

**THE LATIN SOURCE OF THE FOURTEENTH-
CENTURY ITALIAN TRANSLATION OF ALHACEN'S
DE ASPECTIBUS (VAT. LAT. 4595)**

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Composed in the early eleventh century, Ibn al-Haytham's *Kitāb al-Manāẓir* ("Book of Optics") marked a turning-point in the development of optics not only because of its technical sophistication but also because of its comprehensiveness. Accordingly, while taking ray-analysis to a far higher mathematical level than before, Ibn al-Haytham (or "Alhacen" as he came to be known in Latin¹) also offered an extensive and compelling account of visual perception that was based broadly on physical, physiological, and psychological principles. Small wonder that, soon after it was translated into Latin under the title *De aspectibus* (c. 1200), Alhacen's treatise assumed canonical status in the Latin West, counting among its most enthusiastic proponents such perspectivist optical theorists as Roger Bacon (fl. c. 1260), Witelo (fl. c. 1270), and John Pecham (fl. c. 1280).²

But Alhacen's influence extended beyond the realm of optics, reaching as far afield as theology and art. The late-thirteenth-century theologian, Peter of Limoges, for instance, looked to Alhacen for visual examples to include in his *De oculo morali*.³

¹ Although it has been traditional to Latinize Ibn al-Haytham's name as "Alhazen" according to the form used by Friedrich Risner in his 1572 edition of the *De aspectibus*, the Latin manuscript-tradition simply does not support that rendering. Among the various forms to be found within that manuscript-tradition ("Hacen," "Alacen," "Achen," and "Alhacen") the most common by far is "Alhacen," which is a relatively faithful transliteration of "al-Ḥasan," Alhacen's given name in Arabic: i.e., al-Ḥasan ibn al-Ḥasan ibn al-Haytham.

² Much has been written lately on the impact of Alhacen's optical work upon the development of ray-theory and visual-theory in the medieval Latin West, but the still-standard account is to be found in David C. Lindberg, *Theories of Vision from Alkindi to Kepler* (Chicago, 1975).

³ See, e.g., Richard Newhauser, "Der 'Tractatus moralis de oculo' des Petrus von Limoges und seine *exempla*," in Walter Haug and Burghart Wachinger (eds.), *Exempel und Exempel-sammlungen* (Tübingen, 1991), pp. 95-136. See also Dallas Denery, *Seeing and Being Seen: Vision, Visual Analogy and Visual Error in Late*

And, as Graziella Vescovini has recently shown, Lorenzo Ghiberti relied heavily upon Alhacen – quoting verbatim and at length from him – while framing his account of art and its aesthetic imperatives in the “*Commentario terzo*.” As Vescovini has also shown, Ghiberti’s actual source was not the Latin version of the *De aspectibus* but, rather, a fourteenth-century Italian translation entitled *Deli Aspecti*.⁴ Currently extant in MS Vat. Lat. 4595,⁵ this “volgarizzamento” of Alhacen’s work was thus central to the development of Ghiberti’s thought about art and visual aesthetics. Even more important, according to Vescovini, it may well have been central to the development of artificial perspective in early Renaissance Italian painting.⁶

Given the significance of both versions, Latin and Italian, of Alhacen’s optical masterpiece, it is of more than passing historical interest to know precisely what Latin manuscript served as the source for the Italian translation. There are at least seventeen candidates according to the number of complete, or virtually complete, Latin manuscript-versions of the *De aspectibus* that are currently known to exist. They are as follows:

1. London, British Library: MS Royal 12.G.7, fols. 1r-102v (14th century)
2. Cambridge, University Library: MS Peterhouse 209, fols. 1r-111v (14th century)

Medieval Optics, Theology and Religious Life, PhD Diss.: University of California (Berkeley, 1999). For a broader look at Alhacen’s impact within the theological realm, see Katherine Tachau, *Vision and Certitude in the Age of Ockham* (Leiden/New York/Copenhagen/Cologne, 1988).

⁴ G. Vescovini, “Alhazen vulgarisé: Le *De li aspecti* d’un manuscrit du Vatican (moitié du XIV^e siècle) et le troisième Commentaire sur l’optique de Lorenzo Ghiberti,” *Arabic Sciences and Philosophy*, 8 (1998): 67-96. Building on her earlier “Contributo per la storia della fortuna di Alhazen in Italia: Il volgarizzamento del manoscritto Vat. 4595 e il ‘Commentario terzo’ del Ghiberti,” *Rinascimento*, ser. 2, 5 (1965): 17-49, Vescovini devotes this later study to the actual passages that Ghiberti imported directly from the *Deli aspecti* into his own *Commentario terzo*. For a broader discussion of Alhacen’s – and his perspectivist disciples’ – influence on Renaissance art and aesthetics, see David Summers, *The Judgment of Sense: Renaissance Naturalism and the Rise of Aesthetics* (Cambridge, 1987).

