
Article:
Jagot, Shazia (2022) Chaucer and Ibn al-Haytham (Alhacen): Perspectiva, Arabic Mathematics and Acts of Looking. Studies in the Age of Chaucer. pp. 27-61. ISSN 0190-2407

https://doi.org/10.1353/sac.2022.0029

Chaucer and Ibn al-Haytham (Alhacen): *Perspectiva*, Arabic Mathematics, and Acts of Looking

Shazia Jagot
University of York

Abstract

The question of "how one sees" gives rise to a brief, learned interjection on optics and *perspectiva* in the Squire's unfinished, interlaced romance—an intervention that draws "Alocen," the Arabic mathematician Ibn al-Haytham (Latin: Alhacen or Alhazen) into discussion. Alhacen's *De aspectibus*, the Latin translation of his extraordinary treatise *Kitāb al-Manāzir* (*Book of Optics*) has long been acknowledged and utilized in Chaucer scholarship. However, little focused attention has been paid to tracing the intertextual routes that lead to Chaucer's "Alocen" from Jean de Meun's reference to "Alhacem" in the *Roman de la Rose*, through to entries on "Ibn al-Haytham" in Arabic bio-bibliographic dictionaries. In tracing the ways that European vernacular literature can be connected with Arabic textual traditions, this article also challenges the under-examined Eurocentric approaches to Chaucer and late medieval vernacular literature where Arabic figures such as "Alocen" have been collapsed into generic molds of medieval philosophers. It argues that repositioning Chaucer's "Alocen" as an Arabic mathematician and optical authority allows us to understand better not only his presence in *The Squire's Tale*, but the depiction of the physical act of looking and the cognitive and psychological consequences of key moments of sight beyond this romance. In order to demonstrate this, the exact question of "how one sees" as presented in the *Kitāb al-Manāzir* is explored with particular attention paid to the psychology of sight in examining the relationship between perception and judgment in three pivotal acts of looking in *The Knight's Tale*, *The Physician's Tale*, and *Troilus and Criseyde*.

I am grateful to many interlocutors: Anya Burgon and Michelle Karnes for reading early drafts of this article; Kristin Bourassa and Aglae Pizzone who accompanied me on vital philological hunts; Giles Gasper, Nader El-Bizri, and Tom McLeish for inviting me to a multidisciplinary reading group on Ibn al-Haytham's *Kitāb al-Manāzir*, which energized and deepened my understanding of the text; and the journal editors and anonymous reviewers who provided instrumental comments and suggestions. An initial draft of this article was presented at *The Senses in Medieval and Renaissance Europe: Sight and Visual Perception*, University College Dublin (2016).

Studies in the Age of Chaucer 44 (2022): 27–61

Keywords

Chaucer; sight; mathematics; *perspectiva*; Ibn al-Haytham/Alhacen; Arabic literature; Jean de Meun; *The Squire's Tale*; *The Knight's Tale*; *The Physician's Tale*; *Troilus and Criseyde*

In his study on linear perspective in Renaissance art and Arabic optics the art historian Hans Belting sets out a compelling history of the Latin term *perspectiva*:

> The word "perspective" (*perspectiva* in Latin) was commonly used in the Middle Ages by scientists before it was introduced in the field of art during the Renaissance. Then it denoted a visual theory that was Arab in origin; only later, during the sixteenth century, did writers begin using it as a synonym for the term "optics," which occurs in scientific texts of classical antiquity.[1]

Belting attributes a precise cultural signifier to medieval visual theory: it is unequivocally "Arab in origin," a position that cuts against the grain of the simplest transmission narratives whereby Arabic, relegated to a transitive position, mediates between Greek and Latin in the development of medieval scientific learning.[2] Here, instead, it is cast as the originator of the Latin *perspectiva*, a term that is also closely associated with the

[1]Hans Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, trans. Deborah Lucas Schneider (Cambridge, Mass.: Harvard University Press, 2011), 1. See also Nader El-Bizri, "Classical Optics and the Perspectivae Traditions Leading to the Renaissance," in *Renaissance Theories of Vision*, ed. J. S. Hendrick and C. H. Carmen (London: Routledge, 2016), 11–30, who also discusses the move from "the natural visual theory into a pictorial theory" (28). See also A. Mark Smith, who provides a detailed counter-argument to Belting's use of Alhacen's visual theory to explore western and Islamic art: "Skating on Thin Eyes: Hans Belting on the Optics of Arabic and Western Art," in *Optics, Ethics, and Art in the Thirteenth and Fourteenth Centuries: Looking into Peter of Limoges's Moral Treatise on the Eye*, ed. Herbert L. Kessler, Richard G. Newhauser, and Arthur J. Russell (Toronto: Pontifical Institute of Medieval Studies, 2018), 103–19.

[2]For a good overview of the critical debates on the position of Arabic in the history of medieval science see George Saliba, *Islamic Science and the Making of the European Renaissance* (Cambridge, Mass.: Massachusetts Institute of Technology, 2007). The definition of Arabic and Islam follows Peter Adamson, who distinguishes between Arabic as the *lingua franca* of the Near and Middle East, and Islamic as a reference to religion and its influence on culture. See Peter Adamson, "Introduction," in *The Cambridge Companion to Arabic Philosophy*, ed. Peter Adamson and Richard C. Taylor (Cambridge: Cambridge University Press, 2005), 1–9, esp. 3.

Basran mathematician Ibn al-Haytham (c. 965–c. 1040), known in Latin as Alhacen, who became the foremost authority on visual theory: a position that was not lost on medieval scholastics nor on medieval poets.[3] Yet, if we turn to the *Middle English Dictionary* (*MED*), it seems that Ibn al-Haytham's contribution as the Latin Alhacen has not only fallen out of focus, but is altogether absent. In the entry on "perspectif," the only authority referenced is Ptolemy, as seen in the line "a text treating optics, esp. that attributed to Ptolemy."[4] However, from the thirteenth century onward, it was Ibn al-Haytham's optical treatise the *Kitāb al-Manāzir*, known in Latin variously as *De aspectibus* or *Perspectiva*,[5] that proved to be the most lucid and detailed examination of a visual theory, supplementing and supplanting the Latin translations of Arabic optics already in circulation.[6] The *Kitāb al-Manāzir* covers extraordinary ground across mathematics, geometry, faculty psychology, physiology, and meteorology, and provides a visual theory that not only synthesizes the work of Aristotelian natural philosophers (*al-'ulūm al-tibbīyah*) and Euclidean and Ptolemaic

[3]When referring to the Latin figure I employ the spelling "Alhacen," as it accords with the medieval Latin manuscript tradition, rather than the better-known "Alhazen." This form of his name only appears in the first printed edition of the *De aspectibus* by Friedrich Risner, *Opticae thesaurus: Alhazeni arabis libri septem* (Basel, 1572).

[4]*MED*, s.v. *perspectif* (n.).

[5]The Latin *De aspectibus* has been ascribed to Gerard of Cremona, but there is little concrete evidence to suggest that Gerard or the translators appended to him rendered the Arabic *kitāb* (book) into Latin. It is likely that more than one translator, or set of translators, produced the Latin copy, as there is a clear division in the style of translation. The first half (up to Book III, Chapter 3, but missing the first three chapters of Book I) is most faithful to the Arabic original, and the second (Book III, chapters 4–7) is freely adapted from the Arabic. For more on the translations see A. Mark Smith, *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," Transactions of the American Philosophical Society* 91, no. 4 (2001): xx–xxi.

[6]See Seyyed Hossein Nasr, *Science and Civilisation*, 2nd ed. (Cambridge: Islamic Texts Society, 2003), 49–60; and David C. Lindberg, *Theories of Vision from al-Kindi to Kepler* (Chicago: University of Chicago Press, 1976), 31–32. Already in circulation were copies of al-Kindī's *De aspectibus*, based on Euclid's *Optics*; Avicenna's explanation of the intromission theory of sight and his description of the anatomy of the eye in the *Qanūn fī al-tibb* (*Liber Canonis*; *Canon of Medicine*); Hunayn ibn Ishāq's ophthalmological compendium *The Ten Treatises on the Eye*, translated into Latin by the North African Benedictine monk Constantinus Africanus, known to Chaucer as "the cursed monk, daun Constantyn" (*MerT*, 1810); and the work of al-Fārābī, who defined optics as a discipline in its own right in his *Ihsa' al-'Ulūm*, the *Classification of the Sciences*. All citations from Chaucer's works are taken from *The Riverside Chaucer*, gen. ed. Larry D. Benson, 3rd ed. (Boston, Mass.: Houghton Mifflin, 1987), and will be cited parenthetically by work and line number.

mathematics (*al-'ulūm al-ta'līmīyah*),[7] but evidences it—his exacting, frequent, and controlled experiments (*al-i'tibār*), including the use of *camera obscura* (*al-bayt al-muzlim*), are comprehensively set out in his *opus major*.[8] In this sprawling and erudite treatise, he created a single theory of vision that combined Aristotelian natural philosophy, Ptolemaic optics, Galenic medicine, and Euclidean geometry with empirical observation, arguing for an intromission model of sight and the physical existence of light.[9] By the 1260s, this innovative approach had gained particular traction in western scholasticism evident in Bartholomaeus Anglicus's distillation of the Latin *De aspectibus* in his *De proprietatibus rerum*, the first encyclopedia to demonstrate proof of the wide circulation of Alhacen's treatise (c. 1240s). Indeed, the *MED* definition is even remiss to note that, from one of the earliest vernacular uses of the term *perspectiva* found in John Trevisa's Middle English translation of Bartholomaeus Anglicus's *De proprietatibus rerum* (1398), Alhacen is not only associated with *perspectiva* but is clearly lauded as "þe auctor of þe science of persectiue."[10]

That his name is absent in the *MED* entry calls into question the approaches that scholars take when faced with Arabic authorities in an English literary context. In addition to Trevisa's translation, the Latin Alhacen is cited as "Alocen" in *The Squire's Tale* (*SqT*, 232), where he joins a series of polymathic figures cited across Chaucer's work including the Persian *al-shaikh al-ra'is* "Avycen" (*GP*, 432 Avicenna; Ibn Sīnā), the Andalusian Aristotelian "Averois" (*GP*, 433 Averroes; Ibn Rushd), and the astronomical "Arsechieles" (*Astr*, II.45.2 Azarchel; Ibn al-Zarqālluh). Taken

[7]See Ibn al-Haytham, *Kitāb al-Manāzir*, ed. A. I. Sabra (Kuwait: National Council for Culture, Arts and Letters, 1983), 10. Here he makes the distinction between the natural sciences (*al-'ulūm al-tibbīyah*) and mathematical sciences (*al-'ulūm al-ta'limīyah*).

[8]See for instance the *camera obscura* experiment described in I.4.83–86 ("On the Manner of Vision") where the experimenter (*yā'tibār*) can "employ a chamber with a two-panel door in a dark night" (*baytān min al-buyūt fi-layl muzlim*). See I.IV.86 and, for the Arabic, *Kitāb al-Manāzir*, 170; cf. El-Bizri, "Classical Optics," 17. All subsequent references to the *Kitāb al-Manāzir* will be from *The Optics of Ibn al-Haytham. Books I–III: On Direct Vision*, ed. A. I. Sabra, 2 vols. (London: Warburg Institute, 1989), cited parenthetically in the text by book, chapter, and section marker.

[9]Ibn al-Haytham also drew on the work of Arabic mathematicians working in the "Archimedean-Apollonian tradition" such as Thābit ibn Qurra and Ibn Sahl (El-Bizri, "Classical Optics," 11).

