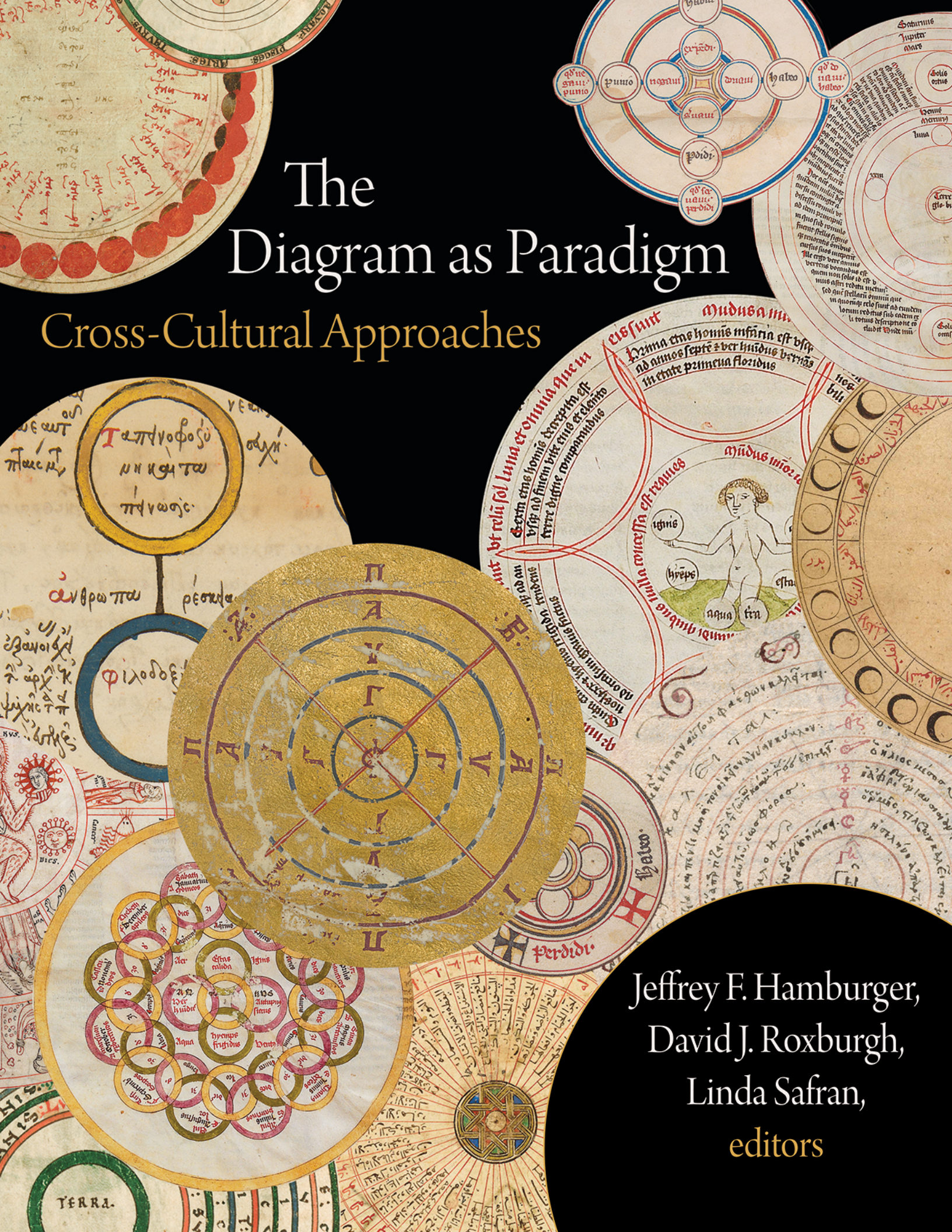


# The Diagram as Paradigm Cross-Cultural Approaches



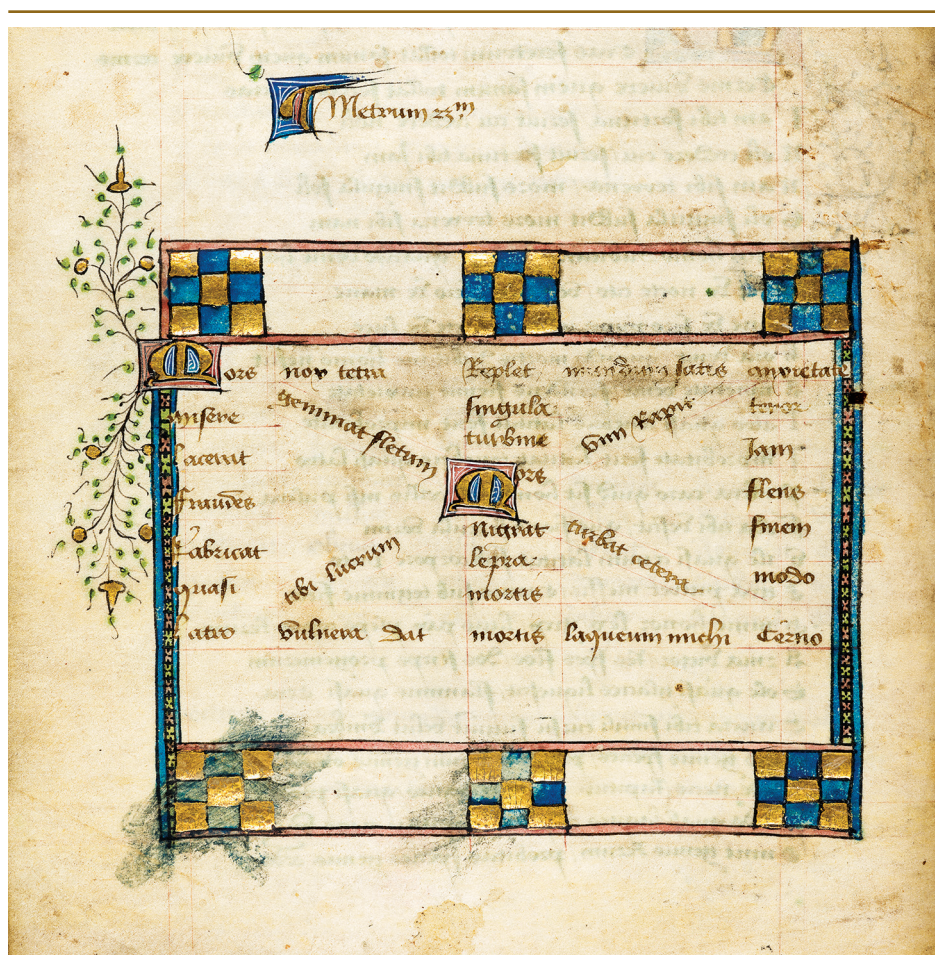
Jeffrey F. Hamburger,  
David J. Roxburgh,  
Linda Safran,  
editors

# THE DIAGRAM AS PARADIGM

## Cross-Cultural Approaches

*Edited by*

JEFFREY F. HAMBURGER, DAVID J. ROXBURGH,  
AND LINDA SAFRAN



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# DIAGRAMS IN GREEK MEDICAL MANUSCRIPTS

PETROS BOURAS-VALLIANATOS

**A**NCIENT AND MEDIEVAL WORKS USE SCHEMATIC REPRESENTATIONS of verbal descriptions to summarize, clarify, or illustrate an argument or a certain theory. Joachim Heisel emphasized the importance of five elements—source, transmitter, medium, message, and recipient—in contextualizing the process of learning and communication using visual representations, and, in particular, the surviving ancient (Mesopotamian, Egyptian, Greek, and Roman) corpus of architectural diagrams. Drawings are employed as “mediums” to express an idea or concept (i.e., “source”) derived from the author’s (“transmitter’s”) perception. They contain some information (“message”) presented through a graphic representation received by the reader (“receiver”), whose background and expertise play a major role in this cognitive process, which may inter alia include thinking, reasoning, memorizing, and remembering. The receiver acquires new knowledge through the aid of these visual mediums. Whether essential or supplementary parts of the text, they can constitute an important element in the process of understanding the message of a verbal entity.