⁵ For a detailed description of this manuscript, see E. Narducci, “Intorno ad una traduzione italiana, fatta nel secolo decimoquarto, del trattato d’Optica d’Alhazen, matematico del secolo undecimo, e ad altri lavori di questo scienziato,” *Bollettino di bibliografia e di storia delle scienze matematiche e fisiche*, 4 (1871): 1-48.

⁶ See, esp., Vescovini, “Alhazen vulgarisé,” p. 68.

3. Edinburgh, Crawford Library, Royal Observatory: MS Cr3.3, fols. 3r-186r (13th century)
4. Paris, Bibliothèque Nationale: MS Lat 7319, fols. 1r-340v (late 13th/early 14th century)
5. Paris, Bibliothèque Nationale: MS Lat 16199, fols. 1r-277v (16th century)
6. St-Omer, Bibliothèque Municipale: MS 605, fols. 1r-153v (14th century)
7. Vienna, Österreichisches Nationalbibliothek: MS 5322, fols. 1r-270r (15th century)
8. Cambridge, Trinity College: MS 0.5.30, fols. 1r-165r (13th century)
9. London, Royal College of Physicians: MS 383, fols. 1r-132r (14th century)
10. Florence, Biblioteca Nazionale Centrale: MS II.III.324, fols. 1r-136v (14th century)
11. Brugge, Stedelijke Openbare Bibliotheek: MS 512, fols. 1r-113v (13th century)
12. London, British Library: MS Sloane 306, fols. 1r-177v (14th century)
13. Munich, Bayerische Staatsbibliothek: MS CLM 10269, fols. 1r-160r (14th century)
14. Erfurt, Wissenschaftliche Bibliothek der Universität: MS Ampl. F.392, fols. 1r-143v (13th century)
15. Oxford, Corpus Christi: MS 150, fols. 1r-112r (13th century)
16. Paris, Bibliothèque Nationale: MS Lat. 7247, fols. 1r-107v (14th century)
17. Vatican, Biblioteca Apostolica: MS Palat. Lat. 1355, fols. 1r-147r (13th century)

To pinpoint any of these manuscripts as the actual source of the Italian translation – or at least most proximate to that source – requires isolating it according to shared characteristics or “variants.”⁷ At the level of gross variants, for instance, the Italian version (henceforth referred to by the siglum *I*) and the first

⁷ Although the chronological position of many of the manuscripts listed above might seem to disqualify them (after all, how could a fourteenth-century translation have been derived from a sixteenth-century text?), it is quite possible that both derive from a common ancestor. Thus, it could easily happen that the Italian translation derives from precisely the same manuscript as a far later Latin copy, so the ancestor would be this, the most proximate manuscript-source. Note that a “variant” is such only insofar as it represents a deviation from some norm or established standard. That norm or standard, of course, is established by the critical text of the work in question.

seven Latin manuscripts listed all include Ibn Mu‘ādh’s brief *De crepusculis et nubium ascendentibus* at the very end of the *De aspectibus*.⁸ According to this major shared variant, then, the field of candidates can be narrowed to seven. We can truncate this field even further on the basis of the incipit found at the beginning of book four in *I: el libro quarto de hacen figluolo de o hucam figlolo de haiten deli aspecti*. The Latin version of this incipit – *liber quartus hacen filii hucam filii haiten de aspectibus* – occurs in only four of the manuscripts listed above: entries 1, 2, 8, and 9. Thus, while *I*’s Latin source, or its nearest relative, would seem to lie among entries 1-7 listed above, it would also seem to lie among entries 1, 2, 8, and 9 listed above. Since only entries 1 and 2 overlap within the two groups, these two manuscripts emerge as the most probable candidates of all. Between 1 and 2, finally, the choice is dictated by the fact that, unlike entry 2, the London manuscript listed as entry 1 (henceforth referred to by the siglum *L*) has virtually the same explicit as *I* at the end of Ibn Mu‘ādh’s treatise: *L = Explicit liber etc.: Alacen in scientia perspectiva; I = Explicit liber Alacen in scientia prespectiva*. Hence, by a simple process of elimination we find that *L* is the most probable source for *I*, a conclusion that *I* in fact reached several years ago on other grounds.⁹

Based as it is on such a small range of variants, though, the analysis to this point is merely suggestive, not conclusive. True, our analysis so far indicates that *L* is the likeliest candidate among the seventeen listed manuscripts, but *I*’s true source may not be among this group at all; it may actually lie undiscovered or, worse, be irretrievably lost. In order, therefore, to establish whether *L* is indeed the source for *I*, we must compare both manuscripts closely on the basis of a wide range of idiosyncratic variants – variants, that is, that are unique to both. The more such shared idiosyncratic variants, the greater the likelihood that there is a direct link between the two versions.