[10]*MED*, s.v. *perspectif* (n.). See Bartholomaeus Anglicus, *On the Properties of Things: John Trevisa's Translation of Bartholomaeus Anglicus De Proprietatibus Rerum*, ed. M. C. Seymour et al., 3 vols. (Oxford: Oxford University Press, 1975–88), XIX.19–20, 11–12 (Vol. 2, 1269, 1372). On Trevisa's translation and the vernacular sciences see Emily Steiner, *John Trevisa's Information Age: Knowledge and the Pursuit of Literature, c. 1400* (Oxford: Oxford University Press, 2021), esp. 143–76.

together, they encapsulate an extraordinary range of rich scholarship on the natural sciences, philosophy, astronomy, and mathematics, cultivated and produced in locations that stretched across multiple Islamic worlds from Buyid Persia, to Almohad Andalusia, and 'Abbasid Baghdad. And yet, within a literary context, more often than not, these names are either dismissed as colorful citations or collapsed into a generic mold of Arabic medieval philosophers. In critical discussions on the vicissitudes of vision in Chaucer's poetry, the Latin Alhacen has long joined the coterie of Latin scholastics who produced work on optics, including the Franciscans Roger Bacon, Erasmus Witelo, and John Pecham.[11] Indeed, all three of the so-called perspectivists were profoundly influenced by Alhacen's *De aspectibus*, a copy of which circulated in the papal court at Viterbo, where Bacon's *Perspectiva* (c. 1265) was also *in situ*, and where Witelo and Pecham produced their optical treatises in succession: Witelo's *Perspectiva* (c. 1275) and Pecham's *Perspectiva communis* (c. 1280).[12] It is no surprise, then, that Belting positions *perspectiva* as "Arab in origin," considering that Alhacen stood at the helm of late medieval visual theory.[13]

That Chaucer draws on contemporary scholastic discussions on the psychology, philosophy, and theology of sight has been well established. As Carolyn Collette observes, his poetry explores "a complex, evolving, and ambivalent medieval attitude toward the processes involved in seeing, imagining, and understanding."[14] What this means for his representation of human will, determinism, knowledge, and love has also been the subject of extensive critical inquiry. In recent years, literary attention has turned to Januarie's blindness in *The Merchant's Tale* explored through the interdisciplinary frameworks of medieval disability studies and the medieval senses, while more broadly, the topic of optics has generated interdisciplinary scholarship galvanized in part by the soaring interest in the medieval

[11]See Suzanne Conklin Akbari, *Seeing through the Veil: Optical Theory and Medieval Allegory* (Toronto: University of Toronto Press, 2004), 178–233; Norman Klassen, *Chaucer on Love, Knowledge and Sight* (Woodbridge: D. S. Brewer, 1995); Peter Brown, *Chaucer and the Making of Optical Space* (Bern: Peter Lang, 2007); Carolyn P. Collette, *Species, Phantasms, and Images: Vision and Medieval Psychology in "The Canterbury Tales"* (Ann Arbor: University of Michigan Press, 2001); and Carolyn P. Collette, "Seeing and Believing in the *Franklin's Tale*," *ChauR* 26, no. 4 (1992), 395–410.

[12]Lindberg demonstrates that the primary source for their optical writings is Alhacen's *De aspectibus*; see David C. Lindberg, "Lines of Influence in Thirteenth-Century Optics: Bacon, Witelo, and Pecham," *Speculum* 46 (1971): 66–83, and "Alhazen's Theory of Vision and Its Reception in the West," *Isis* 58 (1967): 321–41 (331).

[13]Belting, *Florence and Baghdad*, 1.

[14]Collette, *Species, Phantasms, and Images*, 1.

senses and the manifold ways in which *perspectiva* opens up and integrates discussion on art, images, science, mathematics, medicine, and theology.[15] This article builds on the vitality of the interdisciplinary foci on optics in order to revisit earlier discussions on sight, vision, and faculty psychology in Chaucer's writing with a twofold aim: first, to shed new light on the reference to "Alocen" and second, to demonstrate how an intertextual, decolonial way of engaging with the *Kitāb al-Manāzir* opens up new avenues for exploring the cognitive, psychological, and physical ramifications of the processes of sight in conjunction with the literary motif of *amor courtois* in a number of Chaucer's romances. Such an approach requires attending not only to psychology, but also to mathematics. I put forward that an understanding of this particular Arabic authority has been obscured by an approach that categorizes him simply as another medieval Arabic philosopher. This not only clouds his more exact position as a mathematician who sought to rectify and innovate the findings of natural philosophers through empirical methods of proof, i.e. to mathematize natural philosophy, but conceals the wider, potential impact of his work on Chaucer's poetics. [16]

I begin by demonstrating the wider literary contexts, French and Arabic, in which the name "Alocen" is drawn upon, before bringing the Arabic Ibn al-Haytham and the Latin Alhacen into sharper focus within *The Squire's Tale*. The mathematician is positioned within a nexus of careful and precise references to Arabic and Islamic literature and technology in the romance that are rarely read together. A closer look reveals the interlocking,

[15]See for instance Beatrix Busse and Annette Kern-Stähler, "Bleary Eyes: Middle English Constructions of Visual Disabilities," in *The Five Senses in Medieval and Early Modern England*, ed. Annette Kern-Stähler, Beatrix Busse, and Wietse de Boer (Leiden: Brill, 2016), 69–96; and James M. Palmer's earlier study interested in the aetiology of blindness, "Your maladye is no 'sodeyn hap': Ophthalmology, Benvenutus Grassus, and January's Blindness," *ChauR* 41, no. 2 (2006), 197–205. On interdisciplinary optical scholarship see the various essays in Herbert L. Kessler, Richard G. Newhauser, and Arthur J. Russell, eds., *Optics, Ethics, and Art in the Thirteenth and Fourteenth Centuries: Looking into Peter of Limoges's Moral Treatise on the Eye* (Toronto: Pontifical Institute of Medieval Studies, 2018); Christopher R. Lakey, *Sculptural Seeing: Relief, Optics, and the Rise of Perspective in Medieval Italy* (New Haven: Yale University Press, 2018); and Wendy K. Shaw, *What Is "Islamic" Art? Between Religion and Perception* (Cambridge: Cambridge University Press, 2019).

[16]This is with the understanding that he stands within a complex network of Latin scholarship that developed out of the multiple translation ventures that brought Arabic learning into western medieval scholasticism. For a good overview of the translation of Arabic learning see Charles Burnett, "Arabic into Latin," in *The Cambridge Companion to Arabic Philosophy*, ed. Peter Adamson and Richard C. Taylor (Cambridge: Cambridge University Press, 2005), 370–404.

mathematical ways in which the Arabic-Islamic world appears, which cuts against the grain of orientalizing perspectives that have long held sway in approaches to the *Tale*.[17] In fact, what becomes clear is that late medieval vernacular poets, in parallel with Latin scholastics and theologians, were intrigued by and familiar with Arabic scientific material in conjunction with some knowledge of the wider cultural production emerging from the Arabic-Islamic world.

In *The Squire's Tale*, Ibn al-Haytham's appearance is generated through a question on the act of sight: "hou men myghte in it swiche thynges se" (*SqT*, 227). In one line of verse Chaucer also captures the entire premise of Ibn al-Haytham's *Kitāb al-Manāzir*: How do we see? For Ibn al-Haytham, the answer to this is not only mathematical but also psychological, and involves the very same "complex processes involved in seeing, imagining, and understanding," as Collette puts it for Chaucer's poetry. I argue that the particular relationship between perception and judgment as presented in the *Kitāb al-Manāzir* is valuable for exploring three striking acts of looking that cause *amor hereos* in *The Knight's Tale*, *The Physician's Tale*, and *Troilus and Criseyde*, which also demonstrates the close correlations between Arabic optical theory and Middle English poetry.[18]

In order to bring these two languages and textual traditions together, this article utilizes an approach that examines the Arabic *Kitāb al-Manāzir* in conjunction with Middle English. This methodology is inspired in part by Hans Belting's comparative model of *Blickwechsel* ("a shift of focus" or "an exchange of glances"), which enables two texts and two cultures to be explored without requiring one to answer the thorny, "colonial" question of influence.[19] As a mode of critical inquiry in scholarship, influence (similar to the notion of transmission) not only positions one dominant narrative

[17]See for instance Kenneth Bleeth, "Orientalism and the Critical History of the Squire's Tale," in *Chaucer's Cultural Geography*, ed. Kathryn L. Lynch (New York: Routledge, 2002), 21–31.

[18]The lover's malady of *amor hereos* caused by the act of gazing is a familiar and well-established convention of *fin'amors*. See Klassen, *Chaucer on Love, Knowledge, and Sight*, which draws on a range of Latin scholastic writings including Alhacen to illuminate the intricate and interdependent relationship among medieval *perspectiva*, faculty psychology, and metaphysics in the work of Chaucer; and Mary F. Wack's magisterial study of the medieval pathology of *amor hereos* and the intersection between the literary gaze and the treatment of the gaze in natural philosophy in *Lovesickness in the Middle Ages* (Philadelphia: University of Pennsylvania Press, 1990), esp. 56–59.

[19]Belting, *Baghdad and Florence*, 4. Belting's study, primarily concerned with the use and appropriation of the optical and mathematical study of *perspectiva* for the innovation of a pictorial technique that used the vanishing point in Renaissance art, moves deftly across both Arabic science and Renaissance art.

(usually western and Christian) over another, but "concedes a non-European culture's influence in one area but still relegating it to a lower level of importance overall."[20] Moreover, to prove influence a direct and traceable source is often required, not least for literary texts, narratives, and images that are situated outside a western Christian purview. Sahar Amer has recently outlined the ideological and conceptual challenges this poses for the study of medieval French literature, pointing to the types of questions frequently asked of her work on cross-cultural encounters between Arabic and French literary culture: "How did Marie de France know about *Kalila wa Dimna*? Did she read Arabic? . . . And what manuscript of the Arabic fable collection did she have access to?"[21] Such questions push for unidirectional and concrete answers that, as Amer demonstrates, do little justice to the complex realities of intercultural contact and exchange between French and Arabic that took place in almost every corner of society from mercantile communities to scholarly centers of translation and learning: contact that manifests in literary and cultural production in a myriad of ways that can be discerned if one takes a global perspective that eschews literary, textual, and national borders.[22]

This rings true for English literary studies and Chaucer criticism too. Unlike medieval French literary studies, which has only "recognized the need for a critical gaze that looks outside France" in the last decade, Chaucer scholarship has long recognized his references to Arabic authorities and the Islamic world.[23] Yet, dynamic and detailed exploration is still bound by the idea of "influence" and tied to the Eurocentric parameters of "sources and analogues" where, for instance, named Arabic authorities are

[20]Ibid., 5.

[21]Sahar Amer, "Reading Medieval French Literature from a Global Perspective," *PMLA* 130 (2015), 367–74 (369). See also Sahar Amer, *Esope au féminin: Marie de France et la politique de l'interculturalité* (Amsterdam: Rodopi, 1999).

[22]Amer, "Reading Medieval French Literature," 370–71.

