Transmedial Technics in Chaucer’s
*Treatise on the Astrolabe*: Translation, Instrumentation, and Scientific Imagination

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Abstract

An astrolabe is a versatile technical medium that rescales and renders aspects of the world at large. Accordingly, I argue that Chaucer’s *Treatise on the Astrolabe* configures perceptions of the environment through varieties of simultaneous translation. As a translated text, the treatise mobilizes knowledge practices drawn from diverse languages and scientific cultures; as a technical object, the accompanying device expresses correspondences among observed phenomena. The result is a technoscientific idealization of a common world propagated by prose instruction and physical instrumentation. Verbal, numerical, geometrical, and material figures are also joined by uncanny metaphors that augment and intensify the astrolabe’s ecological orientation. Affiliated zoomorphic images of the spider, horse, and eagle suggest that the instrument embodies more-than-human sentience and skill, virtually distributing agency across an imagined multispecies spectrum. The essay concludes with Chaucer’s cautious consideration of scientific intermediaries in *The Squire’s Tale* and *The House of Fame*.

Keywords

Geoffrey Chaucer; astrolabe; history of science; media archeology; global Middle Ages; eco-materialism; translation studies; cross-cultural studies; environmental history; anthropomorphism; multispecies spectrum; scientific imagination

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STUDIES IN THE AGE OF CHAUCER

GEOFFREY CHAUCER’S TREATISE ON THE ASTROLABE describes a multipurpose mechanism (all-in-one clock, compass, calculator, star map, and data storage-and-retrieval device) whose primary reference is the predictable arrangement of empirical phenomena. Two of five projected parts make up the unfinished work: the first details the physical components of a planispheric astrolabe, the second ranges over forty possible applications (“conclusions”). Tables with auxiliary data were intended but not included. The spare, expository prose together with the impulse to diagram and tabulate reflect a deliberate pedagogic strategy, training up a ten-year-old boy, “Lyte Lowys my sone” (1).1 Adapting the matter to the needs of an amateur, Chaucer embraces an artless style (“full light reules and naked wordes in Englisshe” [21–22]) and employs purposeful redundancy (what he calls “my superfluite of wordes” [36]). For example, the border of the instrument is said to be marked by degrees “from 5 to 5 as shewith by longe strikes bitwene” (135–39), and nearly 100 lines later the same information is presented. “Now have I tolde the twyes” (220). The next part progresses incrementally with a systematic explication of use-cases. The first describes how to find the sun’s longitude by setting the alidade on the back of the astrolabe to the day of the month and then reading off degrees; the second concerns the altitude of the sun, moon, or another celestial body by suspending the astrolabe from the right thumb and rotating the alidade until the sunlight shines through the holes, before noting the degree of altitude; there follows a third technique for finding the time of day or night, and so forth. Chaucer attends throughout to pragmatic means and soluble ends, issuing a stepped series of actions and calculations to arrive at repeatable results, insisting on procedural clarity and correctness. The astrolabe emerges as a practical instrument, affording efficient modes of information capture, conversion, and display, based in sound observational methods.

Chaucer’s Astrolabe may seem relatively restrained and unimaginative to readers expecting more in the way of the poet’s signature irony and

irresolution. Nor is it engaged in fabling or fictive world-making. The prose treatise can seem the antithesis of the poetic, a momentary turn away from well-appreciated forms of narrative invention and indirection associated with other traditions in which he wrote. Yet if the pragmatic purpose and exposition occasion any ambivalence, the situation may helpfully expose unexamined assumptions about literary and technical forms, then as now, and regarding the very notion of instrumentality. Chaucer’s role as translator and technical adviser, admired in the following centuries by the likes of John Lydgate, Gabriel Harvey, and John Selden, was not so hard to fathom at earlier moments in literary history.

Within a few decades the handbook was circulating broadly, in over thirty manuscript copies, more than for any other work by Chaucer outside the Canterbury Tales. “Emarrassed by the apparent popularity of a work that seems so foreign to our modern view of Chaucer’s attractions,” observes Simon Horobin, “scholars have sought to explain away this situation as an aberration.” How might readers better recognize the particular significance of the Astrolabe? One way is to show how the technical matter applies to the literary, making use of the treatise to calculate horoscopes, date fictional events, and interpret celestial allegories in the narrative poems. Another is to champion an earlier literary

2 For one thing, exact measures associated with the mathematical geometry of Ptolemy and the algebra of al-Kwarizmi are preferred over the celestial metaphysics of Macrobius or Martianus Capella. For another, an earnest account of factual and practical information may be difficult to square with Chaucer’s characteristic ambivalence toward alleged expertise and the clerical elite. There is nothing like the satirical pressures exerted elsewhere—exemplified by a well-placed astrolabe and copy of Ptolemy’s Almagest in The Miller’s Tale, or by the exposé of mystifying alchemical operations in The Canon Yeoman’s Tale—to qualify the acts and authority of science. My initial point is that without those sharp edges, Chaucer’s Astrolabe is liable to yield an image of a more mundane, pragmatic, and plain-style Chaucer than many are accustomed to.


subjectivity, rightly insisting that, if Chaucer’s *Astrolabe* can appear out of place, the work should remain a thorn in the side of facile notions of authorship. Chaucer is a reminder that the accountant, administrator, amateur scientist, and literary artist can be found in the same person.6 Both are necessary approaches and yet, while showing renewed appreciation for the treatise, they may confirm that the work is ancillary to Chaucer’s exhilarating literary fictions. A third claim is worth pressing along with the others. Even as we enlarge conventional notions of literary activity and authorship, we should grant the prosy, technoscientific object its primacy. Chaucer devotes himself to a technical medium at least as expressive and imaginative as any literary composition, perhaps “poetic” in older senses of constructing or compiling figures.7 Only here, we are not speaking of fashionable letters. The technical apparatus rather springs from a medieval “scientific imagination.”8 I argue that it is precisely from a pragmatic, object-oriented vantage that the technical matter may show itself as more than a mere appliance. Here the sincere technicity and barefaced instrumentality of the work poses a useful

6 That is why we should hesitate to accept John North’s suggested that Chaucer’s pursuit of a computational science is congruent with the more familiar image of the poet as an “ingenious schemer,” evidence for which there is none in the treatise itself; see North, *Chaucer’s Universe*, ix. The calculating mind on display in the astrolabe treatise is rather more like the one he exercised at the *computorium*, the counting house where Chaucer worked for over a decade as Controller of the Customs. Notably, he began the treatise around the time he retired as Clerk of the Works, an office in which he would have had occasion to employ an astrolabe in civil engineering projects he oversaw at the Tower of London or Windsor Castle. Accounting for poets who engage in counting is a general cultural problem as well as a specifically Chaucerian one. As Steven Connor observes in his wry formulation of the modern “anti-numerical prejudice,” literary scholarship has often foundered on the dilemma; see *Living by Numbers: In Defense of Quantity* (London: Reaktion, 2016).

7 See the useful remarks on *poiesis* in E. R. Curtius, *European Literature and the Latin Middle Ages*, trans. Willard Task (London: Routledge, 1953), 145–47. Encouragement to look beyond bellettristic appreciation to what technical matters may accomplish can also be found in Lisa Cooper’s work on the “poetics of practicality” in how-to texts, inviting investigation into “whether insistently practical texts, those whose explicit goal is to assist their readers to make something in the world beyond the page (a book, a culinary dish, an ointment, an object), might be said to have a poetics and, if so, in what that poetics might be said to consist”; see Lisa Cooper, “The Poetics of Practicality,” in *Middle English: Oxford Twenty-First Century Approaches to Literature*, ed. Paul Strohm (Oxford: Oxford University Press, 2007), 491–505 (492). Cf. Jonathan Sawday, *Engines of the Imagination: Renaissance Culture and the Rise of the Machine* (London: Routledge, 2007), xviii, who argues that early technoculture involves a “work of imagination.” He observes that “the elaborate devices of the artist-engineers of the Renaissance reached deep into early-modern political, aesthetic, and philosophical structures of thought.”

8 Edward Grant, *The Nature of Natural Philosophy in the Late Middle Ages* (Washington: The Catholic University of America Press, 2010), 163ff.
stumbling block, for Chaucer’s Astrolabe is sufficiently mundane as to perform a productive decentering of the model literary subject.9 What comes into focus instead is the ingenuity and imaginative modality of an engrossing medium of geometry, geography, architecture, and practical astronomy. It compels us to ask what it can mean to instrumentalize.