⁸ For the critical edition of this treatise, see A. Mark Smith, “The Latin version of Ibn Mu‘ādh’s treatise ‘On Twilight and the Rising of Clouds’,” *Arabic Sciences and Philosophy*, 2 (1992): 83-132.

⁹ See A. Mark Smith and Bernard R. Goldstein, “The medieval Hebrew and Italian versions of Ibn Mu‘ādh’s ‘On Twilight and the Rising of Clouds’,” *Nuncius*, 9 (1993): 611-43, esp. 628. For a description of *L*, see 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. Note, finally, that *L*’s dating (14th century) raises the probability of its being the actual parent of *I*, not merely a proximate source (see n. 7 above).

The first step in this process of comparison is to isolate *L*'s idiosyncratic variants relative to all the other Latin manuscripts. That can be done only on the basis of a comparative transcription of all seventeen. For reasons quite apart from this study, I have already produced such a transcription, not for the entire treatise (which runs to nearly 200,000 words), but for roughly one-third.¹⁰ In addition, with a critical edition of Ibn Mu'adh's *De crepusculis* already published, I could easily locate *L*'s idiosyncratic variants in that edition's critical apparatus. Altogether, then, the textual basis for my comparative analysis was not just adequate, but more than adequate. I decided on that basis to whittle it down to manageable proportions according to three textual segments: fols. 1r-4v in *L* (1r-6v in *I*), fols. 46r-49r in *L* (73r-78v in *I*), and fols. 102v-104r in *L* (177v-181v in *I*), this latter segment containing Ibn Mu'adh's appended treatise.¹¹ Hence, for the purposes of comparative analysis I relied upon roughly eight percent of the entire work, a swath of text amounting to somewhat over 16,000 words.

The analysis itself involved three basic procedures. First, I combed the textual segments listed above for all of the variants that are unique to *L*. Whenever I found one, I turned to the same place in the text of *I* to determine whether it was manifested there. At first blush, such a determination might seem unfeasible, given the syntactic and grammatical differences between Latin

¹⁰ Some years ago I produced this comparative transcription as a first step in critically editing books 1-3 of the *De aspectibus*. I have since used this transcription as means of analyzing the family-relationships, as well as specific lines of filiation, among the seventeen manuscripts that contain all, or most, of the *De aspectibus*. It is on the resulting critical text that the subsequent analysis of variants is based. For that text see A. Mark Smith (ed. and trans.), *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 Kitāb al-Manāẓir*, forthcoming in *Transactions of the American Philosophical Society* (Philadelphia: American Philosophical Society Press). For complete details on the manuscripts and my editing procedures, see the section of that critical edition entitled "Manuscripts and Editing."

¹¹ The choice of these particular three segments was dictated not only by their having been critically edited but also by their being relatively evenly distributed through the text according to beginning, middle, and end. It is, of course, possible that the portions of the Italian text that lie between the three slices I chose for comparison (i.e., the portions contained in 7r-72v and 80r-177r – which are paralleled by 5v-45v and 49r-102r in *L*) were based on one or more other Latin versions, but it is extremely unlikely that the Italian translator would have departed from *L* somewhere after the middle of the treatise and then returned to it for the last five folios, which contain Ibn Mu'adh's treatise.

and Italian. But, as it turns out, the Italian translation hews so closely to the Latin original that I rarely found it difficult to locate the parallel variants (or lack thereof) in the two texts.

The two subsequent procedures were meant to provide controls for the one-to-one comparison of *L* and *I* on the basis of uniquely shared variants. Limiting myself to the first textual segment (i.e., fols. 1r-4v in *L*), I started by combing the text for variants that are unique to each of the remaining sixteen manuscripts and that also appear in *I*. The point of this exercise was to rule out a corollary link between *I* and any of the Latin manuscripts other than *L*.¹² That done, I concluded by tabulating the variants that *I* and *L* share with one or more of the remaining manuscripts in order to determine how deeply the correlation between *I* and *L* extends when all their shared variants are taken into account. As will become clear in short order, these two control-analyses make it virtually certain that *L* was the source – and the sole source – for *I*. Before presenting my results, though, I should explain briefly how I tabulated my data and, therefore, how the resulting tabulations are to be understood.