[23]Ibid., 367. On Arabic science in Chaucer criticism see for instance John Livingston Lowes, "The Loveres Maladye of Hereos," *MP* 11 (1914), 491–546; R. T. Gunther, *Early Science in Oxford*, Vol. 5, *Chaucer and Massahalla on the Astrolabe* (Oxford: Oxford University Press, 1929); Dorothee Metlitzki, *The Matter of Araby in Medieval England* (New Haven: Yale University Press, 1997); and Kathryn L. Lynch, "East Meets West in Chaucer's Squire's and Franklin's Tales," in *Chaucer's Cultural Geography*, ed. Kathryn L. Lynch (New York: Routledge, 2002), 76–101. On the broader topic of Chaucer and the Islamic world, see Carol Falvo Heffernan, *The Orient in Chaucer and Medieval Romance* (Woodbridge: D. S. Brewer, 2003); and the various essays in Lynch, *Chaucer's Cultural Geography*. Most recently, Suzanne Conklin Akbari and James Simpson, eds., *The Oxford Handbook of Chaucer* (Oxford: Oxford University Press, 2020), has placed Chaucer in a wider context including a "Mediterranean Frame"; see in particular Karla Mallette, "The Hazards of Narration: Frame-Tale Technologies and the 'Oriental Tale,'" 185–96.

rarely discussed beyond their Latinate guises. The lack of attention and doubling-down on (the lack of) direct sources are also a result of the treatment of Arabic in a wider critical discourse. English literary studies has yet fully to embrace the possibilities that emerge from situating Arabic (along with Hebrew) as language(s) of multilingual medieval Britain. Charles Burnett reminds us that "the society of the British Isles in the eleventh to thirteenth centuries . . . was characterized by several languages and several cultures—among which Arabic should be included."[24] Arabic was present in Britain from at least the late eleventh century, largely in distinct scientific and scholarly contexts, but as Kathleen Kennedy has recently demonstrated there was a plethora of pseudo-Arabic script, which was recognized as Arabic script (*mores-letters*), on ceramics and textiles in late medieval England: material culture that may have graced the home of "urban gentry" families such as the Chaucers.[25] Kennedy emphasizes the need for critics to "accept that at least some of the English some of the time could recognize Arabic scripts when they saw them." This chimes with Amer's call for critics to exhibit "a sensitivity to Islamicate voices," which, as she notes, "can be achieved even without competency in Islamicate languages."[26] While I engage with both Arabic and English textual traditions here, it is worth noting that with the soaring number of new critical translations and editions of Arabic and Persian texts, critical scholars are in better positions than ever before to turn to a range of material once considered to sit firmly outside the boundaries of Christian Europe.

While repositioning Arabic as a language of medieval Britain is one step toward reconfiguring the largely Eurocentric approaches to "sources and analogues," Amer and Kennedy's calls to attend to language and script return us to the thorny, colonial idea of "influence" and Belting's *Blickwechsel*. Here, I put forward that one of the ways to push against a colonial gaze hampered by sources and analogues is through better and nuanced treatment of Arabic names in late medieval English literature. Indeed, as Suzanne Conklin Akbari reminds us, named authorities are not always reflective of a source, but likewise, we cannot begin fully to appreciate the value of these named authorities until we recognize that their names have

[24]Charles Burnett, *The Introduction of Arabic Learning in England* (London: British Library, 1997), viii.

[25]Kathleen Kennedy, "Moors and Moorishness in Late Medieval England," *SAC* 42 (2020), 213–51 (232).

[26]Amer, "Reading Medieval French Literature," 367.

value.[27] For Chaucer's "Alocen," we can begin this process by closely interrogating the possible direct source for this reference: the *Roman de la Rose*. The French romance refers to Ibn al-Haytham as "Alhacem" in a verse that contains an odd throwaway comment on Alhacen's character that has remained unexplained, but through an "exchange of glances" it seems to echo the language used to describe Ibn al-Haytham in the Arabic bio-bibliographic tradition. Thus, in attending to this Arabic name, we are listening to those "Islamicate voices," as Amer puts it, that are present in the lines of both a French and a Middle English poet. Hearing this name reveals, on the one hand, some of the precise, traceable, and intertextual ways in which these European vernacular romances and Arabic literary traditions can be connected, and on the other, what is lost when we pay attention only to the Eurocentric parameters of "sources and analogues" in order to prove "influence."

What's in a Name? From Jean de Meun's Alhacen to Ibn Abī Usaybī'ah's Ibn al-Haytham

In Jean de Meun's encyclopedic completion of the *Roman de la Rose*, Nature's confession to Genius veers into the territory of medieval optics in an extended digression that turns to the celestial heavens.[28] In a subsection on rainbows, Nature draws on the authority of Ibn al-Haytham:

> Alhacem, li nieps Huchaÿn,
> qui ne refu ne fos et garz,
> cist fist le livre des Regarz
> (lines 18004–6)

["Alhacen, the nephew of Huchain, was neither a fool nor a simpleton, and he wrote the book of Optics."][29]

[27]See Akbari, *Seeing through the Veil*, 78–114.

[28]On optics in the *Roman de la Rose* see Patricia J. Eberle, "The Lover's Glass: Nature's Discourse on Optics and the Optical Design of the *Romance of the Rose*," *UTQ* 46, no. 3 (1977): 241–62; and Akbari, *Seeing through the Veil*, 78–114. For wider explorations of the *Roman de la Rose* and natural philosophy see Alastair Minnis, *Magister amoris: The "Roman de la Rose" and Vernacular Hermeneutics* (Oxford: Oxford University Press, 2001); and Jonathan Morton, *The "Roman de la Rose" in Its Philosophical Context: Art, Nature, and Ethics* (Oxford: Oxford University Press, 2018).

[29]Guillaume de Lorris and Jean de Meun, *Le roman de la Rose*, ed. Félix Lecoy, Classiques français du Moyen Age (CFMA) 92 (Paris: Honoré Champion, 1965–70), 3:40–41, 47. Translation adapted from Guillaume de Lorris and Jean de Meun, *The Romance of the Rose*,

Ibn al-Haytham's brief feature here coincides with the moment when the Latin translations of the *Kitāb al-Manāzir* were gaining traction in scholastic circles in the second half of the thirteenth century. Jean de Meun's recognition of "Alhacen" signals his cursory understanding of the new developments in optical knowledge; as Patricia Eberle notes, it is a reference of "the most general sort and does not involve any knowledge of the precise details of Alhazen's theories."[30] While this may be the case—Ibn al-Haytham's work on the rainbow was not available in Latin translation, but his work on catoptrics (reflection) and dioptrics (refraction) form a substantial portion of the *Kitāb al-Manāzir*—the lines that introduce his figure suggest a specificity of some kind.[31] The lines are bookended with familiar information that usually catches the attention of critics: the Latinized name of an Arabic figure "Alhacem" and the title appended to his work, which is deployed in the vernacular as the "livre des Regarz" ("Book of Observation"). Yet what is nestled between the nouns reveals some "precise details" of Ibn al-Haytham's figure in ways that draw together French and Arabic literary culture across linguistic and textual boundaries.[32]

---

trans. Frances Horgan (Oxford: Oxford University Press, 2008), 278. See also Guillaume de Lorris and Jean de Meun, *The Romance of the Rose*, trans. Charles Dahlberg (Hanover, N.H.: University Press of New England, 1983), 300; and Robert M. Correale and Mary Hamel, eds., *Sources and Analogues of the Canterbury Tales*, 2 vols. (Cambridge: D. S. Brewer, 2002–5), 1:193–94.

[30]Eberle, "The Lover's Glass," 250. Akbari demonstrates that while Jean de Meun references Alhacen, he is in fact drawing on the work of Roger Bacon; see *Seeing through the Veil*, 92–93.

[31]El-Bizri, "Classical Optics," 11. Ibn al-Haytham is considered to have produced a significant number of works on a range of mathematical subjects, but only sixty of these are extant in Arabic. Only three texts were translated into Latin: *De aspectibus*, *De speculis comburentibus* (*On Burning Mirrors*), and *De configuratione mundi* (*On the Configuration of the World*). Ibn Abī Usaybīʿah provides a list of texts by Ibn al-Haytham. See Ibn Abī Usaybīʿah, "Ibn al-Haytham," trans. and ed. Franak Hilloowala, E. Savage-Smith, G. J. van Gelder, and Ignacio Sánchez, in *Uyūn al-anbāʾ fī ṭabaqāt al-aṭibbāʾ* (*The Best Accounts of the Classes of Physicians*), ed. E. Savage-Smith, S. Swain, and G. J. van Gelder (Leiden: Brill, 2020), 14.22.4.1, https://doi.org/10.1163/37704_0668IbnAbiUsaibia.Tabaqatalatibba.lhom-tr-eng1 (accessed April 29, 2022). See also Sabra's commentary on the list of works attributed to Ibn al-Haytham, in *Kitāb al-Manāzir*, ed. Sabra, "Preface," II, xxiv–xxxii; and Smith, "Alhacen's Theory of Visual Perception," xix–xx.

[32]On the permeability of these boundaries see Amer, "Reading Medieval French Literature," 369; and her fuller-scale studies, Sahar Amer, *Crossing Borders: Love between Women in Medieval French and Arabic Literatures* (Philadephia: University of Pennsylvania Press, 2008), and *Esope au féminin*. For an example of material manuscript connections see Sharon Kinoshita, "Translatio/n, Empire and the Worlding of Medieval Literature: The Travels of *Kalila wa Dimna*," *Postcolonial Studies* 11 (2008), 371–85.

In introducing "Alhacem, li nieps Huchayn," the French poet misappropriates the Arabic *nasab* (patronym) of Ibn al-Haytham's full name: "Abū ʿAlī al-Hasan ibn al-Husayn ibn al-Haytham," reconfiguring his given name al-Hasan (Latinized Alhacen) into the nephew of Husayn rather than the son of Husayn ("li nieps Huchayn"). Latinized Arabic patronyms are commonly found in western manuscripts, including copies of Alhacen's *De aspectibus*. Two thirteenth-century copies contain incipits and explicits that abbreviate his name; for instance, we find "Alacen filii alhaycen" in Edinburgh, Royal Observatory, MS Cr3.3, and "Explicit liber hacen filii hucaym de aspectibus" in Cambridge, Trinity College, MS 05.30.[33] Jean de Meun's misunderstanding of the patrilineal genitive (*ibn/filii/nieps*) most likely signals his slight knowledge of the new Arabic authority on the scholastic scene, but the line that follows suggests that he may have heard something of his character. At first glance, the negation present in "qui ne refu ne fos et garz" ("was neither a fool nor a simpleton") might simply affirm Alhacen's scholarly prowess. But when read in light of the Arabic bio-bibliographic tradition, it seems to capture an extraordinary (and possibly fictive) moment in Ibn al-Haytham's biography.[34]

For a period of time before 1021, Ibn al-Haytham feigned a mental illness and spent a proportion of his life under "house arrest" in order to avoid falling foul of his patron, the Fatimid caliph, al-Hākim bi-ʿAmr Allāh (reigned 996–1021).[35] The caliph, who was known for his capriciousness

[33]There are twenty-two extant manuscripts of the Latin *De aspectibus*, including a fourteenth-century Italian translation, *De li aspecti* (Vat. Lat. 4595). See Smith, "Alhacen's Theory of Visual Perception," clv–clvii; and 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, no. 1 (2001), 27–43.

[34]There are two biographical accounts of Ibn al-Haytham found in Ibn al-Qiftī (1172–1248) and Ibn Abī Usaybīʿah, *Classes of Physicians*, 14.22. See A. I. Sabra, "One Ibn al-Haytham or Two? An Exercise in Reading the Bio-Bibliographic Sources," *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* 12 (1998), 1–50. In general, biographical entries consist of names, location, occupations, and anecdotal information confirmed through a chain of authorities known as an *isnād*. The bio-bibliographic genre developed alongside historical chronicles and *akhbār* (reports) in the ninth-century, a "period of stock-taking" as Tarif Khalidi calls it, where the preservation and recording of present and contemporary history were prioritised, driven by a desire to capture and gather information on the general populace, people of note and piety, and rulers and their regions during the first few centuries of Islam (Tarif Khalidi, "Premodern Arabic/Islamic History Writing," in *A Companion to Global Historical Thought*, ed. Prasenjit Duara, Viren Murthy, and Andrew Sartori [Chichester: John Wiley, 2014], 78–91 [80]). See also Tarif Khalidi, "Islamic Biographical Dictionaries: A Preliminary Assessment," *The Muslim World* 63 (1973), 53–65.