“Instrument-knowledge” has of course come to seem at odds with civilizing, humanizing endeavors at least since Matthew Arnold.10 Modern culture has segregated aesthetic and technical objects.11 Yet the earliest recorded instances of English “instrument” are found in Chaucer’s writings (in reference not just to a mechanism but also to bodily members), indicating that we had better be careful with assumptions that have since accreted around that term to connote dehumanizing routines or alienating machines.12 To start, the charisma of the astrolabe, “so noble an instrument” (14), should not be underestimated. Finely crafted, molded, and engraved, astrolabes were often ornamental as well as useful, befitting something designed to mirror the cosmos, Greek for “order” and “ornament.” Aware of the implications, Stephen G. Nichols considers Chaucer’s description “as essentially an ekphrasis of a work of art (the astrolabe).”13 The connotations of musical instrumentation

9 We could insist, as a provisional heuristic, that Chaucer’s Astrolabe is instructive precisely as a conspicuous parergon (allegedly secondary or supplemental), evidently distinct from the ergon of a creative, singular, masculine literary artist. The Kantian parergon (an effaced background, border, frame) is discussed in Jacques Derrida, The Truth in Painting, trans. Geoffrey Bennington and Ian McLeod (Chicago: University of Chicago Press, 1987), 54–73.

10 As cited by Jentery Sayers, “Technology,” in Keywords for American Cultural Studies, ed. Bruce Burgett and Glenn Hendler (New York: New York University Press, 2014), available at http://hdl.handle.net/2333.1/tr4xh08x (accessed August 21, 2016). The rise of instrumental rationality has occasioned vigorous critiques leading to the further pejoration of the term, associating it with shallow thinking and worse; see, for example, Darrow Schecter, The Critique of Instrumental Reason from Weber to Habermas (New York: Continuum, 2010).

11 As Gilbert Simondon observes in The Mode of Existence of Technical Objects, trans. Cecile Malaspina and John Rogove (Minneapolis: Univocal Publishing, 2017), high culture tends to banish technical objects “into a structureless world of things that have no signification but only a use, a utility function,” neglecting their real social, historical, and aesthetic import (16).

12 See MED, s.v. instrument (n.), def. 1(a), where the first recorded usage of the word to mean “[a] device operated by hand, a tool, an implement, a utensil” is attributed to The Equatorie of the Planetis, which may be Chaucer’s composition (c. 1392). The more specific sense (def. 1(d))—“an instrument used in astronomy or astrology”—is attested in Chaucer’s Treatise (c. 1391). Definitions 1(b) (“a musical instrument”) and 1(c) (“a surgical instrument”) were also current. See also WBP, 149–50.

would also not be entirely out of place. That may exaggerate, but such notions do the service of pointing beyond literary to technological invention, fascination, and sophistication. Chaucer’s *Astrolabe* is concerned with the capacity of an instrument to propagate alternative perspectives and positional information, generate surprising associations among species, and access otherwise remote geographical regions. I will argue that, by taking the measure of times, places, and polities in the world at large, the scientific apparatus constitutes an elegant and efficient multiscalar medium of translation.

For the effects of mediation and translation to register, however, we need a rebooted critical methodology to restore fundamental competencies to technical objects. One sort of stimulus can be found in digital humanities, media archaeology, and platform studies. A forensics of physical machines and system could be just as productive in the study of past technics. My working assumption is that instrumental technologies make claims on attention, mount arguments, structure thought and feeling, and achieve functional objectives by eclectic means. Further encouragement may be found in nondualist eco-theory that underscores the vital materiality, autonomy, and agency of physical artifacts.

14 There is no direct reference to the consonance of the spheres producing celestial frequencies in Chaucer’s *Astrolabe*, but instruments that measure time and space must in a sense be attuned to the complex score of the cosmos. Medieval musicology is also grounded in number, interval, and ratio, and, as part of the quadrivium (i.e., the four ways of mathematical method, leading, by stages, to advanced arithmetical exercises), was preparatory to geometry and astronomy. See further Henry Chadwick, *Boethius: The Consolations of Music, Logic, Theology and Philosophy* (Fairohn: Clarendon Press, 1990), 101; and Philipp Jeserich, *Musica naturalis: Speculative Music Theory and Poetics, from Saint Augustine to the Late Middle Ages in France*, trans. Michael J. Curley and Steven Randall (Baltimore: Johns Hopkins University Press, 2013), 125–26.


Adapting a Spinozan formulation motivating recent eco-materialist philosophy, we can ask: What if we don’t know what the technical instrument can do? How might a device compile and transmit knowledge not just through language but also by way of articulating pointers, plates, numbers, gestures, and speculative relations? Chaucer’s Astrolabe happens to be lucid about the way instrumentation actively embodies and expresses understanding. At some moments, he limns the technical object a sort of extended organ of cognition and sensation. Chaucer’s language is provocative. He employs quasi-literary figures and, with those vivifying traces of prosopopoeia, the functional device practically comes alive. An estranging notion of near sentient instrumentation is corroborated in literary narratives to suggest what the device may represent. In Chaucer, a gathering notion of the weird hybridity of technical matter starts to take shape along with the idea that astrolabic science, in practical ways, portends more-than-human intelligence.

This essay consequently proposes an inclusive, cross-disciplinary, ecological approach to technical modes of intermediation. It takes the astrolabe to be a transmedial interface. Arianna Borrelli has already defined “astrolabe” to include verbal expression and nonverbal mental concepts, practical procedures, visual diagrams, and physical objects working together, clearing the ground for further analysis of the multimodal object. Taking a wide-angle view, I insist that the astrolabe is transsected by yet other lines (e.g., mineral substance, numerical quantities, University Press, 2010). While it once seemed natural to me to go to Martin Heidegger’s analysis of tool-being, my citations here and elsewhere in the essay reflect a preference for and endorsement of feminist and queer historians of science and technology. I find further stimulus in medieval scholarship that has started to reframe science, technology, and technical ingenuity (e.g., E. R. Truitt, Medieval Robots: Mechanism, Magic, Nature, and Art [Philadelphia: University of Pennsylvania Press, 2015], and Patricia Clare Ingham, The Medieval New: Ambivalence in an Age of Innovation [Philadelphia: University of Pennsylvania Press, 2015]) and nonhuman ontologies (e.g., Jeffrey J. Cohen, Stone: An Ecology of the Inhuman [Minneapolis: University of Minnesota Press, 2015]).


external motions, and metaphors), obtaining its manifold utility by con-
ducting aspects of both nature and culture. The transformative effects
manifest themselves in varieties of simultaneous *translatio* (linguistic,
numerical, geometrical, and technological). Accordingly, the first part
of the essay addresses Chaucer's theory and practice of translation to
underscore the translingual ecology at work in the *Astrolabe*. But
because an astrolabe is no mere verbal construct, I go on to mathematics
and material facture in the second part to show how magnitudes and
motions are made intelligible in the physical device. In turn, the mech-
nism lends itself to animating figures of speech, and so the third part
returns to the medium of language mindful of what lies beyond the
text. Merciful metaphorical figures (spider, mother, horse, and eagle)
reveal an uncanny hybridization within astrolabic science, which is fur-
ther attested by zoomorphic imagery in Chaucer's *Squire's Tale* and *The
House of Fame*. What follows draws a thread through disparate elements,
conjoining figures from overlapping domains that co-constitute sci-
entific activity. The broader point I wish to make is that while early loca-
tive and calculative technologies identify points and dimensions in the
proximal environment—latitude, altitude, direction, time—they also
register pervasive cross-cultural and ecological entanglements. The
result is a heterogeneous assemblage, embodying what I am calling a
transmedial technics through which to engage the cosmos beyond the
human. The astrolabe, in short, is practically worldly-wise.

**Translation and Translingual Ecology**

Chaucer’s *Astrolabe* may once have stoked triumphalist claims about the
rise of a native scientific culture. It continues to attract attention for
what it might suggest about Chaucer’s ambitions as an innovative vernac-
ular translator, leading some to suppose that the text and technology
are not so ecologically expansive. Granted, Chaucer relates his work to

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the cultural and political milieu of his day, deferring to “the king, that is lord of this langage” (45–46). Scholars have accordingly argued that the treatise belongs to a larger project to promote himself or cultivate English, by analogy with what has often been assumed to be maverick Wycliffite efforts to translate the Bible. In this light, we may find ourselves wondering if Chaucer has found an ideal territorializing device in an English Astrolabe. Kathleen Biddick for one has attempted to argue that the language of the treatise is implicated in a broader ethnocentrism and exclusionary scientific rationalism in the period. Yet the scientific matter is not parochial in Chaucer’s case, exhibiting instead—in respect of textual sources, terminology, and portable knowledge—a worldly orientation. Chaucer’s Astrolabe materializes the sort of linguistic ecology that Jonathan Hsy associates with Chaucer’s other works, where translingual exchange and exposure are constitutive rather than incidental to the text. Drawing together international knowledge practices, Chaucer’s technical apparatus opens up transhemispheric horizons.