The basic organizing principle for my tabulation is that, depending on type, variants fall within a rather broad range according to probability or significance. In Latin, for instance, a simple transposition (e.g., “res visa” to “visa res”) is of relatively high probability and commensurately low significance, whereas the omission of an entire line of text is of relatively low probability and commensurately high significance. The same transposition might well occur by coincidence in two or even more manuscripts, but not omission of the very same line of text. So there is a hierarchy of variants according to the probability of their occurring accidentally in more than one manuscript. The lower that probability, the higher the variant’s significance. On this basis, the fundamental variant-types can be categorized as follows from most to least significant: 1) omission of a phrase, 2) insertion of a phrase, 3) repetition of a phrase, 4) omission of a word, 5) insertion of a word, 6) repetition of a word, 7) substitution of a word, 8) transformation of a word, 9) transposition of words.¹³

Although most of these categories are self-explanatory, two

¹² In other words, this procedure was meant to determine whether the Italian translator consulted two or more Latin versions at the same time when composing *I*.

¹³ This schema is based on one laid out by Joseph Mogenet half a century ago in *Autolycus de Pithane* (Louvain, 1950). For a brief explanation of its import and implications, see Smith, “The Latin version of Ibn Mu‘ādh’s treatise,” pp. 92-3.

of them – substitution and transformation – require some elucidation. By “substitution” I mean the replacement of one word by another that is of entirely different form and/or meaning. For instance, the replacement of “distincta” with “determinata” would constitute a substitution because of the signal change in form, if not meaning. On the other hand, a mere change in tense, mood, or number – e.g., altering “intuetur” to “intueatur” or “quam” to “quem” – would constitute a transformation.

In the case of our analysis, transposition is irrelevant, because the Italian translator would most likely have suited the word-order to native linguistic demands rather than to the literal imperatives of the text. Thus, unlike a Latin scribe who, when confronted with “visa res,” would be inclined unthinkingly to reproduce the phrase in that form, the Italian translator would surely recast it in the form “la cosa visa” that proper Italian syntax requires.

Among the remaining eight variant-types, certain problems of distinction can arise from time to time. Substitution and transformation are especially vexing in this regard because of various scribal conventions followed during the Middle Ages. At first glance, for example, the replacement of “quem” with “quoniam” appears to be a fairly clear case of substitution, but certain forms of medieval abbreviation for the two terms are so close that they can readily be confused. Likewise, because of the inherent difficulty in distinguishing among minims, one can easily mistake the abbreviation for “ut” as an abbreviation for “non.” What look to be omissions can be misleading, as well. Adverbs, such as “vero,” or conjunctions, such as “enim,” often function so weakly in the Latin that they are better left untranslated. Their absence in the Italian version can therefore not be taken as an unequivocal indication of their absence in the Latin.

While these difficulties should not be ignored, they should not be exaggerated either. For the most part, the distinctions among variants listed above are quite clear, and where they are not they involve relatively insignificant variants. In those cases where the distinctions are unclear or problematic, moreover, I have taken a conservative stance, putting equivocal variants within the category of higher or lower significance, depending on context.¹⁴

¹⁴ For example, when an equivocal variant was uniquely shared by *L* and *I*, I placed it in the lower category of significance in order to lessen its effect on the correlation. On the other hand, when an equivocal variant was unique to *L* but not to *I*, I placed it in the higher category of significance for the same reason.

In so doing, I counted as substitutions several variants that were probably mere transformations, and vice versa. By the same token, several of the omissions I recorded as such probably reflect stylistic quirks on the part of the Italian translator rather than true omissions. Bearing these points in mind, let us turn to some actual examples from *L* and *I* in order to clarify the discussion of methodology.

Let us start with an instance of phrase omission. Take the following passage from the critical Latin text: *et iam declaravimus hoc in aere et cum fuerint experimentata omnia corpora diafona invenietur quod lux non extendetur in eis nisi secundum lineas rectas et nos declarabimus post apud nostrum sermonem in obliquatione quomodo illud experimentabitur*. The same passage rendered in *L* reads as follows: *et iam declaravimus [...] post apud nostrum sermonem in obliquatione quomodo illud experimentabitur* (4va, 35-36). Note that the entire phrase *hoc ... declarabimus* underlined in boldface type in the first passage has been omitted by *L* in the second. This very same omission occurs in *I*'s version of the passage: *anchora dechiaramo [...] apresso al nostro sermone in la obliquatione como quello si spremintara* (6ra, 1-3). There is thus no question that *L* and *I* share this key variant. More to the point, since this particular omission is unique to *L* within the Latin manuscript-tradition, the fact that *I* shares it indicates not only a linkage, but a potentially tight linkage, between *I* and *L*.