[35]The caliph employed a number of scholars at his court, including a Jewish astronomer known as al-Isrāʾīlī, whose text on judicial astrology, *Fusul fī ʿilm al-nujūm li-al-Isrāʾīlī khādima*

and tyranny, had recruited Ibn al-Haytham to work as the chief engineer in Cairo on an ambitious project on the Nile.[36] The project quickly failed, and Ibn al-Haytham was relocated to an administrative post, which he held "only out of fear"—frightened of a caliph who was known to spill "blood without cause."[37]

Nature's insistence that "Alhacem" is neither "fos et garz" echoes the language used in the Arabic bio-bibliographic catalogues that demonstrate the precarious political environment of the Fatimid court. The Syrian physician Ibn Abī Usaybīʿah (d. 1270) records two accounts that comment on Ibn al-Haytham's state of mind in his ambitious *ʿUyūn al-anbāʾ fī ṭanbaqāt al-aṭibbāʾ* (*The Best Accounts of the Classes of Physicians*). The first comes from a reputable "geometer" (*al-muhandis*) who notes that Ibn al-Haytham "feigned mental confusion" ("khabālan fī ʿaqlahū").[38] The second is taken from the earlier bio-bibliographer Ibn al-Qifṭī (d. 1248) and provides a more expansive anecdote: "Ibn al-Haytham pondered the matter, but could not think of a way to get out of his predicament except by displaying madness and disturbance of mind" ("al-janūn wa al-khabāl").[39]

It is worth pausing on the language used to describe mental illness here. The Arabic *janūn* (madness), which found literary expression in the figure

bi-hā al-Ḥākim bi-ʿAmr Allāh (*Chapters on the Science of the Stars by al-Isrāʿīlī with which He Serves al-Ḥākim bi-ʿAmr Allāh*), was known in Latin and disseminated with the mistaken title *Liber almansoris*. A gloss referencing the "libro Mansor" can be found at lines 701–5 of *The Wife of Bath's Tale* in the Ellesmere manuscript (San Marino, Huntington Library, MS El 26 C 9). See Correale and Hamel, *Sources and Analogues*, 2:385; Dag Nikolaus Hasse, *Success and Suppression: Arabic Sciences and Philosophy in the Renaissance* (Cambridge, Mass.: Harvard University Press, 2016), 385; and Shazia Jagot, "Almansor," in *The Chaucer Encyclopedia*, ed. Richard Newhauser, Vincent Gillespie, Jessica Rosenfeld, and Katie Walter (Hoboken, N.J.: Wiley-Backwell, forthcoming).

[36]Ibn al-Haytham spent his early life in Buyid Basra under the protectorate of the Sunni ʿAbbasid caliphate. According to his bio-bibliographers, he remained in self-imposed exile until al-Ḥākim's death in c. 1021, which brought him release and, one can only assume, relief. He relocated closer to al-Azhar, the madrasa complex built to consolidate the Fatimid caliphate, where he undertook the greatest bulk of his scholarship, including the *Kitāb al-Manāzir*. See Ibn Abī Usaybīʿah, "Ibn al-Haytham," 14.22. On Fatimid architecture see most recently Jennifer A. Pruitt, *Building the Caliphate: Construction, Destruction, and Sectarian Identity in Early Fatimid Architecture* (New Haven: Yale University Press, 2020).

[37]Ibn Abī Usaybīʿah, "Ibn al-Haytham," 14.22.3.1.

[38]The first anecdote is related to Ibn Abī Usaybīʿah by "the shaykh ʿAlam al-Dīn Qaysar ibn Abī al-Qāsim ibn ʿAbd al-Ghanī ibn Musāfir al-Ḥanafī, the Geometer." For the English translation see ibid., 14.22.2, and for the Arabic see "Ibn al-Haytham," ed. Hilloowala et al., 14.22.2, available at https://doi.org/10.1163/37704_0668IbnAbiUsaibia.Tabaqatalatibba.lhom-ed-ara1(accessed May 7, 2022).

[39]Ibn Usaybīʿah, "Ibn al-Haytham," 14.22.3.1.

of the *majnūn* (madman), was codified as a cerebral illness caused by excess yellow bile in the Arabic medical encyclopedic tradition that flourished in the ninth and tenth centuries.[40] According to Ibn Manzūr's Arabic dictionary *Lisān al-'Arab*, by the thirteenth-century *janūn* was closely aligned with *khabāl* (unsoundness of body and mind) as an affliction caused by possession of the *jinn*, the intelligent, intermediate spirits of Islam.[41] Ibn al-Qifṭī's synonymic deployment of the terms underscores the serious nature of Ibn al-Haytham's mental condition, albeit feigned, mental condition, but it also finds a parallel in Jean de Meun's "fos et garz" where "garz" takes the vernacular meaning of a young, foolish man, or as both Frances Horgan and Charles Dahlberg render it, "a simpleton."[42] The literariness of the Arabic bio-bibliographic tradition resonates in the poetics of the French verse further still in the paralleled use of "fos" and "janūn": both echo the complex literary figure of the madman (Old French *fol* and Arabic *majnūn*), who by the twelfth century was informed by new developments in natural philosophy in the Latin West, via translated Arabic texts, and the metaphysics of Sufism in the Islamic East.[43]

[40]The best critical examination of *janūn* and *majnūn* continues to be Michael W. Dols, *Majnūn: The Madman in Medieval Islamic Society*, ed. Diana E. Immisch (Oxford: Clarendon Press, 1992). Dols examines the condition of madness in Arabic medical encyclopedias including al-Majūsī's *Kitāb al-Malakī* (Chaucer's "Haly" [*GP*, 431]): "If the melancholic could not sleep and there were much raving, lovesickness, reclusiveness, and restlessness, it is an indication that the illness is from the burnt yellow bile. Then it is said to be madness [*janūn*]" (Dols, *Majnūn*, 67).

[41]Ibn Manzūr, *Lisān al-'Arab*, s.vv. *kabala*, http://arabiclexicon.hawramani.com/search/خبل?cat=3; *janūn*, http://arabiclexicon.hawramani.com/جنن/ (both accessed May 7, 2022). That both *janūn* and *jinn* share a linguistic root is not a coincidence, as Amira el-Zein notes: "In Arabic each time the two letters *jīm* and *nūn* occur together, like in jinn, they convey the meaning of the invisible, unseen, or hidden"; Amira El-Zein, *Islam, Arabs and the Intelligent World of the Jinn* (Syracuse: Syracuse University Press, 2009), xvi.

[42]See for instance the use of "garzone" to mean young and foolish in Italian: *Il tesora di Brunetto Latini volgarizzato da Bono Giamboni* (Venice, 1839), 1:412.

[43]For the long history of the term *majnūn* see Dols, *Majnūn*, 216–20. The literary *majnūn* finds its fullest expression in Nizāmī's Persian *Majnūn Layla*, composed in 1188. Nizāmī gives narrative shape to the Arabic legends of Qays ibn al-Mulawwah (given the epithet *al-majnūn*, the madman) and his beloved, Layla, drawing on the pathology of *'ishq* (passionate love) and the developing tropes of mystical love. See Leila Anvar, "The Hidden Pearls of Wisdom: Desire and Initiation in *Layli u Majnun*," in *A Key to the Treasure of the Hakim*, ed. Johann Christoph Burgel and Christine van Ruymbeke (Leiden: Leiden University Press, 2011), 53–76. Dols calls the *Majnūn Layla* narrative "the ideal of the romantic fool" (Dols, *Majnūn*, 12), examined in full at 320–45. On the French *folie/fou/fol* see Sylvia Huot, *Madness in Medieval French Literature: Identities Lost and Found* (Oxford: Oxford University Press, 2003), esp. 10–23, where Huot sets out the connections among folly, chivalric romance, devotional writings, and medical melancholia—a topic that itself developed through the newly translated Latin–Arabic medical encyclopedia present in Latin university curricula that treat melancholia as a condition of *'ishq*. See also Wack,

The linguistic reverberations that rebound from French to Arabic exemplify what can be seen if one exchanges glances in the manner of Belting's *Blickwechsel*. At the very least, these intertextual references demonstrate the rich and unexpected ways in which European vernacular literature is entangled with the large corpus of Arabo-Latin scientific translations and commentaries. These entanglements come into focus when we turn our gaze back to Jean de Meun. In three octosyllabic lines, the poet captures a moment of new knowledge and provides us with a misplaced Arabic patronymic, a vernacular title of a translated Arabic treatise, and a glimpse into an Arabic figure's biography. That the most scintillating detail of Ibn al-Haytham's supposed life makes its way into a French romance is itself worthy of comment and raises a number of enticing questions: Why does Jean de Meun call Alhacen a "simpleton"? How might he have come across information about Ibn al-Haytham's alleged madness? Such questions may never be answered with a direct textual "source"; instead, we can only imagine the chatter and hearsay that accompanied manuscript copies of Alhacen's *De aspectibus* in Jean de Meun's Parisian scholastic circle, ultimately manifesting in a line of poetry. Yet, if anything, this odd aside reveals that there was interest in the lives of the Arabic figures who became *auctores* in Latin curricula and a familiarity with the Arabic-Islamic context to which they belonged.[44] But this yields interest for another reason too. Jean de Meun's knowledge of Ibn al-Haytham is the direct route through which Chaucer most likely came to Alhacen, who appears (by way of chatter) in a passage on the properties of the marvelous mirror gifted to the Mongol princess Canacee in the unfinished, interlaced romance told by the pilgrim Squire.

Marvelous Mirrors, Mechanics and Oriental Gazes

The four wondrous gifts brought to the court of the Mongol king Cambuyskan by the envoy of the "King of Araby and Inde" (*SqT*, 110), two imaginative geographical regions that are startlingly unified under a single

Lovesickness in the Middle Ages; and Mary F. Wack, "The *Liber de heros morbo* of Johannes Afflacius and Its Implications for Medieval Love Conventions," *Speculum* 62 (1987), 324–44.

[44] A similar parallel to this might be Roger Bacon's misplaced comments on Avicenna's religious beliefs; see John V. Tolan, "Saracen Philosophers Secretly Deride Islam," *Medieval Encounters* 8, nos. 2–3 (2002): 184–208.

crown, have long captured the imagination of readers and critics alike.[45] The mirror, one of two gifts given to Canacee, is said to be capable of seeing future adversity and detecting treachery ("And openly who is youre freend or foe" [*SqT*, 136]): capabilities that give rise to an animated discussion by the local Tatars who, in their curious, learned musings on the mechanics of a mirror, call upon Alhacen as an *auctor* on *perspectiva*:

> They speken of Alocen, and Vitulon,
> And Aristotle, that writen in hir lyves
> Of queynte mirours and of perspectives,
> As knowen they that han hir bookes herd.
> (*SqT*, 232–35)

The anonymous group of locals who lead the discussion summons the full spectrum of medieval learning: Arabic ("Alocen"), Latin ("Vitulon") and Greek ("Aristotle"). Both Alhacen and Aristotle, whose intromission theory of sight was known through his *De sensu et sensato* and the *De anima*, appear in a similar configuration in the *Roman de la Rose*, but as Norman Klassen observes, Chaucer updates his list with the addition of the Silesian Franciscan Erasmus Witelo ("Vitulon").[46] By the fourteenth century, Alhacen's authority is firmly established in the Latin *artes liberales*; he was taught alongside Bacon, Witelo, and Robert Grosseteste (c. 1168–1235) in the university curriculum at both Oxford and Cambridge. In the English universities, the *De aspectibus* and the trio of perspectivist writings by the Franciscan friars Bacon, Witelo, and Pecham were incorporated into the study of geometry, one of the subjects of the quadrivium central to the *artes liberales*, remaining a core component of the arts degree well into the fifteenth century.[47] Indeed, Pecham's *Perspectiva*, largely derived from Alhacen, is considered to have been the "standard optical text in the medieval university."[48] At Oxford, Alhacen's work joined the existing

[45]On "Araby" and "Inde" see Vincent DiMarco, "The Historical Basis of the Squire's Tale," in *Chaucer's Cultural Geography*, ed. Kathryn L. Lynch (New York: Routledge, 2002), 56–75.

[46]See Klassen, *Chaucer on Love, Knowledge, and Sight*, who notes it is "a list that suitably represents contemporary optical learning" (40).

[47]See Brown, *Chaucer and the Making of Optical Space*, 71–72. In the later fourteenth century, there was a move from approaching *perspectiva* through a geometrical understanding to "ontological problems about the physical phenomena of sight" (72–73).