Chaucer’s Astrolabe depended for its existence on transcontinental text networks and scientific cultures from around the medieval Mediterranean. At the time, Latin and not English was still the default medium of technical knowledge, and Chaucer’s efforts belong to the history of the slow vernacularization of textbook science. Aware of the contingencies involved, Chaucer speaks only of the limited sufficiency of his


20 Kathleen Biddick, Typological Imaginary: Circumcision, Technology, History (Philadelphia: University of Pennsylvania Press, 2003), 23–33, proposes that the rationality and false universalism of the instrument served Christian supersessionism. She claims that the alphabet etched on the front border serves to “mechanize human diversity,” and instantiates an ethnocentric orientation. As Catherine Eagleton shows, Biddick’s argument is based on erroneous extrapolation from a limited sample, as Chaucer’s is the rare case: “the vast majority of astrolabes do not have the alphabet on them” (Catherine Eagleton, “Chaucer’s own astrolabe: Text, Image and Object,” Studies in History and Philosophy of Science Part A 38, no. 2 [2007], 303–26 [320]).

English to accompany “a suffisant astrolabie as for oure orizonte com-
pnowned after the latitude of Oxenforde” (7–9). In his prologue, Chaucer
adopts the pose of belated compiler: “I am but a lewde compilator of
the labour of olde astrologiens and have it translatid in myn Englishe
ooly for thy doctrine” (49–50). A sense of just how much the work
of translation absorbed Chaucer in manifold disciplines, traditions, and
tongues—what Stephen McCluskey calls medieval astronomies and sci-
centific cultures in the plural—can only be suggested here.22 Specifically,
Chaucer is adapting a Latin translation of a work attributed to the
eighth-century Jewish-Arab astronomer Mâṣḥāʾallāh ibn Ṭāhār (Messa-
hala), *De compositione et operacione astrolabii*. Chaucer also relays information
from the *Tractatus de sphaera* by the thirteenth-century Parisian scholar
John Sacrobosco, whose treatise, a staple of the liberal arts curriculum,
passed on a version of antique cosmology and spherical geometry. How
was such a synthesis possible? The story begins with the abstract geomet-
rical sophistication of Ptolemy’s *Almagest*, digested and developed into
sophisticated planetary theory by scholars working around Baghdad,
Maghrib, and al-Andalus from the eighth century onwards. Important
conduits to the Latin West included Gerbert of Aurillac in the late tenth
century (who returned from northern Spain with the abacus and arabic
numerals) and, in the twelfth century, Adelard of Bath (translating
Euclid’s *Elements* and the tables of al-Kwarizmi, and composing an intro-
duction to Abu Ma’Shar and a treatise *On the Use of the Astrolabe*). The
available texts and techniques engaged a circle of scholars working in
the West Midlands, where a keen interest in “Saracen calculation” took
hold.23 Growing familiarity with instruments (e.g., astrolabe, armillary
sphere, and planetary equatorium) provoked the further spread of math-
ematical and empirical methods. An “astronomical corpus” took shape.
One example is London, British Library (BL), MS Harley 3647, a
fourteenth-century compilation from Paris, where Sacrobosco taught, con-
taining Sacrobosco’s *De sphaera*, Mâṣḥāʾallāh’s *Astrolabium*, Gerard of
Cremona’s *Theorica planetarum*, Toledan *Tabulae*, and four astronomical
treatises of Thābit ibn Qurra. Academic science was soon Englished in


23 Charles Burnett, “Algorismi vel beneep decentor et diligenter: The Arithmetic of Ade-
lard of Bath and His Circle,” in *Mathematische Probleme im Mittelalter: Der lateinische und
in Charles Burnett, *Numerals and Arithmetic in the Middle Ages* (Farnham: Ashgate,
2010), 221–31.
such compilations as Peterhouse, Cambridge, MS 75.1, which includes the unique copy of *The Equatorie of the Planetis*, and Trinity College, Cambridge, MS 0.5.26, whose matter includes Prolemy, Alkabucius, Māshāʾal-Iūr, and *The Newe Theorik of Planetes*. In sum, Chaucer’s *Astrolabe* represents a westering movement of multilingual scientific practices, where historical currents and countercurrents came to flow, blend, and pool in new vernaculars.

That scientific culture was on the move is everywhere evident in Chaucer’s *Astrolabe*. What Chaucer had ahead of him to translate was predicated on linguistic migration and cross-cultural exchange. Just so, his theory of translation appears rather encompassing: “suffise to the these trewe conclusions in Englissh as wel as sufficith to these noble clerkes Grekes these same conclusions in Grek; and to Arabiens in Arabik, and to Jewes in Ebrew, and to Lattin folk in Latyn; which Latyn folk had hem first out of othere diverse langages, and written hem in her owne tunge, that is to seyn, in Latyn” (23–29). He says English is as adequate as Greek, Arabic Hebrew, or Latin for translating “trewe conclusions,” a view that is remarkable for refusing to exalt one or another tongue. Whereas others would reassert linguistic hierarchies, Chaucer levels and historicizes them as local varietals. He had only to reflect on the fact that his English treatise is pervaded by a rich technical vocabulary descending from regions between the Persian Gulf and the

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Compare the contemporaries John Trevisa, Thomas Usk, and Giles of Rome. Giles argued that philosophers invented Latin in order better to communicate “the natures of things, the customs and men, and the course of the stars,” and would probably bristle at vernacular astronomy; cited and translated in T. Matthew N. McCabe, *Gower’s Vulgar Tongue: Ovid, Lay Religion, and English Poetry in the “Confessio Amantis”* (Cambridge: D. S. Brewer, 2011), 77. Usk is rather disingenuous given his own marvelous attempt to render science in the common tongue: “Let than clerkes endyten in Latyn, for they have the propetie of science and the knowynge in that facultie; and lette Frenchmen in their Frenche also endyten their queynt termes, for it is kyndely to their mouthes; and let us shewe our fantasyes in suche wordes as we lerneden of our dames tonge.” See Thomas Usk, *The Testament of Love*, ed. R. Allen Shoaf (Kalamazoo: Medieval Institute Publications, 1998), Prol.23–27.
North Atlantic. A barbarolexis of borrowed terms in astronomy (Arabic azimuth, almucantar, alidade, zenith, nadir; Greek horizon, planet, zodiac; Latin mater, latitude, umbra versa) is expressive of the profound intimacy of neighboring scientific cultures—Judaic, Christian, and Islamic. Chaucer is also cognizant of his use of relatively uncommon Hindu-Arabic numerals (“nombres of augrym” [124, 126]), and affectionately, even over-enthusiastically, attributes names of several months to “statutes of lorde Arabiens, somme by othre lordes of Rome” (130–31), since fewer of them are actually derived from the former. Chaucer defers to the Muslim forerunner “Alkabucius” (126) as much as to the Greek “Ptolome” (228), and hews throughout to the lessons of the Jewish-Arab Māsha’allah, his chief source. In translating science, Chaucer produces what Jenna Mead has called a “vernacular cosmology” alert to cross-cultural currents and energetic exchanges of language and learning on which astronomy depended. In its nomenclature alone, the ecolinguistic texture of the treatise would have been obvious. It is not just that Chaucer’s treatise avoids xenoglossia. Nor does he achieve mere diglossia—a concept to which Tim William Machan appeals in describing a general “ecology of Middle English”—according to which different languages are socially stratified and allocated separate functions. In the linguistic ecology of Chaucer’s Astrolabe, language is rather more finely reticulated, and the translator remains sensitive to ongoing multilingual exchanges and transcultural entanglements of the sciences.

If I am at pains to underline the ecumenical scope and significance of the translated matter, it is partly because Chaucer’s Astrolabe stands out against the monoculturalism of scientific publications today, the result


of the eventual passage from plural and polyglot disciplines to ones that are now narrowly anglophone. It wasn’t always so. Chaucer’s scientific discourse models a cosmopolitan translatio studii, recollecting antecedent transcultural exchanges and positioning the astrolabe within broad text networks. Part of what his treatise imagines into being is the intermingling of cultures without antagonism or, at least, reflexive protectionism. In this respect, the Astrolabe should be put into relation to other efforts to “deprovincialize” and “decolonize” medieval knowledge practices, situating the vernacular prose treatise within a more global Middle Ages. Yet the transmission of astronomical knowledge in language is only the most obvious example. Verbal translatio has a corollary in other sorts of transformations specific to astrolabic science (mathematical, material, and metaphorical), suggesting that in both descriptive and functional terms the instrument expands horizons.

Mathematics, Mobility, and Multi-Scalar Models

Among the necessary conditions of the natural sciences are texts and technical know-how, which are any serious practitioner’s pay for knowledge. Writing transforms matter into legible form. For Chaucer the works of Ptolemy, Māshāʾallāh, and Sacrobosco reproduce in some small way what the Man of Law calls “thilke large book / Which that men

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STUDIES IN THE AGE OF CHAUCER

clepe the hevene ywriten . . . / With sterres.”