In order to round out this discussion of methodology, I have provided a few additional examples below in parallel format, the left-hand column containing the critical Latin text, the middle column *L*'s version, and the right-hand column *I*'s version.

PHRASE-INSERTION

verumptamen [...] terre non est apud hunc orbem magna quantitas

*verumtamen **punctus vel centrum** terre non est apud hunc orbem magna quantitas* (104v, 13-14)

*ma pure **el punto o veramente el centro** dela terra non e apresso questo orbe grande quantita* (181rb, 9-11)

WORD-OMISSION

*et in loco a quo reflectitur **lux** fortiozem et magis scintillantem.*

et in loco a quo reflectitur [...] fortiozem et magis scintillantem (1va, 1-2)

e in lo luoco dove si reflecte [...] e piu forte e piu sintilante (1va, 41-42)

WORD-INSERTION

<i>et iste [...] circulus est equidistans</i>	<i>et iste sectionis circulus est equidistans</i> (3ra, 34)	<i>e di questa sezione el circulo e equidistante</i> (3vb, 38-39)
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SUBSTITUTION

<i>et linea aeh sit transiens per zenith capitis</i>	<i>et linea aeh sit transiens per centrum capitis</i> (104v, 6-7)	<i>e la linea aeh sia passante per lo centro del capo</i> (181ra, 44-45)
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TRANSFORMATION

<i>in orizonte occidentali</i>	<i>in orizonte accidentali</i> (102vb, 23)	<i>nel orizonte accidentale</i> (178ra, 11-12)
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Since it would serve little or no purpose to multiply examples, or, for that matter, to list every instance in which *L* and *I* share idiosyncratic variants (there are at least 180 such in the three textual segments selected for analysis), I have chosen to present my data in statistical form. Actual documentary evidence I have remanded to an appendix, where I have listed in full every instance of phrase-omission and phrase-insertion to be found in the three textual segments selected for analysis: twenty-three in all.

Let us therefore turn to the following four tables, where the results of our comparison are given for the first textual segment, consisting of fols. 1r-4v in *L*.

TABLE 1

	1	2	3	4	5	6	7	8
L	7			21	4		5	31

Table 1 lists all the variants unique to *L* relative to the sixteen other Latin manuscripts. Reading from right to left we see that *L* contains seven unique phrase-omissions, twenty-one unique word-omissions, four unique word-insertions, five unique word-substitutions, and thirty-one unique word-transformations.

TABLE 2

	1	2	3	4	5	6	7	8
L				1	1			5
I	7			20	3		5	26

Table 2, for its part, provides a comparison between *L* and *I* on the basis of the unique variants listed in Table 1. The second line shows the variants that are shared by *L* and *I*, whereas the first line shows those variants that remain unique to *L*. As is clear from this tabulation, *I* shares the vast preponderance of *L*'s idiosyncratic variants: i.e., 61 out of 68.

TABLE 3

	1	2	3	4	5	6	7	8
L/R	1		1		3			3
I/R	2	4		8	2		2	12

Next in order, Table 3 provides a comparison between *I* and *L* in terms of variants in *L* that are shared with one or more of the sixteen remaining Latin manuscripts. Line two lists those shared variants that are also common to *I*, whereas line 1 lists those shared variants that are absent from *I*.¹⁵

TABLE 4

	1	2	3	4	5	6	7	8
L	1		1	1	4			8
I	9	4		28	5		7	38

Table 4, finally, gives an overview of all the variants that are shared by *L* and *I* within the first textual segment, no matter whether they are unique to *L* or whether they are common to *L* and one or more of the remaining sixteen Latin manuscripts.

Taken in concert, all four tables indicate a remarkably high correlation between *L* and *I*. This point is especially clear in Table 2. Of the 68 variants listed there that are unique to *L* all but seven are common to *I*. Five of those seven, moreover, are insignificant, consisting as they do of transformations. The other two unshared variants – one being a word-omission, the other a word-insertion – could easily represent variants unique to *I*, the omission in *L* actually being an accidental insertion in *I*, the insertion, conversely, being an accidental omission in *I*. In

¹⁵ Thus, the line designated L/R indicates those variants shared between *L* and all the remaining Latin manuscripts but that are not in *I*; the line designated I/R indicates those variants shared among *I*, *L*, and any one or more of the remaining Latin manuscripts.

short, the unshared variants may well represent idiosyncratic variants imported into *I* by the Italian translator himself.