[48]Lindberg, "Alhazen's Theory of Vision," p. 334. Similar to Bartholomeus Anglicus, Pecham refers to Alhacen simply as "physicum" (John Pecham, *Perspectiva communis*, I.31, line 683, in *John Pecham and the Science of Optics: 'Perspectiva communis' with an Introduction,*

translations and commentaries of Arabic mathematics that had long been central to the *libri mathematicales*, not least the work of al-Khwārizmī whose name is captured as "Argus the noble countour" in the elegiac *Book of the Duchess* (435). As Charles Burnett has shown, al-Khwārizmī's astronomical tables as evidenced in Oxford, Corpus Christi College, MS 283 (fols. 114r–145r) were available in England from as early as the twelfth century.[49] Two centuries later, the mathematical sciences were revived through the so-called Oxford Calculators at Merton College, who advanced work in the fields of astronomical mathematics with a particular interest in the "technicalities of making astronomical instruments," including astrolabes.[50] Merton College has long been associated with Chaucer in light of his citation of the Oxford Calculator Thomas Bradwardine ("Bisshop Bradwardyn" [*NPT*, 3242]), and the logician Ralph Strode, to whom Chaucer dedicates his "litel bok" (*TC*, V.1786).[51] At the very least, it is clear that Chaucer understood Alhacen to be an authority of higher learning. We are told that the anonymous speakers "speken," "writen," and "knowen" of "hir lyves," which emphasizes that this complex field of knowledge led by Alhacen is accessible through "book-learning" only.[52] The townsfolk's references to these *auctores* and "mirours and perspectives" are preceded by lines that stress textual authority, codified in the reference to the books they have heard ("they that han hir bookes herd"), likely to be an allusion to the medieval lecture, from which they have drawn their use of highly learned language:

English Translation, and Critical Notes, ed. David C. Lindberg [Madison: University of Wisconsin Press, 1970], p. 114), or "auctoris" (I.57, line 859 [p. 131]).

[49]See Burnett, *The Introduction of Arabic Learning*; and Charles Burnett, "The Works of Petrus Alfonsi: Questions of Authenticity," *MÆ* 66 (1997): 42–80.

[50]G. H. Martin and J. R. L. Highfield, *A History of Merton College, Oxford* (Oxford: Oxford University Press, 1997), 60. See also Hilary M. Carey, *Courting Disaster: Astrology at the English Court and University in the Later Middle Ages* (Basingstoke: Macmillan, 1992), 2–22; Brown, *Chaucer and the Making of Optical Space*, 71–72; and J. D. North, "Astronomy and Mathematics," in *The History of the University of Oxford*, Vol. 2, *Late Medieval Oxford*, ed. J. I. Catto and T. A. R. Evans (Oxford: Clarendon Press, 1992), 103–74. On the Oxford Calculators, see Edith Sylla, "The Oxford Calculators," in *The Cambridge History of Later Medieval Philosophy: From the Rediscovery of Aristotle to the Disintegration of Scholasticism, 1100–1600*, ed. Norman Kretzmann, Anthony Kenny, Jan Pinborg, and Eleonore Stump (Cambridge: Cambridge University Press, 1982), pp. 540–63; and J. A. W. Bennett, *Chaucer at Oxford and at Cambridge* (Oxford: Oxford University Press, 1974), 63–65.

[51]Rodney Delasanta, "Chaucer and Strode," *ChauR* 26, no. 2 (1991): 205–18.

[52]Vincent DiMarco, "The Dialogue of Science and Magic in the Squire's Tale," in *Dialogische Strutkuren/Dialogic Structures: Festschrift für Willi Erzgräber*, ed. Thomas Kühn and Ursula Schaefer (Tübingen: Gunter Narr Verlag, 1996), 50–68.

> . . . it myghte wel be
> Naturelly, by composiciouns
> Of anglis and of slye reflexiouns,
> And seyde that in Rome was swich oon.
> (*SqT*, 228–31)

The townsfolk invoke natural philosophy ("naturelly"), deploying terminology that refers, however slightly, to advanced mathematical compositions ("composiciouns") in observing that the mirror must be understood through the calculation of angles and lines of reflection. The multivalent "anglis" (sing. *angle*) came to be deployed in medical descriptions of the eye, geometrical treatises, and astronomical texts in a reference to one of the four houses of the zodiac.[53] Chaucer uses it in this latter context in *The Man of Law's Tale*, when the pilgrim Lawyer cries out the astrological coordinates that foreshadow the marriage between Custance and the Sultan of Syria: "Infortunat ascendent tortuous, / Of which the lord is helplees falle, allas, / Out of his angle into the derkeste hous!" (*MLT*, 302–4). In *The Squire's Tale*, it appears that the composition of angles determined "naturelly"—a nod to natural philosophy—refers to the geometric model of "[a] figure formed by two converging lines, or the space between them."[54] The shape of the model resembles Alhacen's guiding principle of vision—the mathematical cone of sight created by the rectilinear lines of light rays that enter the eye from the percipient object.[55] This momentary attempt at a mathematical explanation of Canacee's mirror is bolstered by the final term uttered by the Tatar townsfolk: "slye reflexions," which encapsulates the complex and indeed ingenious process of the reflection of light.[56]

The topic of reflection sits at the heart of the question posed by the Tatar townsfolk when they learn of Canacee's gift, which catalyzes their discussion on medieval *perspectiva*: "hou men myghte in it swiche thynges se" (*SqT*, 227). In the critical edition of the Latin *De aspectibus*, A. Mark Smith

[53] *MED*, s.v. *angle* (n.), defs. 2(a), 3(a), 4.

[54] *MED*, s.v. *angle* (n.), def. 3(a).

[55] The cone of sight remodels the intromission theory and demonstrates that light rays emanate from an object and enter the eye "in a configuration that is geometrically determined in the form of a pyramid/cone (*makhrūt*) of vision" (El-Bizri, "Classical Optics," 17). A cone is formed between the object (the base) and the centre of the eye (the vertex). Within the cone, perpendicular lines of sight are imagined between the object and the eye, lines that are cut off at the eye's crystalline surface. The form of the object is carried through the air within the cone until it reaches the eye.

[56] *MED*, s.v. *reflecciοun* (n.), defs. 2(a, b).

notes that "throughout his analysis of reflection, Alhacen's ultimate goal is to explain how and why things appear as they do in mirrors": an aim that would certainly strike a chord with the townsfolk's curiosity about how one sees in a mirror, albeit for far more wondrous purposes.[57] Across books IV–VII, Alhacen examines the geometry of reflected light (catoptrics) and refracted light (dioptrics) in demonstrating how and why reflection can be deceptive to the eye, as well as exploring the principles of reflection and distortion in different forms of mirrors (convex, concave, and spherical). Alhacen's précis to his examination of how "forms in bodies are perceived through reflection" speaks to the kind of book-learning on optical reflection that the townsfolk have heard:

> A number (of authorities) disagree about how the (visible) form is perceived in polished bodies. Accordingly, some of them (suppose) that rays emanate from the eye to the mirror, return from the mirror, and perceive the form of an object (seen in the mirror) upon its return. Others claim that the form of the object is impressed upon a facing mirror, so it is seen in the mirror the same way that natural forms of objects are perceived in objects.[58]

The rhetorical contrasting of authorities here, as it presents an extramissive explanation of sight, finds a neat parallel in the multiple explanations suggested by the Tatar townsfolk as they grapple with understanding how the forms of treason and treachery might appear in the polished surface of a "brood mirour" made "of glas" (*SqT*, 82).

Despite the use of learned language in these lines ("composiciouns," "anglis," "reflexiouns"), which are mathematically sharper than the parallel lines in the *Roman de la Rose*, Chaucer may well have heeded Jean de Meun's cautionary note on the complex geometry involved in Alhacen's "le livre des Regarz."[59] The mathematical density of his work is underscored by the French poet, who emphasizes the necessity of understanding

[57] Smith, *Alhacen's Theory of Visual Perception*, xii.

[58] Alhacen, *De aspectibus*, in *Alhacen on the Principles of Reflection: A Critical Edition, with English Translation and Commentary, of Books 4 and 5 of Alhacen's "De aspectibus": The Medieval Latin Version of Ibn al-Haytham's "Kitāb al-Manāzir,"* ed. and trans. A. Mark Smith, *Transactions of the American Philosophical Society* 96, no. 3 (2006): 289–697, IV.1.325.

[59] "Mes ne vueill or pas metre cures / en desclarïer les figures / des mirouers / comment sunt reflechi li rai / ne leur angles ne vueil descrive (tout est ailleurs escrit an livre)" ("But I do not now want to take the trouble to clarify the shapes of mirrors, nor do I want to

geometry ("et sache de geometrie / don necessaire est la metrie" [18012–13]) before approaching Alhacen's optical treatise: a caution that would not have been lost on a curious, mathematically inclined layman such as Chaucer.[60] Indeed, the particular use of "slye reflexions" evokes the "subtle and advanced calculations" needed for the study of *perspectiva*, but not the exact mathematical computation required in order to find out "how and why things appear as they do in mirrors," which concerns so much of Alhacen's treatise: these books on reflection are heavily reliant on complex mathematics derived from Euclid, Apollonius, and Serenus combined with Ptolemaic optical theory.[61] The fifth book on reflection in particular, containing "Alhazen's problem," proved to be especially difficult for medieval schoolmen who needed first to master Euclidean proportional theory.[62] Indeed, the first book of Witelo's *Perspectiva* is dedicated to a series of mathematical theorems essential for understanding Alhacen's discussion of reflection.[63] Composed at the papal court in Viterbo in c. 1275 under the guidance of William of Moerbeke, the Greek translator to whom he dedicated his work, Witelo's *Perspectiva* is heavily derived from Alhacen's *De aspectibus*, so much so that the sixteenth-century Italian scholar Giambattista della Porta referred rather crassly to Witelo as "Alhazen's ape."[64] With this in mind, it is worth suggesting that at the very least, Chaucer does more than update his list of authorities when he includes "Vitulon" as an optical *auctor*, as has been suggested.[65] Instead, he presents a specific

---

tell how they are reflected or to describe their angles. Everything is written elsewhere in a book"); *The Romance of the Rose*, trans. and ed. Dahlberg, 18217–22 (300).

[60]See Brown, *Chaucer and the Making of Optical Space*. More recently, attention has turned to mathematics and physics; see Alexander N. Gabrovsky, *Chaucer the Alchemist: Physics, Mutability and the Medieval Imagination* (New York: Palgrave Macmillan, 2015), esp. Part 3 on modal logic, 225–32; Matthew Boyd Goldie, *Scribes of Space: Place in Middle English Literature and Late Medieval Science* (Ithaca: Cornell University Press, 2019), esp. 188–219; and Neil Cartlidge, "Ripples on the Water? The Acoustics of Geoffrey Chaucer's *House of Fame* and the Influence of Robert Holcot," *SAC* 39 (2017): 57–98.

[61]Smith, "Alhacen on the Principles of Reflection," 1:xii.

[62]"Alhazen's Problem" was coined during the Renaissance as a reference to a complex mathematical problem that sought to determine "mathematically the point at which a ray of light must be reflected on a spherical mirror in order to pass from a given source to an observer"; Belting, *Florence and Baghdad*, 95.

[63]"[A] set of 137 theorems (plus 16 definitions and 5 postulates) that were clearly intended to provide a requisite mathematical foundation for the subsequent account of reflection and image formation in books 5–9 of the *Perspectiva*"; Smith, "Alhacen on the Principles of Reflection," 1:lxxix.

[64]See *Witelonis perspectivae liber primus: Book I of Witelo Perspectiva*, ed. and trans. Sabetai Unguru (Wrocław: Polish Academy of Sciences Press, 1997).

[65]See Klassen, *Love, Knowledge, and Sight*, 40.

configuration that draws on the deep textual relationship among Alhacen, Witelo, and the subject of optical reflection, alluding perhaps to the complex mathematics that underlie the processes of "queynte mirours and of perspective"—the very subject that brings the Squire to scholastic visual theory.