The point could be understood in a practical, not esoteric, sense. The applications of the astrolabe require executing a series of actions and calculations described in the treatise. But the techniques are not all textual. We can go on to specify nonverbal elements of the apparatus that enable translation, bringing the faraway nearby. Ancient and medieval scientific disciplines counted on mental and mechanical components of an extended cognitive apparatus. Those resources include mathematical images and material media to render and rescale remote phenomena, accessing a cosmos addressed to human capacities.

In an influential Aristotelian view, thought does not occur without images. The basic assumption held for theoretical and practical disciplines throughout the medieval period. Figures contemplated in the mind, expressed in compass-and-line drawings, and embodied in physical objects, reconstitute abstract quantities and aid comprehension. It was common practice to give visible shapes to mathematical properties in manuscripts, for instance by illustrating geometrical propositions in Euclid’s *Elements* or demonstrating theorems in al-Kwarizmi’s *Algebra*. Roger Bacon taught that number theory depends on such figures. Thomas Aquinas asserted that for angles, lines, points, and circles to

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31 *MLT*, 190–93. This and all subsequent citations of Chaucer’s fictional works are drawn from *The Riverside Chaucer*, gen. ed. Larry Benson, 3rd ed. (Boston, Mass.: Houghton Mifflin, 1987), and appear in parentheses.


become intelligible they must be imagined. 

Closer to Chaucer’s time, Nicole Oresme would say that the parts and proportions of all things are so generated:


[But any continuum or magnitude is continually divisible conceptually in the human mind, as astrologers divide the heavens into degrees; the degrees into minutes; the minutes into seconds; the seconds into thirds, fourths, and then fifths. The imagination can proceed thus endlessly.]

Then, in his treatise on the sphere, Oresme begins with the idea that points and lines are not of nature, “in rerum natura,” but are of the imagination, “sed solum fingitur per ymaginationem.”

The verb he uses to describe the process is a conjugation of fingo, whose range of meanings include to form, frame, fashion, feign, and pretend, from which is derived the noun fictio for something fictional, fabricated, or invented.


He goes on, in Le livre du ciel et du monde, to say “[c]et est semblablement de toutes choses continues si come sont ligne, superfice, corps, movement, temps et teles choses” (and the same applies for all continuous things such as a line, a surface, a solid body, motion, time, and similar things); Nicole Oresme, Le livre du ciel et du monde, ed. Albert D. Menut and Alexander J. Demony (Madison: University of Wisconsin Press, 1968), I.1, 46–47.


STUDIES IN THE AGE OF CHAUCER

The resulting images are not exact abstract equalities, but they are functional figures for fixing times, locations, and motions; the same is true of mathematical tables that enumerate “mean” motions of planets in numerical figures that adopt “the fiction that the heavenly bodies move obligingly at even rates.” Astronomy consequently concerns neither raw impressions nor pure ideas; it rather mediates between poles of perception and conception. Accordingly, Aquinas would speak of mathematical disciplines such as astronomy as scientia media, an intermediate science, because they “apply mathematical principles to natural things.” Geometrical figures may be said to be one critical means by which theory can be mobilized and manipulated, so that models can be devised and tested—issuing further conjectures based on abstract shapes.

A practitioner can do many things per ymaginationem that cannot be done just by fixing the gaze on the stars. But practical astronomy does not just thrive on mental images; it also embodies them within a sophisticated instrumentarium. A physical apparatus is necessary. As John of Harlebeke wrote in a spirited prologue to Tractatus de sphera solida, an influential fourteenth-century work on the construction of a celestial globe: “The root and basis of all astronomical theory, and also its immense prolixity and inexhaustible depth of ingenuity, take their beginning from things that are observed with appropriate instruments. It is agreed amongst all the authorities on this subject that without...


40 Aquinas, The Division and Methods of the Sciences, 45.

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instruments there would be no way of discovering the motions of the celestial bodies. A manual apparatus such as a metal astrolabe, equatorium, navicula, globe, albion, or rectangulus lends material form and function to abstract quantities, as to some extent do manuscript volvelles modeled on mathematical instruments. Chaucer’s Astrolabe shares conventional assumptions about the cognitive convenience of such geometrical figures. Here they are delineated in a transmedial device, still the abstract product of imagination but now concretized in a manufactured object. A scientia media takes a particular medium. For example, the pin going through the center of the astrolabe, holding all the parts together, is “ymagyned to be the pool artic in thy astralabie” (199–200). Readers are likewise referred to the simulacral lines of the zodiac (“the zodiac in hevene is ymagyned to ben a superficie contenyng a latitude of 12 degrees” [323–25]), the ecliptic (“Amiddes this celestial zodiak is ymagined a lyne whiche that is clepid the ecliptik lyne, under whiche lyne is evermo the weye of the sonne” [327–29]), and the meridian (“Thys lyne meridional is but a manere descripcioun of a lyne ymagyned that passith upon the poles of this world and by the cenyth of oure heved” [1209–11]). An experienced practitioner, Chaucer understands that such artifacts of geometry are approximate: e.g., a margin of error must be accepted, especially when the zodiac circle on the rete nearly aligns with almucantars during midday, making it hard to read off coordinates (458ff.). And yet the treatise works on the assumption that the

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designed object constitutes a sufficient medium for tracking celestial movements and magnitudes because it usefully geometricizes them. An astrolabe instrumentalizes an artificial pattern—which is to say, it *fictionalizes* parts of the universe in an eminently pragmatic way—forming a useable interface to mediate between individual and environment. Ambient celestial phenomena (horizon, meridian, zenith, latitudes, star positions, and so on) can now be reckoned and rendered legible and negotiable. Locations and motions can be compiled and arranged for convenience—effectively picturing them. An amateur will not immediately spot the outline of the heavens, though a proportional diagram of the sky above the horizon of an observer is actually inscribed on the front surface. It takes the effort of exercising what Borrelli calls the "geometrical imagination" to see how coordinates are projected onto the plane in a way that maintains symmetry between astrolabe and environment.  

Specifically, it is by means of stereographic projection that astronomical phenomena are made to inhere in an astrolabe’s physical shape. A projection occurs in obtaining points, lines, and angles from curvilinear space and three-dimensional objects and tracing them in scaled-down quantities against a flat ground. An astrolabe takes selected features of the hemispheric vault and maps them onto a small surface thereby, graphically distributing coordinates on the metal plate. The transformation is more sophisticated than elementary varieties in plane geometry, where figures merely turn (rotation), flip (reflection), or slide (translation), producing isometry. With no loss of properties, such angular figures are visibly congruent, conforming to Euclid’s fourth postulate (i.e., all right angles are equal). Rather, stereographic projection rather results in area distortion. Circles are not all symmetrical; spaces are not equal. As Chaucer says of almucantars, “somme of hem semen parfit cercles and somme inparfit” (269–70). Nonetheless, invariant mathematical properties are retained in the proportions of lines and shapes. Another challenge is posed by the fact that the astrolabe intercalates

45 Helpfully diagrammed in North, *Chaucer’s Universe*, Fig. 5.
46 Those mirroring effects are treasured attributes in later medieval art and architecture (e.g., in symmetrical wings of buildings, rosettes in church windows, and diapering patterns in painting), as discussed in the third chapter of Felipe Cucker, *Manifold Mirrors: The Crossing Paths of the Arts and Mathematics* (Cambridge: Cambridge University Press, 2013).
three coordinate systems and projects them one upon the other. The first is oriented around the local latitude of a terrestrial observer (Oxford in the case of Chaucer’s Astrolabe), so that the metal plate shows a projection of a portion of the sky over the northern hemisphere, subdivided by intersecting lines spreading at constant intervals from horizon to zenith: that is, lines of concentric almucantars (circles of equal altitude) and of radiating azimuths (directions). A second, independent system inscribed on the same plate is centered not on the Oxonian observer but on the celestial North Pole. Nested circles trace the two tropics and the equator; lines of the compass run from side to side and top to bottom; a hole in the center marks the pole. A third coordinate system is indicated by the moveable rete sitting atop the plate, showing the visible stars and ecliptic circle (which indicates the course of the sun and the zodiac band), forming a fretwork rotating on the polar axis. When everything is assembled in a handy device complete with figures and scales on the border, the result is a compact but apparently lopsided interface. An astrolabe appears askew because some lines and circles are centered on local latitude (zenith), others on the pole, while the ecliptic is eccentric to both and also revolves. The total effect of mapping of the celestial vault is a dense meshwork for which, as we will see, Chaucer has recourse to metaphorical figures. In any case, the astrolabe presents a functional interface that formalizes, rescales, and overlays information from the various sources. To observers whose universe appears to rotate around the earth, the sun and moon progress in succession along similar paths; other planets travel at different speeds along individual routes; and the constellations of the zodiac rotate at a different pace. The astrolabe is a mimetic and manipulable medium that superposes the various coordinates on the face of the mechanism. The device configures a perception of formal regularity thereby, wrested from the cosmic kinematics of eccentric motions; it rationalizes and miniaturizes the machina mundi, a Lucretian phrase Sacrobosco adapts to refer to the instrument, manifesting a cosmic geometry.