The case for linkage between *L* and *I* becomes all the more compelling when the data from Table 3 are taken into account. Here we see that, in terms of the 38 variants shared by *L* with one or more of the remaining sixteen manuscripts, *I* manifests all but eight. Of those eight, only two – a phrase-omission and a phrase-repetition – are potentially significant, and both can be accounted for quite easily as idiosyncratic variants imported into *I* by the Italian translator.¹⁶ Consequently, as we see from Table 4, where the data from Tables 2 and 3 are integrated, all but 15 of *L*'s 106 variants, whether unique or not, are found in *I*, and of those fifteen the two that are potentially significant can be readily accounted for as idiosyncratic variants in *I*.

What about a possible corollary link between *I* and one or more of the other sixteen Latin versions? That possibility is ruled out by the fact that *I* shares only six idiosyncratic variants with manuscripts other than *L*. Two of those variants are shared with the manuscript listed under entry 13 on p. 29 above, and one each is shared with the manuscripts listed under entries 5, 7, 12, and 16 on p. 29 above, so there is no clustering of them whatever. Furthermore, only one of the six – a phrase-omission shared with entry 5 – is potentially significant, and that variant turns out to be equivocal at best.¹⁷ Obviously, then,

¹⁶ The omitted phrase occurs in the following passage of the critical Latin text: *et iam declaratum est quod linea transiens per centrum uvee et per centrum corneae et per centrum foraminis quod est in exteriori sive in 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 transit per centrum corneae [et per centrum uvee] et per centrum foraminis* (3rb, 21-27). The Italian translator could easily have restored the phrase “et per centrum uvee” (*e per lo centro del uvea*) coincidentally according to its double recurrence earlier in the passage. As to the phrase-repetition, it is obvious as such: *[visus] sentiet ex tota superficie eius formam cuiuslibet puncti superficierum illius rei vise et formam cuiuslibet puncti superficierum illius rei vise et formam cuiuslibet puncti superficierum omnium visibilium* (4rb, 31-34). Hence, unlike a scribe mindlessly copying the Latin text, the Italian translator could hardly have failed to notice the repetition, and therefore to excise it, as he was attempting to make sense of the passage for translation: *[el viso] sentira de tuta la superficie de essa la forma de ziascheduno punto dele superficie di quella cosa visa [...] e le forme de ziascheduno punto dele superficie de tuti visibili* (5vb, 12-16).

¹⁷ The critical Latin text reads as follows with the phrase omitted in Italian in bold-face type: *quare visibilia erunt ab eo ordinata et distincta* (4rb, 48). The Italian translation is as follows: *per la quale cosa serano le cose visibili ordinate e distincte* (5vb, 39-40). The Latin phrase “ab eo” may well be wrapped up in “per la quale cosa” which was chosen by the Italian translator over the simpler, more obvious “per che.”

I has no links whatever to any of the Latin manuscripts other than *L*.

The close correlation between *L* and *I* that emerges from our analysis of the first textual segment is not only borne out, but even strengthened, by our analysis of the other two textual segments. Tables 5 and 6 below list the comparative results for those segments – i.e., fols. 46r-49r and fols. 102v-104r in *L*. In Table 5 we see that among *L*'s 71 idiosyncratic variants in the second textual segment *I* shares all but eight, and those eight consist solely of transformations. By the same token, we see in Table 6 that among *L*'s 61 idiosyncratic variants in the third textual segment *I* shares all but five, and none of those five is of noteworthy significance.

TABLE 5

	1	2	3	4	5	6	7	8
L								8
I	9	1		13	2		13	25

TABLE 6

	1	2	3	4	5	6	7	8
L					1		1	3
I	2	4		11	10		12	17

When the comparative results for all three textual segments in Tables 2, 5, and 6 are added together in Table 7 below, we see just how high the correlation between *L* and *I* is overall.

TABLE 7

	1	2	3	4	5	6	7	8
L				1	2		1	16
I	18	5		44	15		30	68

As this table indicates, of *L*'s 200 idiosyncratic variants throughout the three textual segments selected for analysis *I* shares all but 20. Of those 20, meantime, only three – one word-omission and two word-insertions – are potentially significant, and they can easily be accounted for as idiosyncratic variants imported into *I* by the Italian translator. Most telling are the eighteen shared phrase-omissions and the five shared phrase-

insertions, all of which occur without any unshared equivalents. Somewhat less telling, but still significant, is the existence of 44 shared word-omissions, counterbalanced by just a single unshared one. These data argue eloquently for the closeness of the bond between *L* and *I*. So close, indeed, is this bond that it is difficult to imagine any relationship between *L* and *I* other than that of progenitor and offspring.

