lxi, lxxv, lxxx, xci, cvii, cxiv,
 cxxvii (nn. 74, 75), cxxviii (n. 79), cxxix (n. 96), cxxviii (n. 204), clii (n. 355),
 402 (n. 41), 405 (nn. 64, 66), 407 (n. 78), 410 (n. 101), 535 (n. 23), 546 (n. 106),
 548 (n. 118), 549 (n. 126), 550 (n. 143), 551 (n. 147), 552 (n. 151), 629-630
 (nn. 5, 7, 8) *See also* **piramis radialis** in *Latin-English Index*.

visual deception/illusion/misperception xviii, xxix, xxxiii, xxxv, xxxvi, liii,
 lxxiii, lxxvi-lxxviii, xcv, cv, cxvi, cxxi (n. 12), cxl (nn. 230-233), clxxvi, 550
 (n. 136), 636 (n. 48), 638 (n. 64) *See also* **Moon Illusion, oculogyral illusion**
above. *See also* **deceptio** in *Latin-English Index*.

visual depiction lxi, lxxvii, cxliv (n. 278), cxlix (n. 323), 541 (n. 64), 557 (n. 206)
See also **pictura, ymago** in *Latin-English Index*.

visual faculty xxxv, lxi, lxxviii, cxxviii (n. 87), 403 (n. 57), 543 (nn. 81, 88), 547
 (n. 111), 550 (n. 135), 630 (n. 9), 636 (nn. 42, 48) *See also* **visus** in *Latin-English Index*.

visual field xxviii, xxx, xxxii, xxxiii, xlii, xlix, lviii, lxv, lxxv-lxxviii, lxxxiv, cv,
 cviii, cxxviii (n. 83), cxxviii (n. 152), cxxvii (n. 190), 403 (nn. 52, 57), 406-407
 (n. 70), 410 (n. 101), 413 (n. 132), 545 (nn. 93, 101), 552 (n. 153), 629 (n. 7), 632
 (n. 19)

visual flux xxviii-xxx, xxxiii, xxxv-xxxvii, xl, xlv, lxxx, cxiv, cxxvii (n. 74),
 cxxviii (nn. 79, 83, 89), 397 (n. 17), 409 (n. 87), 410 (n. 97), 535 (n. 22), 552

- (nn. 151, 153), 636 (n. 48)
- visual focus** xxxiii, lxix, lxxv, lxxvi, lxxxiv, cxxxviii (nn. 204, 205), 632 (n. 21), 635 (n. 36) *See also* **certificare, dirigere, figere, inspicere, intendere, intueri, intuitio, oppositio, visus** in *Latin-English Index*.
- visual illusion** *See* **visual deception** *above*.
- visual imaging** ci, 398 (n. 25),
- visual inspection** lxxi, 555 (n. 187) *See also* **intueri, intuitio** in *Latin-English Index*.
- visual pneuma** xli, xlii, xlviii
- visual radiation/ray** xxv, xxviii-xxx, xxxii, xxxv, xxxvi, xl, l, lvii, lxvi, lxxx, xc-xciii, xcix, cviii, cix, cxiii, cxiv, cxvi, cxxvi (n. 64), cxxvii (n. 74), cxxxiii (n. 151), cxxxv (n. 171), cli (n. 340), clii (n. 356), 405 (n. 64), 407 (n. 78), 408 (nn. 82, 85), 409 (nn. 87-89), 549 (n. 132), 550 (n. 143), 552 (n. 154)
- visual scan** xxix, lviii, lxx, lxxi, lxxvi, xcv, cxxviii (n. 79), cxxxviii (n. 209), 413 (n. 132), 537 (n. 29), 550-551 (nn. 141, 143), 553 (n. 156) *See also* **intuitio, intuitus, motus** in *Latin-English Index*.
- visual spirit** lviii, lxii, lxxii, lxxix, lxxxvi, lxxxviii, xcii, cxiii, cxxxv (n. 171), cxxxvi (n. 180), 400 (n. 32), 405 (n. 65), 411 (n. 108), 535 (n. 22) *See also* **spiritus visibilis** in *Latin-English Index*.
- vital pneuma** xl, xlviii
- vitreous humor** xxxvii, xxxviii, xlvii, lviii, lxi, cxxix (n. 103), cxxxii (n. 139), cxxxv (n. 170), cxxxvi (n. 180), cxxxviii (n. 204), 398 (nn. 27, 28), 399 (nn. 30, 31), 412 (n. 125), 531-534 (nn. 12, 15), 534 (nn. 18, 19), 535 (nn. 21, 24, 25), 536 (nn. 26, 27), 545 (n. 100) *See also* **vitreus** in *Latin-English Index*.
- Vitruvius** cli (n. 337)
- walking stick analogy of sight** xliii, ciii
- William of Ockham** lxxxii, xciv, xcvi, cxiii, cxlviii (n. 311), 408 (n. 85)
- Witelo** xi, xx, lii, lxxxii-lxxxiv, lxxxix, cvi, cxiii, cxxxiii (n. 154), cxlii (n. 252), cli (n. 340), clxi, 400 (n. 34)
- Wyclif, John** lxxxii, xcv, xcvi