Practical astronomy consequently yields a sense of translation to complement others: referring now neither to textual transmission nor to an


attendant transferral of cosmopolitan culture but to the transposition of spatiotemporal dimensions. An astrolabe is an inscriptive and calculative medium that enables information extraction, conversion, and display because of the kind of figures it makes of remote phenomena. Its aim is to obtain reliable and replicable results across distances, registering correspondence where none was obvious, furnishing further evidence of the decolonizing potential of the scientific practice. Applying a universal geometry, holding basic values constant across space and time, the astrolabe amounts to a technological and transcultural idealization of a common world. In a sense, the mechanism is the message. It is a figment of the device to cultivate a sense of place that is eco-cosmopolitan. Chaucer is alive to the implications, which he could hardly avoid in devotion to such a well-traveled scientific apparatus. Such instruments are oriented outward, encouraging a peripatetic intelligence and instantiating a shared topology through a kind of mathematical abstraction. Chaucer goes through a series of exercises on hypothetical projections in foreign lands, using geometrical devices as vehicles. Conclusions 23–25 provide instructions in how to “prove evidently the latitude of any place in a regioun” (239). Conclusion 26 describes how an equatorial astrolabe would have to possess almucantars “streight as a lyne” (943–44). Moreover, the calendars he intended for the third part were devoted to value conversion, assuming the commensurability of number across cultural boundaries. Number, interval, and ratio here constitute the rare phenomena of providing shared grounds for otherwise diverse polities—as if to suggest cultural forms at their most numerocentric could be the less ethnocentric. Further, the astrolabe is an object designed to travel. Portable devices such as Chaucer’s (“so small an instrument portatif” [58]) could contain nested plates for several regions: the so-called Chaucer Astrolabe at the British Museum covers nearly 20 latitude and includes plates for Oxford, Paris, Montpellier, Rome, Jerusalem, and Babylon; others might range from 23 to 48, from roughly Lower Egypt to northern France. As a mathematico-material conveyance, the astrolabe may be said to exemplify the astonishing mobility that Brian Rotman has in mind when observing that

"one does mathematics by propelling an imago—an idealized version of oneself... around an imagined landscape of signs." An astrolabe realizes in form and function the overlooked adjacency of localities and politics, horizontalizing and miniaturizing vast territories. It is as if the astrolabic projection, mathematizing and mapping the cosmos, anticipates Latourian flattened ontology. An astrolabe is not unlike a one-dimensional trail map whose coordinates "maintain intact a certain number of geometrical liaisons, appropriately called constants." Despite "total dissimilarity" between map and territory, one corresponds to the other.

Mediation and Technoscientific Hybrids

Chaucer’s Astrolabe attests to the manner in which astronomy obtains facts by deploying transmedial designs. The technical configuration of transmissible matter is not incidental but constitutive of a rational astrolabic science. As Johanna Drucker observes in general: “Data are capta.” The astrolabe makes the process of data capture and conversion particularly conspicuous to practice (“the taking of stars,” acceptio stellarum, is the root sense of astrolabe according to Mashā’allah), revealing the extent to which practitioners rely on effective media. Astronomy on this view is an attribute of a translatory mechanism; that is, an astrolabe elicits knowledge practices that are to some extent articulated and embodied in it. Perhaps because information is encoded in such intricate and eloquent detail in the arabesque body of the instrument, the astrolabe can seem nearly animate. At least the astrolabe generates other kinds of thought than the purely spatiotemporal, and it is to these implications that the essay will turn to show how the expressive design lends itself to a nearly literary mimesis in and beyond Chaucer’s Astrolabe. Producing surprising yet captivating figures of speech, the science may now be said to take a turn toward irrational anthropomorphic and zoomorphic figures—except that they have their own rationale. The

competence of the technical object is adumbrated by chimerical metaphors that underscore co-adaptive processes and situated knowledge practices.

Several such devices appear in the first part of Chaucer’s *Astrolabe*, devoted to what he calls “the figures and the membes of thyn astrolabic” (53–54). Translating for an amateur, Chaucer first speaks of the circular body of the instrument hollowed out on one side as the “moder” (Fig. 1). The recessed interior is said to be “perced with a large hool that receiveth in hir wombe the thynne plates compounded for diverse clyme” (96–97). Various lines, numbers, letters, and names including figures on the front (the “wombe side” [207]) produce the appearance of “the werke of a wommans calle” (285)—a term that refers to a hairnet but could also apply to the reticulated membrane of an egg or internal organ. Chaucer did not invent these evocative descriptions, the English “moder” for instance having descended from Latin *mater* and Arabic *al umm* as more like a collective enunciation of earlier technics. The concept is conveyed in and through multilingual corpora, and as such, the improbable anatomical metaphor is more evidence of translation. As a figurative device, metaphor is itself something that migrates across distinct domains, as rhetorical handbooks from Quintilian to Geoffrey of Vinsauf onward taught: a form of *translatio* that bears and conveys sense from one place to another. A standard grammatical definition derived from Donatus imagined metaphorical figures as crossing customary ontological limits, from animate to inanimate and back again. They produce strange hybrids. In her analysis of the medieval

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55 MED, s.v. calle.
rhetoric of female embodiment, Jill Ross suggests that metaphor performs "a paradigmatic maternal function of incarnating the invisible in the form of discourse."59 She follows Boncompagno da Signa’s thirteenth-century description of metaphor itself as the “mother of all ornament,” activating the figure in the very definition of rhetorical figuration.60

The allusive troping of technology at once evokes an organic reproductive space and inorganic interface; it renders the material design of the instrument a vital matrix. Here the “moder” enlivens even as it estranges the scientific object by pointing beyond persons toward interrelations that precede human practices. In the immediate context, Chaucer’s Astrolabe is directed at the education of little Lewis, presenting the boy with a sophisticated learning apparatus, linking technology with pedagogy and beyond that children’s nurture, so that it can be taken to tell a story about the dependency of living processes on surrogate matter. Adapted to the capabilities of a young amateur, Chaucer’s treatise represents a variety of children’s literature that trains up the intellect and engages affect, appealing to the curiosity of a child and expressing care for his development. The occasion is reminiscent of one earlier composition, a treatise on the astrolabe Adelard composed for a young Henry Plantagenet.61 The idea that a child could be fostered on natural sciences is not a fanciful modern conceit. Four known manuscripts give Chaucer’s Astrolabe the vivid title “Brede and Milke for Children,” identifying the stimulating matter of the treatise with digestible foodstuffs and nursing (Fig. 2). Anthropomorphized features of the apparatus would then reinforce the connection to natality and early nurture, as would traditional identifications among geography, cosmology, and anatomy in the later medieval period.62

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62 An association of world and womb should have been familiar enough at the time. For some the earth, nested in the center of a Ptolemaic universe, was a great egg. Think also of the Pardoner’s Old Man’s knocking on the earth he calls “mother,” denoting the
What else such archaic figures may imply for the science has occasioned some debate, though the implications have not been pursued very far. On the one hand, quasi-animate terms may facilitate a sense of belonging within an intellectual lineage, following Seth Lerer’s view that Chaucer’s *Astrolabe* exhibits a conspicuous genealogical cast: it situates the son Lewis in relation to a familiar faith and fatherland. Passed down the family line, the work is construed as part of an antique and medieval tradition of intellectual and national paternalism that occludes female involvement. The labor of paternal authorship over source material generates a seminal work in translation, evoking a hylomorphic theory of reproduction. On the other hand, the mother in the machine can produce some resistance to generic masculine authority. As Jenna Mead argues, “the resonance of the instrument’s outer plate (‘moder’) maintains a powerful allure so that we should probably consider alternative constructions of authorship implied by the trope.” Following Derek Pearsall among others who surmise that Lewis was the illegitimate offspring of Chaucer and Cecily Chaumpaigne, Mead suggests the treatise may “bear the hint of confession.” It would be a veiled and attenuated confessional gesture but one that takes the technical metaphor seriously, in this case unmasking a sordid and evidently criminal act.

The analyses so far foreground interpersonal intrigues at the expense of other, no less vital impersonal agencies and complicating attributes very ground measured by a device such as an astrolabe. For other associations one recalls that Rome radiated from a sacred site known as the *umbilicus Romae*, and other cities were likened to bodies with similar symbolic cities, on which see Richard Sennett, *Flesh and Stone: The Body and the City in Western Civilization* (New York: W. W. Norton, 1996); and Keith D. Lilley, *City and Gnome: The Medieval World in Urban Form* (Chicago: University of Chicago Press, 2009).