Difficult though it may be to imagine any other relationship between the two, it is not impossible. After all, the degree of certainty achieved in the preceding analysis is commensurate with the degree of correlation, and that is less than perfect. But bear in mind that we are dealing with manuscripts and that the manual reproduction of texts is as error-prone as it is tedious and mind-numbing. Bear in mind, too, that the Italian translator was not merely reproducing, but construing, the Latin text. He was therefore subject to stylistic, grammatical, and even hermeneutic considerations that would not have concerned a Latin scribes, considerations that permitted him a fair degree of interpretive license. Under these conditions, a perfect correlation between *L* and *I* would be not only astonishing but highly suspect. On the other hand, this less-than-perfect correlation opens up the possibility, slim though it may be, that, instead of being directly linked, *L* and *I* are indirectly linked through an immediate common Latin ancestor. Although we cannot preclude this possibility, we can appeal to Ockham's Razor in rejecting it. For simplicity's sake, in short, we must conclude that *L* and *I* are directly rather than indirectly affiliated.

APPENDIX

Following is a list of all phrase-omissions and phrase-insertions that are uniquely shared by *L* and *I* in the three textual segments analyzed. The critical Latin text is given in the left-hand column, *L*'s text in the center column, and *I*'s text in the right-hand column.

PHRASE-OMISSIONS

<i>deinde revertatur visus eius ad locum obscurum in domo inveniet formam lucis</i>	<i>deinde revertatur visus eius ad locum obscurum [...] inveniet formam lucis</i> (1ra, 42-44)	<i>e poi ritorne el viso suo a lo luoco oscuro [...] trovava la forma dela luxe</i> (1rb, 9-11)
<i>et iterum visui multotiens latent multe res que sunt invisibiles ex sculpturis subtilibus et scripturis subtilisolebus...</i>	<i>et iterum visui multotiens latent multe res que sunt invisibiles ex [...] scripturis subtilibus</i> (1vb, 11-13)	<i>e anchora al vedere molte volto si nascondeno molta cosa le quale sono invisibile per [...] le scultore¹⁸ sotile</i> (2r, 19-21)
<i>et etiam quia istud centrum est centrum superficiei</i>	<i>et etiam quia istud centrum [...] superficiei</i> (3rb, 51)	<i>e anche per che quello centro [...] dela superficie</i> (4rb, 28-29)
<i>ergo est inter totum oculum centrum ergo superficieum tunicarum visus oppositarum foramini uvee est intra totum oculum cum ergo</i>	<i>ergo est inter totum oculum [...] cum ergo</i> (3va, 6-7)	<i>adonche sera tra tuto l'ochio [...] quando adonche</i> (4ra, 38-39)
<i>consolidatur cum eis cum ex eis exeunt duo lacerti</i>	<i>consolidatur cum eis cum [...] exeunt duo lacerti</i> (3vb, 20-21)	<i>si consolida cum essi cum [...] zio sia che eschano due lacerti</i> (4vb, 45-47)

¹⁸ I take *I*'s replacement of "scripturis" with "scultore" to be an idiosyncratic variant that can, in fact, be explained as an interpretive change wrought by the Italian translator.