In his commentary on these mathematically inflected lines, Peter Brown suggests that they are "irrelevant . . . surprising and extraneous, striking an intrusive and incongruous note by introducing into the never-never land of Tartarye a topical discussion of a scientific subject."[66] The conflicts and affinities between magic and science, marvel and mechanics, knowledge and speculation in the romance have long received critical attention, but Brown's assertion here rests on the notion that a non-western imaginative space, presented using unnecessary orientalized language as a "never-never land," cannot also be home to scholarly discussion.[67] This is all the more confounding as Brown later asserts that the reference to Alhacen is "not out of place in a tale with an oriental setting."[68] That an Arabic mathematician would be more welcome in such a setting is entirely speculative, especially considering that Ibn al-Haytham's contemporary, Ibn Sina (Avicenna) is explicitly cited in *The Pardoner's Tale* ("Wroot nevere in no canon, ne in no fen" [*PardT*, 890]): a tale set in Flanders—one of the young Squire's serving posts (*GP*, 85–86)—a far cry from Mongol Sarai. Moreover, unlike "Avycen" (*PardT*, 889), Ibn al-Haytham was not widely known in the Islamicate world.[69] His *Kitāb al-Manāzir* only began to gain traction in the late thirteenth century in the Marāgha school, where Kamāl al-Dīn al-Fārisī (d. c. 1320) worked on the first Arabic commentaries of the text.[70] As A. I. Sabra notes, "The *Optics* of Ibn al-Haytham belongs as much to the history of Latin medieval and early modern science as it does to the history of science in medieval Islam."[71] An intertextual reference that can raise questions of belonging reveals how the mere presence of an Arabic name in Chaucer's poetics can be unsettling. On the one hand, as Brown's careful and erudite analysis of the *De aspectibus*

[66]Brown, *Chaucer and the Making of Optical Space*, 127.
[67]See DiMarco, "The Historical Basis of Chaucer's Squire's Tale."
[68]Brown, *Chaucer and the Making of Optical Space*, 127.
[69]See *Kitāb al-Manāzir*, ed. Sabra, "Introduction," II, lxv.
[70]Marāgha, south of Tabriz (present-day Azerbaijan), was home to a celebrated observatory complex, the foundations of which are still extant, built under the patronage of the Hulagu Khan (c. 1215–65) and under the directive of the astronomer Nasīr al-Dīn al-Tūsī (1201–74). See ibid., "Introduction," II, lxv–lxxiii.
[71]Ibid., "Preface," II, xi.

demonstrates, the Latin Alhacen is vital for exploring the intellectual context of vision in Chaucer's poetry, while on the other, "Alocen" is marginalized and emptied of significance.

The presence of "Alocen" in the tale can be reoriented if we consider that the romance's imaginative convergences with the Islamic world are manifold and interlocked with mathematical inquiry that developed in an Arabic and Islamic milieu. The flying horse made of brass, another magical gift presented at the court, finds a parallel with the "ebony horse," the subject of a cycle of narratives attached to the enigmatic literary organism the *Alf Layla wa-Layla* (*1,001 Nights*).[72] Both operate through a mechanical turning of the screw.[73] The imaginative technology that animates wooden and brass horses is itself the subject of Arabic scientific inquiry into ingenious mechanical devices ("al-hiyal al-handasiyya"), as the polymath inventor al-Jazarī (1136–1206) calls them. These devices produced animated horsemen and chirping birds, automata that were used as entertaining "dinner-table ornaments" at royal courts: scenes that would be familiar to readers of western medieval romances including one set in "Sarai."[74]

[72] As Vincent diMarco notes, "some form of this story—one of the oldest in the anthology—doubtless circulated in western Europe in the late thirteenth century, as is made clear by independent redactions of it in two Old French romances, the *Cléomadès* of Adenet le Roi and the *Meliacin* of Girart d'Amiens"; "The Squire's Tale," in Correale and Hamel, *Sources and Analogues of the Canterbury Tales*, 1:170–74.

[73] "The king said that he must first test the horse, and at that the prince came forward and said: 'I shall mount it and try it out, father, to see how useful it is.' The king gave him permission to do this, and the prince came up and mounted it, but, however much he moved his legs, the horse would not budge from where it was. 'Where is the speed that you claimed for it, wise man?,' the prince asked, but at that the man came up to him and showed him a screw that would make it rise in the air. 'Turn this,' he said, and when the prince turned it, the horse started to move and then flew up with him into the sky, going on and on until it was out of sight" (Night 357 in *The Arabian Nights: A Tale of 1,001 Nights*, ed. and trans. M. C. Lyons and Ursula Lyons [London: Penguin, 2010], 128). On the ebony horse narrative see Marina Warner, *Stranger Magic: Charmed States and the Arabian Nights* (London: Vintage, 2012), 387–402. In addition, there are parallels in the conception of wonder (Arabic *'ajā'ib*) and marvels ("The ebony horse was a wonder and no one has ever seen anything more handsome or better constructed" [Night 368 in *The Arabian Nights*, 143]). See Michelle Karnes, "Wonders, Marvels, and Metaphor in the *Squire's Tale*," *ELH* 82 (2015), 461–90, who notes that "The *Squire's Tale* . . . gives literature the power of startling objects" (461); and Jamal J. Elias, *Aisha's Cushion: Religious Art, Perception, and Practice in Islam* (Cambridge, Mass.: Harvard University Press, 2012): "Wonderment is not just a desired reaction in Islamic aesthetics—it is the starting point of knowledge and mysteries and therefore to be sought out and stimulated" (170).

[74] Marijane Osborn, *Time and the Astrolabe in the Canterbury Tales* (Norman, Okla.: University of Oklahoma Press, 2002), 37. Osborn notes that "even two centuries later clockwork automata had strong associations with the Arabic world" (37). See also E. R. Truitt, *Medieval Robots: Mechanism, Magic, Nature, and Art* (Philadelphia: University of Pennsylvania Press, 2015).

Further mathematical connections can also be drawn. As Marijane Osborn has shown, the mechanical ingenuity of the brass horse, captured in the end rhyme of "pyn"/"gyn" (*SqT*, 321–22), is also connected to the "noble" astrolabie (*Astr*, Pref.17), an equally ingenious mechanical machine made of brass that allowed one to unlock the cosmos in the palm of one's hand and had direct Arabic forebears.[75] The brass horse is further enveloped in astrolabic allusion. In his explanation of the "horsly" (*SqT*, 194) machine's beginnings, the envoy from "Araby" draws on technical language associated with astronomical mathematics:

> He that it wroghte koude ful many a gyn.
> He wayted many a constellacion
> Er he had doon this operacion,
> And knew ful many a seel and many a bond.
> (*SqT*, 128–31)

In these lines, the envoy from the fictional court of the caliph also alludes to the creator of the brass horse ("He that it wroghte"), a figure whose skill set resembles that of the inventive al-Jazarī and the Toledan astronomer and scientific artisan Ibn al-Zarqālluh ("Arsechieles"; *Astr*, II.45.2). Similar to a number of trade artisans who produced astrolabes, Ibn al-Zarqālluh tended both to the fine and intricate metalwork design and to the precise mathematical configurations required to read the "constellation" of the cosmos.[76] The skies also configure Cambyuskan's clan, who are given Arabic star names Elpheta (*al-fakkah*; Corona Borealis) and Algarsyf (*al-saif al-jabbār*; Orion) similar to those found on astrolabes and astronomical tables, including the Clerk of Orléans's "tables Tolletanes" (*FranT*, 1273), a set of

[75]Osborn calls the brass horse "a metaphor for that scientific instrument imported to the Continent and from Arabia, the brass astrolabe" (*Time and the Astrolabe*, 39). On Arabic and Latin sources for Chaucer's *Treatise on the Astrolabe*, see Gunther, *Early Science in Oxford*; Sigmund Eisner, *A Treatise on the Astrolabe: A Variorum Edition of the Works of Geoffrey Chaucer*, Vol. 6, *The Prose Treatises Pt. 1* (Norman: University of Oklahoma Press, 2002); M. Masi, "Chaucer, Messahala and Bodleian Selden Supra 78," *Manuscripta* 19 (1975): 36–47; and Catherine Eagleton, "'Chaucer's own astrolabe': Text, Image and Object," *Studies in the History and Philosophy of Science* 38 (2007): 303–26.

[76]One such craftsman and maker of astrolabes is Muhammad ibn Abd-Allah al-Nastalus, also known as Betelus, whose name is inscribed onto one of the earliest surviving astrolabes, c. 927/8. According to Ibn al-Nadīm's bibliographic catalogue, al-Nastalus ran a workshop for artisans and their apprentices in order to cater to the demand for these mechanical instruments. See Ibn al-Nadīm, *The Fihrist of al-Nadim: A Tenth-Century Survey of Muslim Culture*, ed. and trans. Bayard Dodge, 2 vols. (New York: Columbia University Press), 2:671–72.

astronomical tables associated with Chaucer's "Arsechieles."[77] According to Dorothee Metlizki at least, the cosmological alignment of the romance's central characters also aligns with the fourfold narrative structure intended for this unfinished tale, a structure common to Arabic *sīra*, the genre most closely aligned to the western medieval romance.[78] When read from this perspective, the reference to an Arabic mathematician in a passage that alludes to the geometric models required to understand the processes of reflection seems neither "irrelevant" nor "incongruous," but part of the fabric of multiple mathematical referents drawn from the Islamic world that are woven into the Squire's romance.

Perception, Judgment, and Mind-Mirrors

Canacee's marvelous mirror opens up inquiries into the geometrical processes of reflection, but as Ibn al-Haytham emphasizes, "reflection is not a function of sight."[79] Sight (*al-basar*) and the manner of vision (looking, glancing, gazing) are examined in depth in the first three books of the *Kitāb al-Manāzir*, which provides a structured and systematic explanation of vision. Books I–III of the *Kitāb al-Manāzir* set out a composite examination of the anatomical and physiological structure of the eye; the effect of light upon sight (Book I), the transmission and psychology of visual impressions between the eye and the brain (Book II), and the cognitive formation and distortion of images (Book III). It is primarily the psychological process of sight that is of interest here, but before we turn to this it is worth setting out how light rays form an image in the eye and the brain.

The treatment of light as sensory perception and the calculation of the rays of light that travel from the object to the eye via rectilinear lines of sight are the innovative cornerstones of Ibn al-Haytham's theory of vision.[80] Integral to these calculations are the various conditions that can effect the transmission of the rays of light or forms of light ("sūra al-nūr"), such as

[77]Metlitzki, *The Matter of Araby*, 78. Elpheta, Cambyuskan's wife, bears the name of a pivotal star found close to the centre of the constellation that strings together the rest of the stars, known as the "banū al-fakkah" ("sons of Elpheta"), configuring a family of stars. The Middle English "Algarsyf" is likely derived from the Alfonsine tables, where the Arabic is rendered "ceyf algeuar."

[78]Ibid.

[79]Alhacen, *De aspectibus*, ed. and trans. Smith, IV.5.62.

[80]"[T]he eye's sensation of the light that is in the visible object should occur only through the light passing from the object to the eye" (I.6).