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63 Seth Lerer, “Chaucer’s Sons,” *UTQ* 73, no. 3 (2004): 901–16 (909).
65 Mead, “Geoffrey Chaucer’s *Treatise on the Astrolabe*,” 980. Cf. Derek Pearsall, *The Life of Geoffrey Chaucer: A Critical Biography* (Oxford: Blackwell, 1992), 137–38: “It has often been conjectured that there may be a child hidden away too, and that ‘little Lewis,’ the 10-year-old son to whom Chaucer dedicated the *Treatise on the Astrolabe* in 1391, was the product of the union with Cecily, but the evidence is merely circumstantial.” On the charge against Chaucer of *raptus* and his subsequent release, see Christopher Cannon, “*Raptus* in the Chaumpaigne Release and a Newly Discovered Document Concerning the Life of Geoffrey Chaucer,” *Speculum* 68, no. 1 (1993): 74–94.
Fig. 1. Front of an astrolabe as depicted in Oxford, Bodleian Library, MS e. Mus. 54, fol. 2v, labeling “Riet” and “moder” and showing zoomorphic star pointers. Chaucer’s text above the diagram runs: “The moder of thin asterlabie is thikelste plate perced with a large hole that resseyuyth in hir wombe the thynne plates compowned for diverse clymates and thi Riet shapen in manere of a net or of a web of a loppe.” With thanks to the Bodleian Library.
Fig. 2. Alternative title “Bred and mylk ffor chylderen” at the head of Chaucer’s Treatise on the Astrolabe in Bodleian Library, MS e. Mus. 54, fol. 1. With thanks to the Bodleian Library.
of the sciences. Developing a feeling for what Jane Bennett calls a “touch of anthropomorphism,” we may also sense ways in which the mother in the machine is able to deepen the historical analysis. Chaucer’s astrolabe comes at the end of a long selection process that has taken place, quite without his involvement, in a fecund milieu. His debts to both culture and nature are evident. From a functional standpoint, the instrument is a pregnant matrix in which past technics are brought into the present. Affiliations among scientific cultures and actors are manifest, as previously noted, just in the mathematical geometry. Taking in much longer scales of development, the metal body of the instrument is proof of co-adaptive interactions of entities and environments. Made from mineral substance—coming from what medieval writers would also figure as a gravid mother—the astrolabe is embedded in earth’s history. Alert to what a metaphor carries and delivers, such insistent figures may work to confound distinctions between animate and inanimate, person and thing, positing a dynamic and diffuse morphogenesis. The metallic substrate is allusive of Manuel DeLanda’s “geological history” or Jussi Parikka’s “mineral durations”—terms that describe the planetary scales and substance of media technology to suggest that devices present matter that ultimately predates humans. Tarrying with a meager metaphor, then, we find in the matrix a repudiation of a single, virile source. Here there can be no hylomorphic presumption


STUDIES IN THE AGE OF CHAUCER

of masculine mastery; there are plural points of origin. A scientific corpus is the result of so many intersecting, epigenetic lines that are not reducible to an author. It is from this perspective that the writer’s plea of unoriginality (“I ne usurpe not to have foundenn this werke of my labour or of myn engyn,” 48–49) should be heard as a strong disavowal of any notion of a lone progenitor. The terminology can evoke technical and sexual propagation. 

Accounting for his derivative work, Chaucer stands in a relation of surrogacy to sources of the science and technology. Considering the various geo-social matrixes in which he is absorbed in the treatise, Chaucer is rather like an episode in the life-cycle of the apparatus, which in Gilbert Simondon’s view is how technical objects engender modes of existence. Technical life is always “transindividual.”

By now the strain of “mother” and “womb” has surely been felt. Referring to a metal disc by an anatomical metaphor is odd and distorting, coaxing an awareness of the artificial construct as assemblage. But it is not the only animating figure. Alert to the weblike formations of astrolabe plate and rete, Chaucer follows his sources again in speaking of parts of the instrument as evocatively spiderlike: the azimuth lines on the plate form “a maner croked strikes like to the claws of a loppe [spider]” (276), and twice the rete is said to be “shapen in manere of a nett or of a lopwebbe after the olde descripicioun” (297, 299), recalling the traditional names of the components in Arabic (ankabut) and Latin (aranea). It is imagery that has proven as sticky as a cobweb (Fig. 3). Ptolemy’s Planisphaerium, a first-century treatise on the flattening of the sphere that survives only in Arabic, refers to part of one horary instrument as a “spider.”

Vitruvius mentions astronomical inventions he calls arachne and conarachne, which seem to refer to flat and conical sundials that are ancestors of the astrolabe. As far back as the fourth


Middle English engyn—skill or ingenuity—has origins in Latin giguere—to beget—producing words that are close cousins, such as genital and progeny. Cf. Ingham, The Medieval New, 86.


Fig. 3. Diagram of an astrolabe plate showing spiderlike azimuths (direction), zenith, pole, tropics, horizon, and hours. Bodleian Library, MS e. Mus. 54, fol. 8v. With thanks to the Bodleian Library.
StudieS in the age of ChauCer

century BCE Eudoxus was supposed to have come up with a “geometrical spider” consisting of what appears to be a model of the heavens in the form of intersecting lines arrayed on a plane or bowl. The image may extend to astronomical tables Chaucer had meant to include: these were once called zij, deriving from Persian for “threads” or “chords,” associated in early etymology with textile-making and coming later to describe intertwined rows and columns of data.74

Spider and thread metaphors, crude though they may appear, serve as shorthand for complex material supports and tactics of the sciences. They also introduce more unexpected affiliations. Chaucer’s “loppe” is no biblical spider—a negative exemplum of the wicked who entrap the innocent (Isaiah 59)—but instead conjures the figure of natural industry, practical intelligence, attentiveness, and good nurture set forth in the medieval bestiaries and encyclopedias.75 It is notable that the pregnant spider can serve to reinforce the link between reproductivity and instrumentality. Albertus Magnus observes that spiders make webs into wombs, laying eggs in a kind of external uterus.76 Bartholomaeus Anglicus says that one of the wonders of the spider is that she contains sufficient matter in her womb to spin a great web.77 The spider is more often esteemed for its geometrical sophistication—an ability to join a web at regular intervals and right angles, distributing lines “yliche ferre fro 3e myddel poynt.”78 The spider makes and maintains artificial structures and abstract figures, and even, as Pliny observed, deploys its body as a controlling plumb bob.79 Aristotle, Philo of Alexandria, and Seneca all remarked the spider’s knack for architectural designs; Ovid associates

78 Ibid.
the spider with arts and crafts. The spider—like the bee who fabricates hexagonal cells—possesses such formidable intelligence and instruments, unaided by human learning, that it could pose a challenge to human exceptionalism. Moreover, the spider thwarts assumed gender hierarchies insofar as it was thought that the female, generating filament from within her body, is the preeminent worker and provider. Albertus Magnus observes that as the evident doyenne she has greater advantage and independence as compared to the male whom she sexually dominates. In sum, the feminized spider is a natural observer whose model the sciences belatedly and laboriously follow. She is like an apparitional image of the skillful and well-equipped technician. Hers is the matrix in which human instrumentation is raveled because she possesses the original instrumenta.

Spiderlikeness has long been a summons to distribute sentience and skill across a multispecies spectrum. In particular, the spider realizes a technoscientific ideal according to which one is not just observing an environment but setting out threads through which things become grasped. Radiating lines, chords, angles, ligatures, and so on constitute a tissue of mimetic relations. Jakob von Uexküll’s account of the spider-web’s correlation with the “image of the fly” is an instructive analogue:

80 Katarzyna Michalski and Sergiusz Michalski, Spider (London: Reaktion, 2010), 58–64.
81 As suggested by Harvey in “The Swallow’s Nest and Spider’s Web,” 334: “when admirers of the cobweb start to talk about geometry they are getting dangerously near the liberal arts, those skills proper to man.”
82 See Albertus Magnus, On Animals, Vol. 1, 4.4 (486); Vol. 2, 8.4 (728); Vol. 2, 26 (1744); and for the Latin see Albertus Magnus, De animalibus, Vol. 1, lib. IV, tract. 2, cap. 4 (405); Vol. 1, lib. VIII, tract. 4, cap. 1 (629); Vol. 2, lib. XXVI (1582–83).
83 On her instrumenta venandi, or hunting implements, see Albertus Magnus, De animalibus libri, Vol. 2, lib. XXVI (1579); Albertus Magnus, On Animals, Vol. 2, 21.8 (1740).
84 It is not the only place spiderlikeness is arrogated to the human. Roger Bacon discusses the araneus and retina (net) of the eye, as noted in Suzanne Conklin Akbari, Seeing through the Veil: Optical Theory and Medieval Allegory (Toronto: University of Toronto Press, 2004), 94. Heraclitus of Ephesus (as reported in the twelfth century) and Chrysippus (through Calcidius) compared the soul to a spider whose web extends through the human sensorium, on which see Michalski and Michalski, Spider, 64–65; Heraclitus, The Art and Thought of Heraclitus, ed. Charles H. Kahn (Cambridge: Cambridge University Press, 1979), 289; Josiah B. Gould, The Philosophy of Chrysippus (Albany: State University of New York Press, 1970), 129–30; Michael Frampton, Embodiments of Will: Anatomical and Physiological Theories of Voluntary Animal Motions from Greek Antiquity to the Latin Middle Ages, 400 BC–AD 1300 (Saarbrücken: VDM Verlag, 2008), 227.
“the body structure of the spider has taken on certain of the fly’s characteristics,” which the web expresses and captures in a complex tracery.\textsuperscript{85} The interwoven result is not mental so much as filamental. Still more suggestive is the account of pragmatic experience in Tim Ingold’s SPIDER (an acronym for “Skilled Practice Involves Developmentally Embodied Responsiveness”). Practice relies on a flexible webwork, a set of relays enabling agile receptivity rather than mere representation.\textsuperscript{86} The way things are threaded through each other takes us beyond a static fly-image to elucidate what might be dynamically transmitted by means of material affiliations. It is what ingenious figurative devices (whether cobwebs, mechanical retes, or metaphors) continually do by crossing species and substances.\textsuperscript{87} The spider crops up repeatedly to suggest users are always caught, situated, and entangled. Are we to think practitioners become arachnoid? At least the astrolabe is an apparatus that intensifies human sentience and skill by arithmetical, alphabetical, visual, and haptic means, effectively producing variation on what Andy Clark calls the “mind–body scaffolding.”\textsuperscript{88} Planetary phenomena achieve nucleated form in a virtual organ, an external object that distributes cognition and corporal experience beyond the space of a natural body.

A figurative spiderweb, womb, or woman’s hairnet is a minor conceit that may seem easy to dismiss in Chaucer’s \textit{Astrolabe}. Yet seemingly trivial and amusing turns of phrase configure perceptions of the apparatus; tangential figures introduce alternative angles of view on


\textsuperscript{86} Tim Ingold, \textit{Being Alive: Essays on Movement, Knowledge and Description} (London: Routledge, 2011), 91. Ingold’s SPIDER does not embody quite the same methodology as Latour’s ANT (Actor Network Theory). As SPIDER says to ANT in a playful colloquy, the web is dynamic: “They are the lines along which I live, and conduct my perception and action in the world. For example, I know when a fly has landed in the web because I can feel the vibrations in the lines through my spindly legs, and it is along these same lines that I run to retrieve it.”

\textsuperscript{87} Cf. Jussi Parikka’s account of what he calls “insect media”: prevailing buggy metaphors convey ultramodern notions that technoculture is on a continuum with “technics of nature.” Accordingly, “the issue of categorical difference between animals and humans, nature and technology is bracketed and the view of affects, movements, and relations among parts is posited as primary.” See Parikka, \textit{Insect Media}, 72.

instrumentality. While they obviously fail to reach the heights of sophistication achieved by mathematical geometry and planetary theory, such figments evince something of Jack Halberstam’s “low theory.” In Chaucer’s treatise such meager fictions of science capture additional information by metaphorical transformation, returning technical matter to language in an unexpected manner. The metaphors function to create splayed networks, producing otherwise unlikely associations among species. Other figures that might be considered include the wedge-like pin that goes through the middle and cinches parts together and is “clepid the hors” (197), and the zodiac band, or as Chaucer clarifies, “the cercle of the bestes” (336). Finally, star pointers on the rete are sometimes “disposed in signes of bestes, or shape like bestes” (342). Surviving instruments in the Chaucerian style in fact incorporate such figures as a hound’s head, bird beaks, serpent tails, and human faces, on which more below. So many figures are projected within a beguiling matrix, employing animal intermediaries to make the science intelligible; they are translational, instrumental to the kind of story it can tell about itself.

Mechanimal Devices and Animating Fictions

In other places outside the Astrolabe, in the extended literary mode of romance and dream vision, Chaucer recurs to zoomorphic intermediaries in order to think through technical translation and instrumentation. Astrolabic metaphors now rise to the level of metacognitive devices, where instrumental images seem to have broken loose from pragmatic immediacy to form medieval science fictions about fictions of science. Marijane Osborn has already shown that the mechanical horse in Chaucer’s Squire’s Tale, presented as a gift from the king of Arabia, shares features in common with the astrolabe. The otherworldly flying machine, which can transport its rider anywhere within twenty-four

hours, functions by means of a pin that recalls the “horse” holding together the parts of an astrolabe. Osborn concludes that the pseudo-equine contrivance “serves as a metaphor for the astrolabe in terms of its national origin, its composition of brass, and its function (its ability to move about according to the rider’s will within that astrolabic ‘space’ marked with four and twenty hours.” 92 In the romance, the phenomenology of ingenious devices, both scientific and aesthetic, is at issue. As Patricia Ingham elucidates, the mechanical marvel “alludes to a power of creation beyond nature or the human.” 93 In the presence of such wondrous novelty, learned and unlearned observers are as “fascinated” as they are “stupefied.” 94 It seems the horse is a fantasy of the superior technoscientific matter that confounds simple understanding, registering the primacy of objects over knowing subjects. The technological object, as thematized here, shades over into the occult. What is more, the astrolabe seems to have shifted in the process from practical science to literary discourse, proving again the power of the multimodal device to populate the imagination with figures.

A corresponding metamorphosis of the astrolabe can be found in Chaucer’s House of Fame. Osborn only goes so far as to observe that Chaucer may have used an astrolabe to work out celestial coordinates implied in the poem. On December 10, the night Chaucer (in the guise of “Geffrey”) dreams of the golden eagle, the poet could have checked to see that constellations were arranged so that the sun rose over the horizon just ahead of the “Eagle star Altair.” 95 Osborn is alluding to the fact that Altair (Alpha Aquilae) comes from Arabic al-nasr al-tair for “flying eagle,” anchoring the constellation of Aquila (i.e., Eagle). To this we can add that another bright star shares similar nomenclature and is conveniently situated nearby. Vega (Alpha Lyrae) is Latinized from Arabic al-nasr al-waqi, “swooping eagle.” What is yet more intriguing is the way astrolabes make use of the avian imagery. In diagrams of the rete in manuscript copies of Chaucer’s Astrolabe, both fixed stars are sometimes labeled and, in the case of Oxford, Bodleian Library, MS e. Museo 54, fol. 2v, and Cambridge University Library, MS Dd.III.53, 92 Osborn, Time and the Astrolabe, 53. 93 Ingham, The Medieval New, 133. 94 Ibid., 136. 95 Ibid., 50.
fol. 213v, Vega is figured as a bird. The drawings reflect the fact that star pointers are occasionally zoomorphic in surviving brass astrolabes of the Chaucerian type. An early fourteenth-century example indicates “Altair” by a bird body on the left branch, and “Wega” by the beak of a bird perching on the right branch of the Y-shaped rete (Fig. 4). On another astrolabe from the same century, a complete bird on the left branch points to “Wega.” Astrolabes elsewhere incorporate not a horse but a bird into the design of the wedge. Evidence quickly mounts to suggest that the shimmering eagle of The House of Fame does not evoke stars so much as the silhouette of an astrolabe star pointer. Chaucer’s eagle seems to relish his role. Gaining altitude, the bird draws the attention of his prey to neighboring celestial phenomena: “cast up thyne ye. / Se yonder, loo, the Galaxie, / Which men clepeth the Milky Wey” (935–37). He is eager to show what he knows: “Wilt thou lere of sterres aught?” (993). Had the poet taken him up on the offer, he would have learned that Altair and Vega are situated on opposite sides of the Milky Way. We can draw the conclusion that the eagle carries Geffrey within


97 Epact 40428 (British Museum, MLA 1909, 6–17.1) and 61916 (Museum of the History of Science, Oxford, 49359). The Tomba astrolabe (Museo Galileo, Florence, Inv. 3931) is another example of the latter type, on which see Bennett and Strano, “The So-Called ‘Chaucer Astrolabe.’” See Eagleton’s “Chaucer’s own astrolabe” for the suggestion that—notwithstanding British Museum, MLA 1909, 6–17.1, which has the date 1326 etched on the back—several so-called Chaucerian astrolabes probably take their design from Chaucer’s description, and so would have come after his treatise. Bennett and Strano offer counter-evidence to support the more usual idea that diagrams in selected copies describe an already existing type.