<i>veniente ex rebus visis ad superficiem visus et sensus non</i>	<i>veniente ex rebus visis [...] et sensus non (4va, 28-29)</i>	<i>vegnete dele cose vise [...] e'l senso non (6ra, 41-42)</i>
<i>et iam declaravimus hoc in aere et cum fuerint experimentata omni corpora omnia cor- pora diafona inveni- etur quod lux non extendetur in eis nisi secundum lineas rec- tas et nos declara- bimus post apud nostrum sermonem</i>	<i>etiam declaravimus [...] post apud nostrum sermonem (4va, 34-35)</i>	<i>anchora dechiaramo [...] appresso al nostro sermone (6rb, 1-2)</i>
<i>excessus vie quam incedit unus super eam quam incedit alius</i>	<i>excessus vie quam incedit [...] alius (46va, 42-43)</i>	<i>excesso dela via per la quale [...] l'altro incede (73vb, 5-6)</i>
<i>cum note minutissime inter aliqua corpora similitudinis aut dissimilitudinis fuerint cause</i>	<i>cum note minutissime inter aliqua corpora similitudinis [...] fuerint (46va, 42-43)</i>	<i>quando alcune note ovoi belle ovoi machie minutissimi tra alchuni corpi fosseno cagione de similitudine (74ra, 8-11)</i>
<i>vino eiusdem coloris eiusdem claritatis implenta latebunt</i>	<i>vino eiusdem coloris [...] implenta latebunt (47ra, 46)</i>	<i>piene de vino di quigli colori ovoi di quello medesimo colore se nasconderano (74vb, 10-11)</i>
<i>unde erroneum erit figure iudicium in quantitate erit error ex tali aere quoniam visum maius apparebit</i>	<i>unde erroneum [...] visum magis apparebit (46va, 42-43)</i>	<i>unde el visto eroneo [...] aparera maggiore (74vb, 42-43)</i>
<i>opposito luci forti speculo ferreo et etiam oppositus sit paries</i>	<i>opposito luci forti speculo ferreo [...] oppositus sit paries (48rb, 47-48)</i>	<i>oposito ala lux forte uno spechio di ferro [...] sia oposito el pariete (76v, 15-17)</i>
<i>apparebit quidem super corpus tertium lux secundaria</i>	<i>apparebit quidem super corpus [...] secundaria (48va, 22)</i>	<i>aparera sopra quella [...] la sicondaria (77ra, 16-17)</i>

<i>secundaria et super corpus secundum lux maior illa</i>	<i>secundaria [...] lux maior illa</i> (48v, 22)	<i>la sicondaria [...] luxe maggiore di quella</i> (77ra, 17)
<i>et erit forma directa fortior reflexa cum eadem earum origo et equalis ab ea elongatio et reflexa fortior</i>	<i>et erit forma directa fortior reflexa [...] fortior</i> (49ra, 28-29)	<i>e sera forma directa piu forte dela reflessa [...] piu forte</i> (78ra, 5-6)
<i>usque ad centrum et lineas primas ad divisiones semicirculi protractas est ad lineas tales semidiametro propinquiores</i>	<i>usque ad centrum et lineas primas [...] tales semidiametro propinquiores</i> (49rb, 38-39)	<i>persimo al centro e tale prime linee [...] piu propinqua al semidiametro</i> (78va, 6-8)
<i>que sint due linee bh et et</i>	<i>que sint [...] bh et et</i> (104ra, 5)	<i>che siano [...] bh ed et</i> (180ra, 41)
<i>de causa apparitionis crepusculi et forma appartionis eius nobis et figurationis ipsius in orizonte orientali</i>	<i>de causa apparitionis ipsius [...] et orizonte orientali</i> (104ra, 31-32)	<i>dela cagione del apari-tione [...] de esso in orizonte orientale</i> (180rb, 39-40)

PHRASE-INSERTIONS

<i>et illa proxima super aliam inferiorem [...] propinquam</i>	<i>et illa proxima super aliam inferiorem et illa proxima super aliam inferiorem propinquam</i> (47ra, 12-13)	<i>e quella proxima sopra l'altra inferiore e l'altra proxima sopra l'altra inferiore propinqua</i> (74ra, 8-11)
<i>quando non estimatur [de eo suspicio]¹⁹</i>	<i>quando non estimatur quod sit funditus</i> (103rb, 33-34)	<i>quando non si estima che sia fundato</i> (178vb, 43-44)

¹⁹ This is actually a case of phrase-substitution, which is extremely rare. Aside from granting it its own special category, I had three ways of treating this variant: 1) as three individual word-substitutions, 2) as a combination of one phrase-omission and one phrase-substitution, 3) as either a phrase-omission or a phrase-insertion. Since this particular variant seemed more significant than three mere word-substitutions, yet since I did not want to overstate its significance, I chose to categorize it as a phrase-insertion, thus placing it at a lower level of significance than if I had treated it as a dual phrase-omission/phrase-insertion or even as a phrase-omission alone.

<i>ab ea est [...] apparens soli</i>	<i>ab ea est illuminatum et apparens soli</i> (104ra, 51)	<i>da aessa sia illuminato e aparente al sole</i> (180va, 25-26)
<i>quando est depressio solis [...] 19 gradus</i>	<i>quando est depressio solis in orizzonte 18 gradus</i> (104vb, 56-104v, 1)	<i>quando sia depressione del sole in orizzonte 18 gradi</i> (181va, 34-35)
<i>verumptamen [...] terre non est apud hunc orbem magna quantitas</i>	<i>verumtamen punctus vel centrum terre non est apud hunc orbem magna quantitas</i> (104v, 13-14)	<i>ma pure el punto o veramente el centro dela ttera non e apresso questo orbe grande quantita</i> (181rb, 9-11)