"distance, opposition, luminosity, a sizable magnitude, opacity" (II.3.I). Once these light rays are received in the eye, the act of "visibility" becomes one of "visuality": the cognitive process of sight that perceives, detects, interprets, processes, and recognizes the forms of an object, as well as rectifying the errors of sight.[81]

Ibn al-Haytham's "forms of light" ("sūra al-nūr") work in close association with forms (*sūra*; *species*) and properties (*al-ma'ānī al-mubsara*; *intentiones visibiles*), which enter the eye to create an "abstract mosaic" of the object.[82] Here, Ibn al-Haytham works within the semantic range available to him to present his particular description of the processes of the rays of light. In particular, he is confined by the commonly used term *sūra* (image, or picture) which he dexterously employs in the phrase "forms of light" ("sūra al-nūr"), "sensation," and "shape." The Arabic *sūra* carries echoes of the Greek *eidos*, but also departs from the late Antique notion of images made in the eye as replicas of the objects perceived.[83] As David Lindberg explains, Ibn al-Haytham's forms "are not images in the Epicurean sense. They do not consist of pieces of the object; they are not replicas. Rather they are powers representative of the object, capable of producing effects in a recipient."[84] In order to create this effect, forms work in tandem with the properties of an object known in Arabic as *ma'ānī*. Properties describe the visible, accidental, and intrinsic properties of an object, including light (II.3.1), color, distance, shape, size, motion, beauty, and ugliness (I.5.61). The

[81]Belting categorizes these two ways of seeing as visibility—an act of the eye—and visuality—an act of the brain; *Florence and Baghdad*, 107. In Book I, Alhacen reminds the reader that the "properties perceptible by sight" (I.6.61), which encompass light as well as size, shape, motion, and the position of the object, will be dealt with in his second book (II.3.1).

[82]Belting, *Florence and Baghdad*, 98. Cf. El-Bizri, "Classical Optics," 18. The Latin *species* refers to the visual form, shape, and outline of an object that creates an impression on the senses, such as light and color, and affects the cognitive processing of an object taking into consideration such factors as composition, size, and distance. According to Roger Bacon, "It is called 'form' by Alhacen, author of the widely known *Perspectiva*. It is called 'intention' by the multitude of naturalists because of the weakness of its being in comparison to that of the thing itself, for they say that it is not truly a thing, but rather the intention, that is, the similitude, of a thing"; Roger Bacon, *De multiplicatione specierum*, lines 53–54, in *Roger Bacon's Philosophy of Nature: A Critical Edition, with English Translation, Introduction, and Notes, of "De multiplicatione specierum" and "De speculis comburentibus,"* ed. and trans. David C. Lindberg (Oxford: Clarendon Press, 1983), 5–7.

[83]Jamal Elias suggests that *sūra* can be added to the multilingual repository of words for image—"the Hebrew *tselem*, the Greek *eikōn*, and the Latin *imago*"—which are understood "not as any material picture, but as an abstract, general, spiritual 'likeness'" (*Aisha's Cushion*, 21).

[84]Lindberg, "Alhazen's Theory of Vision," 335.

"powers" that Lindberg refers to are the forms of light ("sūra al-nūr") that create a representation of an image formed not in the eye, but in the brain: "Thus the distances of visible objects from the eye are judged by a perception of the faculty of judgement, for vision is produced in the eye by something external and by the occurrence of this thing in the soul and its becoming unconsciously established [there] over the course of time" (II.3.86).[85] The eye is connected to the brain through "the nerve that stretches beyond the eye and the anterior part of the brain" (I.6.75). The forms of light are carried to the brain through this optic nerve where the brain perceives, judges, remembers, and infers the forms and properties of the image through various modes: contemplation, comparison, and estimation, which also allows for errors in sight to be processed.[86] The visual images are stored in the imagination (*al-takhayyul*), where the brain processes the received forms in order to create a picture or image. Once the image is established, it settles in the soul or, as Ibn al-Haytham notes, it is "unconsciously established."

In western medieval faculty psychology, the imaginative faculty is one of the three ventricles, or cells, thought to constitute the brain, alongside the estimative and common sense, or *phantasia*. The imaginative faculty works in tandem with the estimative, which remembers and recalls images, but also makes instinctive judgments. Ibn al-Haytham follows Aristotle in stressing the interdependence of sight with the faculties of judgment and discernment (*al-quwwa al-mumayyiza*; *virtus distinctiva*); "sight does not possess the capacity to judge" (II.3.17) but "the discrimination performed by the faculty of judgement cannot take place without the mediation of the sense of sight" (II.3.17).[87] Here, mathematical theory is synthesized with natural philosophy. Avicenna, for instance, defines the function of the estimative faculties as "one of the higher faculties to which the imagination transmits images."[88] Moreover, it is in the imagination that the shape of the image is formed and becomes fixed in the soul: "the forms of seen objects occur in the soul and take place in the imagination, and … repeatedly seen forms are fixed in the soul and their shape established in the imagination" (II.4.12).

Chaucer is at least aware that the imaginative faculty is located in the third ventricle of the brain, as we see in *The Knight's Tale*, where the

[85]Cf. *Kitāb al-Manāzir*, 201.
[86]See *The Optics*, ed. Sabra, II.3.
[87]Cf. El-Bizri, "Classical Optics," 18.
[88]Wack, *Lovesickness in the Middle Ages*, 91.

imaginative faculty is considered to be the seat of the "loveris maladye / Of Hereos," which was "engendred / Biforen in his celle fantastik" (*KnT*, 1374–76).[89] The diagnosis of the pathology of love born in the brain ("celle fantastik") reveals the relationship between cognition and visual perception integral to exploring the complexities of the act of falling in love. The vigorous hit to the senses that causes love to appear suddenly and with dramatic potency, as emphasized in the literal iconography of the God of Love in the *Roman de la Rose*, is echoed in the direct force of love that hits Palamon, who, we are told, "cride A! / As though he stongen were unto the herte" (*KnT*, 1078–79).[90] What is described, however, is an act of visibility; upon seeing Emelye roaming in the *hortus conclusus*, Palamon exclaims that he is "hurt right now thurgout myne ye / Into myn herte" (*KnT*, 1096–97). The main organ for visibility ("ye") and the final organ for visuality ("herte") are pinpointed with exact measure, while the repetition of "myne" enforces the rapidity with which the image of Emelye has been processed. The forms of light that have entered Palamon's eye have entered the heart with little time for the brain to estimate, judge, and contemplate its properties.

The speed with which this act of looking occurs is conditioned by the precise form of sight that Palamon engages in: he "cast his eye upon Emelya" (*KnT*, 1077). Here, the Middle English *casten*, a multivalent term used to signal acts of looking, throwing a physical object, as well as divinatory reckoning or calculating, is deployed to denote a sudden and quick turn of the eyes in an act of looking equivalent to a glance.[91] Across the *Canterbury Tales*, Chaucer pairs the verb *casten* with *eye* when emphasizing the direct, physical action involved in looking, especially in the context of falling in love.[92] In *The Physician's Tale* the fiendish judge, ironically unable to cast judgment on Virginia, instead falls in love with her after casting his eye in much the same manner as Palamon: "And so bifel this juge his eyen caste / Upon this mayde" (*PhyT*, 123–24).

The precise use of the Middle English *casten* finds an equivalence in Ibn al-Haytham's notion of glancing. Glancing is one of two processes of

[89]See Lowes, "The Loveres Maladye of Hereos"; Wack, *Lovesickness in the Middle Ages*, 182–83; and Wack, "The *Liber de heros morbo*," 333.

[90]In the *Roman de la Rose* the arrows travel through the eye to the heart, "par l'ueil ou cuer" (1741). See also Akbari, *Seeing through the Veil*, 45–78.

[91]*MED*, s.v. *casten* (v.), def. 17 (a, b).

[92]Elsewhere in *The Knight's Tale* we are told that Theseus "was war, as he caste his eye aside" (*KnT*, 896), and in the temple of Diane Emelye casts her eyes down: "Hir eyen caste she ful lowe adoun" (2081).

immediate sight for perceiving visible objects "by glancing and by contemplation" ("ibṣār bi-al-badīha wa-ibṣār bi-al-ta'ammul" [II.4.33], rendered in Latin as "comprehensio per aspectum" or "comprehensio superficialis," and "comprehensio per intuitionem."[93] Both of these processes of sight are contingent on a "percipient–object relationship," but glancing is distinguished from contemplation. Glancing allows one to perceive the *ma'ānī* of an object in two manners: with or without prior knowledge of the object (*ma'rifa*; *cognitio*).[94] Either way, however, glancing does not allow sight to perceive or ascertain the true image of the object ("what the object really is") or allow for a verification of the object (II.4.33). In casting their eyes, both Palamon and the judge glance briefly at the images of Emelye and Virginia with prior knowledge, discerned through their appreciation and knowledge of a singular property of the object of their vision: their beauty. According to Ibn al-Haytham, glancing with prior knowledge is the form of vision that allows one to recognize an object but without scope for contemplation at the very moment of vision (II.4.33). Both are able to recognize the traits of beauty in Emelye and Virginia ("So was he caught with beautee of this mayde" [*PhyT*, 127]), yet neither contemplates the image at the moment of vision. This is equally true for Arcite, who does not cast his eye but spies upon Emelye ("espy" [*KnT*, 1114]), yet nonetheless is affected deeply by Emelye's beauty: "the fresshe beauty sleeth me sodeynly" (*KnT*, 1118). That Palamon and the judge are merely glancing is also clear from the additional emphasis that Chaucer places on the accidental nature of their act of looking; in both cases to cast a look is accompanied by happenstance ("bifel" [*KnT*, 1074; *PhyT*, 123]) that also stresses the determining power of sight.

This form of glancing also causes both Palamon and the judge's faculties of sensation to move. As we have seen, Chaucer locates the movement caused by sight in Palamon's heart. Likewise, the image of Virginia causes an intense impression that affects the judge's faculty of judgment: "Anon his herte chaunged and his mood" (*PhyT*, 126). Avicenna, following Aristotle, notes in his *Kitāb al-Nafs* (*Book on the Soul*), known in Latin through the translation by Abraham ibn Dawūd (Avendauth) and Dominicus Gundissalinus: "The soul reigns over the body by means of the heart," and "the sensibility of the heart (especially touch) is stronger than that of the

[93]For the Arabic see *Kitāb al-Manāzir*, 337. Cf. El-Bizri, "Classical Optics," 18.

[94]"A mere glance at an object without prior knowledge results in sight neither recognising nor contemplating the *ma'ānī* "at the moment of noticing them" (II.4.33).

brain."[95] As we have seen, the brain is vital for the processing and recollection of an image; it is the center of sensation, where the sensory nerves originate, and plays a vital role in sensory activity, as "the faculties of sense-perception and movement are transmitted from the heart through the nerves to the brain."[96] When Ibn al-Haytham explains that images from the eye are fixed in the soul (*nafs*), he may be also referring to the heart (*virtus spiritus*): the seat of the soul. It is no surprise, then, that when he casts a look at Emelye, Palamon's mode of sight is one of glancing that moves immediately and directly from his eye to his heart. Moreover, at the point that both Palamon and Arcite see Emelye, neither of them fully ascertains her nature as it is encapsulated in the pivotal line that differentiates their vision: "I noot wher she be womman or goddesse" (*KnT*, 1101). It is worth briefly noting that environmental conditions are also important for processing the forms of light ("sūra al-nūr"), which Ibn al-Haytham comprehensively sets out in Book II, Chapter 3. Chaucer is keen to stress the iron bars of the prison, described as an impenetrable barrier, "thikke . . . greet and square" (*KnT*, 1075–76) that would undoubtedly hinder both Palamon and Arcite's ability to see the full nature of Emelye. Indeed, neither of the imprisoned knights is able to ascertain the true nature of the image—especially not Arcite, who, I put forward, neither glances nor contemplates, but engages in a far more insidious spying that results neither in knowing whether she is human or divine, nor in being able to ascertain the veritable nature of their love: "Thyn is affecciun of hoolynesse, / And myn is love as to a creature" (*KnT*, 1158–59). Certainly, neither Palamon nor Arcite has contemplated her image, and as Ibn al-Haytham reminds us, it is only through contemplation that the quiddity or the essence of an object can be recognized and understood—even if the object is seen once or for the first time.

Contemplation similar to glancing is also subdivided into two categories: "vision by simple contemplation and vision by contemplation together with prior knowledge" ("ibṣār bi mujarrad al-ta'ammul wa-ibṣār bi-al-ta'ammul ma'taqdim al-ma'rifa" [II.4.34]).[97] Contemplating an object seen for the first time or one not recognized at first sight is considered to be vision

[95] *Avicenna Latinus Liber de anima seu Sextus de naturalibus*, ed. Simone van Riet, 2 vols. (Leiden, 1968–72), 2:180.