98 See CCA, no. 144 (dated 1304, from the Maghrib) and no. 4001 (dated 1224, made in Moorish Spain), in Gibbs and Saliba, Planispheric Astrolabes, 138, 187. For more birds on European and non-European astrolabes see Gingerich, “Zoomorphic Astrolabes,” 93, 97. A thirteenth-century French astrolabe is festooned with birds, including a whole Corvus (Collection Max Elskamp, no. 400, Musée de la Vie Wallonne, Liège). An English astrolabe from the fifteenth century has “coru[us]” (the raven) inscribed on the body of a bird (CCA, no. 2006, in Gibbs, Planispheric Astrolabes, 153–54 and Fig. 20), while another from the fourteenth century has a bird standing in the place (Wh. 1264, Whipple Museum of the History of Science, Cambridge).
Fig. 4. Zoomorphic star pointers on the 1326 Chaucer Astrolabe (British Museum, MLA 1909, 6-17.1; Epact 40428). "Altair" and "Wega" are indicated by birds on the rete; other star pointers take the form of beaks, bird bodies, and human and dog heads. With thanks to the British Museum.
the vicinity of two stellar “eagles,” with the additional and rather comical implication that, on an astrolabe, both eagle and poet can be found somewhere within the small space between the two branches of a Y-shaped rete. It would be consistent with the poem’s diminishing perspective—where earth vanishes to a point, and the poet is reduced to caricature—to find Chaucer miniaturizing himself in The House of Fame.99

Lending further support to the notion of an instrumental eagle is the 2005 discovery of a copper-alloy Eagle Astrolabe Quadrant from St. Dunstan’s Street, Canterbury (Fig. 5). Elly Dekker has worked out the geographical latitude (corresponding to London, 52°) and probable date (1388).100 The front of the device shows some familiar arcs of the astrolabe, effectively folded over on themselves.101 The back of the instrument depicts “a bird of prey, clearly an eagle, with its wings spread, fixed to the quadrant by a rivet in the middle around which it could once turn. . . . The oxidation spots in front of the left foot of the eagle may be the remnant of a prey held in its claws.”102 The eagle, with its legendary ability to gaze at the sun, is an appropriate emblem for a device made to take solar altitudes, and in this connection Dekker mentions that the royal eagle in Chaucer’s Parliament of Fowls possesses acute vision (“There myghte men the royal egle fynde, / That with this sharp lok perseth the sonne”).103 But there may be another and more sustained aquiline analogue in The House of Fame. There Geffrey is seized by a golden eagle, blazing as “another sonne” (506), who imparts amateur lessons in physics and astronomy. It would seem to suggest the advent of radiant intelligence, conveying the mind to contemplate higher things, answering the poet’s desire for inspiration from the sun-god Apollo, “O God, of science and of lyghte” (1091). Yet Chaucer’s poem is an ironic vision of what can be achieved by means of something like

99 For Chaucer’s recursive literary miniaturization in the Canterbury Tales, see Mitchell, Becoming Human, 104–15.
101 The instrument can be visualized as an arc that is one-quarter of a circular planispheric astrolabe, with which it shares many features: hour lines, north pole, horizon, tropics, equator, and ecliptic containing the names of the zodiac. The zodiac is delineated on a simplified rete, obtained by stereographic projection, whose lines are effectively folded to fit within the 90 arc (much in the way a parchment sheet is folded twice to create the quarto format).
102 Ibid., 214.
Fig. 5. Front and back of the Eagle Astrolabe Quadrant, c. 1375–1425 (British Museum, 2008, 8017.1) discovered in the ground down the road from Canterbury’s West Gate. The front of the instrument shows pole, horizon, tropics, equator, and so on together with the zodiac on a partial rete, after the usual method of stereographic projection; the back contains a calendar, in the center of which is a spread eagle, originally moveable and gripping prey. With thanks to the British Museum.
an astrolabe. In *The House of Fame* the bird’s capacity to act as any kind of instrument of knowledge is exactly in question, with the implication that we should not automatically trust dazzling figures of *scientia media*.

Chaucer is at his most satirical and self-referential in *The House of Fame*, interrogating the merits of informational media and intellectual intermediaries, including animal figures. He makes much of the middling status of an astronomical eagle. Geffrey is abducted and transported to a realm between heaven and earth, and along the way learns that human communications are insubstantial: “every speche that ys spoken, / Lowd or pryvee, foul or fair, / In his substaunce ys but air” (765–68). What is at stake are the epistemic means of acquiring and transmitting knowledge in a sublunary realm where humans are reliant on devices. At a critical juncture in the vision the problem seems to come to a head. In reach of the constellations, when the eagle asks the dreaming poet if he would like to learn more about the stars, Geffrey demurs. It can seem like a missed opportunity, impugning an unambitious or naïve outlook (Chaucer, ever the avid indoorsman!). Yet the satire points in more than one direction. For the vision is a mere fantasy in which a poet—or rather, a spectral image of one—is ported through imaginary space and time. There is no such magical conveyance as an astronomical eagle. Geffrey’s demurral, in effect, recalls the overambitious intellect back to the mundane necessity and effectiveness of instruments. Chaucer counts himself among earthbound observers whose agents of translation are limited even as they remain indispensable. At one point he alludes to his London living quarters (“domb as any stoon, / Thou sittest at another book” [656–57]), and we may well imagine in his possessions an eagle astrolabe quadrant for the same latitude. Codex and quadrant are both communicative media that express and embody scientific authority that is put under immense strain in Chaucer’s *House of Fame*. In this work, the factual becomes simulacral (1074–82).

Chaucer is interested in the possibilities and liabilities of technologies that seem to cross the threshold between animate and inanimate. In the *Astrolabe* he goes so far as to speak of the independent agency and authority of the device quite apart from human implementations, imagining that the instrument has yet to disclose everything about itself: “Truste wel that alle the conclusions that han be found or ellys possible might be founde in so noble an instrument as in an astrolabe ben un-knowe parfitly to eny mortal man in this regioun, as I suppose” (13–16). On the one hand, the instrument is a ready tool that brings some things
within reach. On the other, the multifunction mechanism becomes a phantom presence and takes on a life of its own in Chaucer’s *Astrolabe*. As Ruth Evans says, Chaucer shows that “the artifacts we use to think with embody more knowledge than can be perfectly comprehended by one human.”\textsuperscript{104} It is one of the enigmas to which Stanislaw Lem’s *Summa technologiae* is addressed in imitation of the great medieval theological compendia of Thomas Aquinas and Albertus Magnus. In Lem’s futuristic account—faced with omnipotent machine intelligence—we will venerate devices instead of a divine mind. What I take to be useful in Lem’s apocalyptic reveries is not the supposed rupture between medieval and modern systems but rather the idea of an articulate and semi-autonomous apparatus. Responsive to the untapped noetic capacity, Chaucer bequeaths a palpable sense of how the human subject comes to rely on instrumental intensifications of memory, attention, and action as elaborated and embodied in transmedial technics. This is not to neglect distinctions between old and new media. Implicit in this essay is the critical importance of attending to the gap, appreciating the distinctive metaphors and meanings of pre-digital machines, suggesting that it is never wise to jump to identify astrolabes with our smartphones or GPS. There are surely advantages to studying earlier technocultures in context, unboxing technical matter.\textsuperscript{105} Nor is my idea to gush utopian for


\textsuperscript{105}The seductive cinematic or virtual magic associated with digital media today, where users are prompted to take visual outputs to be fundamental to computing processes, produces what has been diagnosed as “screen essentialism.” In a pre-electronic device, there is not the same screening-out of materiality and active processes. For critiques of frictionless computing and screen essentialism see Kirschenbaum, Galloway, Emerson, and others; the idea of the digital as cinematic comes from Stanley Cavil, as discussed by Galloway in *The Interface Effect*, 8–11. The idea is that, in relation to modern computers, the screen comes between the user and the machine with the effect of blackboxing objects and technical operations that make computing possible. Connected, born-digital media consumers then become accustomed to passive, frictionless spectatorship and are encouraged in the fallacious ideological split between “media” and “non-media,” software and hardware. Preferring pixels to code processes and hardware chassis, mathematical and material elements get relegated to the status of substrate. Only the graphical user interface appears to be engaged in higher functions of conceptualizing and interpreting; the rest is appliance. By contrast, the astrolabe interface is a haptic and visual mechanism whose operations are not merely simulated or symbolic, restricted to a surface membrane (“screen”); there are procedures to follow, dials to move, functions to perform. Part of what is peculiar is the effort required to overcome resistances to interpretation and work out meanings in practice. Practitioners, not mere consumers, are needed. The astrolabe is a platform one must configure and on which one must perform as a competent actor, hand and head engaged. Employing such an interface,
post- or trans-human technocultures, since we can hardly ignore the menace of transnational capital, digital surveillance, toxic waste, and exploitative labor in the digital age. Chaucer for his part resists fetishizing technical objects even as he finds them fascinating and worthy of technical specification. More work is needed to elucidate the many sources of trouble, but Chaucer’s works portend the technoscientific transformations with which we grapple, and so might help us to imagine more inclusive figures of the future.