[96] Ibid., 179. See also Dag Nikolaus Hasse, *Avicenna's "De anima" in the Latin West: The Formation of a Peripatetic Philosophy of the Soul 1160–1300* (London: Warburg Institute, 2000), 99–100.

[97] For the Arabic see *Kitāb al-Manāzir*, 337.

by simple or mere contemplation. Vision with prior knowledge extends to "all objects which sight has previously perceived and now remembers having seen" and, upon recognition, resumes contemplating and surveying their properties (II.4.34). Ibn al-Haytham further divides contemplation with prior knowledge into two subsections: familiarity and complete contemplation. Contemplating a familiar object is a process of quick recognition or a brief surveillance of the properties of a new object. Ibn al-Haytham stresses that this process of sight is contingent on time; contemplating a familiar object occurs in "an insensible interval of time," which results in a partial recognition of the object (II.4.34). In contrast, complete contemplation is achieved by a full surveillance of all the properties of an object that happens within a reasonable, sensible period of time dependent on the visible properties of the object: only complete contemplation allows familiar objects to be "perceived with full certainty" (II.4.34).

The difference between casting a glance and a deeper form of deliberation on an image is crystallized in *Troilus and Criseyde*. Troilus's sight of Criseyde in the throng of the temple goes deeper and further than either of the Theban cousins' sight of Emelye:

> On this lady, and now on that, lokynge,
> Wher so she were of town or of withoute;
> And upon cas bifel that thorugh a route
> His eyes percede, and so depe it wente,
> Til on Criseyde it smot, and ther it stente.
> (*TC*, I.269–73)

The act of vision is emphasized with some force that suggests this is not simply a glance, especially as Troilus does not cast a look on Crisyede. Instead, his "lokynge" is accompanied by a more virulent and deep piercing ("percede"). Similar to the Theban knights, Troilus is able to recognize Criseyde's beauty—a singular property that suggests some familiarity of the object—but unlike that of his lovesick counterparts, Troilus's gaze stops and lingers on the image. The alliterative "smot" and "stente" underscore the first step in contemplation of an image, one that we can discern is a form of familiar contemplation that occurs within a short period of time: just enough for Troilus to recognize and process the overriding property of Criseyde that plunges him into a pathological state of *amor hereos*. Chaucer clearly demarcates the genesis of love in Troilus's gaze that causes the generation of love in the *virtus spiritus*: "Right with hire

look the spirit in his herte" (*TC*, I.306). Indeed, Troilus's very act of visibility ("look") has a profound physical effect on him; upon seeing Criseyde, the tragic Troilus "sodeynly hym thought he felte dyen" (*TC*, I.306). This effect, typical of the hyperbole that is characteristic of Chaucer's Trojan knight, is a result of the cognitive process of his act of looking:

> And of hire look in him ther gan to quyken
> So gret desir and such affeccioun,
> That in his herte botme gan to stiken
> Of hir his fixe and depe impressioun
> And though he erst hadde poured up and doun,
> He was tho glad his hornes in to shrinke:
> Unnethes wiste he how to loke or wynke.
> (*TC*, I.295–301)

That this force of an impression is dependent on a stronger form of vision than a glance is further indicated in the final line of the stanza, where Chaucer notes that Troilus is unable fully to control his perception. He is unable to either "loke or wynke." The language of vision here—in particular "loke," a synonym of *casten* that also denotes glancing—emphasizes Troilus's loss of control of his eyes: he has now left perception and has fallen into the depths of contemplation.[98]

Moreover, the certain outcome of his fixation on Criseyde's image is indicative of the estimative faculties and the faculty of judgment. The image of Criseyde is imprinted and stored in the brain, but the estimative faculty has malfunctioned and fixated upon the beauty of the beloved: Criseyde's image leaves a "fixe and depe impressioun" upon the brain that suggests that the "excessively pleasing sense-perception" has overtaken all other sense-perceptions. As J. D. Burnley observes, "An image so forcefully impressed into the heart may lead to a disorder of the lover's power of perception. It is a measure of the sensitivity of the heart, the force of the impression, or of both, that the impression is so fixed and deep that it alters perception of the world outside."[99] Troilus's act of looking has caused a direct effect on his heart ("his herte botme gan to stiken"); however, it is not entirely a reflection of a malfunctioned form of perception but rather the psychological effects of contemplation. Unlike the acts of glancing by

[98] *MED*, s.v. *loke* (v.), def. 1(a–c).

[99] J. D. Burnley, *Chaucer's Language and the Philosophers' Tradition* (Cambridge: D. S. Brewer, 1979), 108.

Palamon and the Physician's judge, both of whom are also affected in the heart, Chaucer pauses on this psychological effect of the image before its final location is settled in the heart.

For Ibn al-Haytham, the process of contemplation is also psychological; it takes place in the imaginative faculty, which supplements the image with mental recollections of the object in order to form a mental picture. This in turn is aided by the faculty of judgment, which is responsible for the "comparison mode in the act of seeing" and for recognition, which cannot "take place without remembering" (II.3.9). The true nature of objects can only be perceived by visual scrutiny (*tafaqqud*; *consideratio*), which is the role of contemplation as it draws on the function of memory and the faculty of judgment, either by seeing the whole object or through inference of a few properties. Further contemplation is essential when an object is seen only and briefly through inference in order to allow the faculty of judgment to process the image. Therefore, when one sees an object through "recognition or by an extremely quick reference" the full object is not perceived at that moment of sight; "rather it is one that requires further contemplation" (II.3.25).

As soon as Troilus sees Criseyde, he immediately retreats to his "chamber" (*TC*, I.358) and, with the symptoms of *amor hereos* beginning to take hold, "at first he gan to sike, and eft to grone" (I.360); his thoughts are overwhelmed with the singular and exact remembrance and recollection of Criseyde's image, "That he hire saugh a-temple, and al the wise / Right of hire look, and gan it newe avise" (I.363–64). Troilus undergoes a painful form of contemplation, one that causes him continually to remember the form of Criseyde, despite his fixed and deep impression at first glance: "he makes a mirour of his mynde / In which he saugh al holly hire figure" (I.365–66). As Mary Carruthers astutely demonstrates, Troilus's reaction is in accordance with medieval cognition: "He behaves in a manner considered at the time to be ordinary rational behaviour, and far from self-indulgence, 'making a mirror of [one's] mind' was a standard medieval procedure of analytical thought prior to making informed judgements."[100] Carruthers argues that Troilus's "imagenynge" (I.372), recollecting the sight of Criseyde in his mind's eye and imagination, is part of the process required for him to come to an informed and rational judgment.

[100]Mary J. Carruthers, "Virtue, Intention and the Mind's Eye in *Troilus and Criseyde*," in *Traditions and Innovations in the Study of Middle English Literature: The Influence of Derek Brewer*, ed. C. Brewer and B. Windeatt (Cambridge: D. S. Brewer, 2013), 73–87 (74).

However, it is also in accordance with Ibn al-Haytham's notion of contemplation, which is vital for Troilus's ability rationally to comprehend his vision. Troilus's deep impression and continual visual scrutiny over Criseyde's form have the same effect and enable her image to be impressed into his soul or, as Chaucer locates it, within "[h]is herte, which that is his brestez yë" (I.453). Troilus is entirely dependent on the image of Criseyde created in his imagination, which he continues to dwell over. The metaphor of the mirror in his mind not only suggests the cognitive process of contemplation but the use of inference (*qiyās*) in order to settle on an image and decision as to the nature of his love. Ibn al-Haytham notes that an object's universal forms have to be seen repeatedly and "settled in the imagination" for it to be fixed in the brain and in the soul; once the image "occurs to the soul, the faculty of judgement will assert the conclusion without needing to resume the inference" (II.3.31). Troilus sees Criseyde only once before her image is firmly impressed in his soul, which suggests his contemplation is based on inference and prone to error.[101]

Moreover, the metaphorical mirror that creates a visual impression in Troilus's mind also resonates with the marvelous mirror gifted to Canacee in *The Squire's Tale*. In the second part of the tale, we are made alert not only to the physicality of the mirror as Canacee takes it to her chamber, but to its ability to impress a mental image:

> And in hire sleep, right for impressioun
> Of hire mirour, she hadde a visioun.
> (*SqT*, 371–72)

The similarities with Troilus's contemplative scene are striking: both scenes take place in a chamber, both visions are associated with *fin'amors* (as Canacee's mirror tells her if lovers are true or false), and both draw on the image of the mirror. Not only does Canacee's mirror exist materially and mathematically as a large piece of glass that creates reflections through compositions of angles, but it is also an aid for contemplation and visuality: the cognitive process of sight that creates a mosaic of forms, a "visoun" in the mind. Here, the mind-mirror trope, one that combines Ibn al-Haytham's geometrical examination of reflection and psychological discussion of sight, is used to metaphorical effect.

[101] The errors of sight are discussed extensively in Book III of the *Kitāb al-Manāzir*.

Conclusion

The single instances of sight explored here are reliant on the "intent of the beholder" ("bi-hisāb qasad al-nāzir" [II.1.3]), a phrase neatly capturing the poetic resonances of Ibn al-Haytham's examination of sight that take us beyond his immediate scientific context.[102] Indeed, the mirror's wondrous capabilities, its ability to detect treason, treachery, and true love, are reliant on the beholder's intention or, as Chaucer puts it, "if any lady bright / Hath set hire herte on any maner wight" (*SqT*, 137–38). The expression "to set your heart on a matter" also works to both metaphorical and scientific effect here. As we have seen, the heart can be considered to be the final organ in which an image seen by the beholder—in Ibn al-Haytham's terms—is "unconsciously established" (II.3.86). Whether deeply contemplating, furtively glancing, or insidiously spying, the Theban cousin-knights, the lovesick Troilus, and the Physician's judge all set their heart on—ultimately destructive—matters that begin with a look. As these males cast a look or linger on an image, they engage in precise acts of looking that reveal the cognitive and psychological processes they undergo as they fall quickly and painfully in love. The relationship among visual perception, cognition, and *amor hereos*, critical territory that is well-trodden, is made all the more complex as the linguistic equivalences in Chaucer's poetic expression and Ibn al-Haytham's scientific exposition of "how one sees" are drawn together through an "exchange of glances."

However, this is not only an exercise in comparison. Employing an "exchange of glances" across the Arabic *Kitāb al-Manāzir* and these instances of looking across Chaucer's poetry opens up a new method of intertextual reading that works to bypass and undo the colonial gaze of "influence." Here, it is worth returning to Sahar Amer, who notes that intertextuality "challenges the alleged boundaries between the medieval Arab Islamicate and Christian European worlds, as well as the very notion of textual and national boundaries."[103] The porosity of these boundaries is made evident as we glance across the iterations of Ibn al-Haytham's name in Middle English, French, and Arabic, revealing that Chaucer's reference to "Alocen" can be read as more than simply an empty mention of another Arabic philosopher. Going beyond intertextual references within Eurocentric source structures, poetic or scientific, allows us to hear those "Islamicate

[102] Ibn al-Haytham, *Kitāb al-Manāzir*, 200.
[103] Amer, "Reading Medieval French Literature," 372.

voices," as Amer puts it, that were present in northern Europe. These voices had particular currency in the capital of the Arabo-Latin scientific translations that brought not only "newe science" (*PF*, 25) but some slight "tidynge" (*TC*, II.951) of the names attached to them. Thus, taking into serious consideration the Latin *De aspectibus* and the Arabic *Kitāb al-Manāzir* as intertexts for Chaucer's poetry opens up novel and decolonial ways of exploring complex modes of sight and seeing outside the parameters of sources and analogues. In turn, this also requires a reconsideration of critical approaches to Arabic science and its presence in Middle English poetry: a presence that is not of empty citation, but a genuine commerce of ideas that exists in a cyclical rather than linear sphere of movement from text to hearsay, from the technical to the literary.