In this chapter I provide a critical examination of different forms of medical diagrams in Greek manuscripts, which are related to works by both ancient Greek and Byzantine medical authors. Due to the large number of surviving Greek medical codices and the fact that they have for the most part been little studied, my examination cannot be exhaustive. It focuses instead on representative examples, mostly derived from my personal consultation of medical manuscripts in various libraries.

Whether all kinds of drawings can be grouped under the term “diagram” is a matter of debate.<sup>1</sup> In ancient and medieval Greek works, for example, the term *διάγραμμα* (derived from *διαγράφειν*, “to mark out by lines”) was used not only for a figure that aimed to prove a geometrical proposition or for various kinds of branch diagrams, but also for maps and even for lists or inventories.<sup>2</sup> Throughout this study, I mainly use the term “diagram” to signify any combination of graphic elements (e.g., horizontal,

✦ I am grateful to Jeffrey F. Hamburger, Linda Safran, and the anonymous reviewer for their helpful comments on an earlier draft of this chapter. Special thanks go to the Wellcome Trust for funding my work (214961/Z/18/Z). All translations are mine, unless otherwise stated. Transcriptions from Greek retain the same spelling (including accents) and punctuation as in the relevant codex, apart from the fact that I have supplied the iota subscript. In transcribing the texts of the various diagrams, I have tried to keep the original line division of the manuscript in most cases. Where a spelling is clearly erroneous, I have indicated the correct spelling of the term in a footnote preceded by sc. Throughout this chapter the term “Byzantine” is used with reference to the Byzantine Empire (330–1453). I have adopted the following abbreviations: LSJ (9th ed., 1940, with rev. suppl. 1996); Kühn = C. G. Kühn, *Claudii Galeni opera omnia*, 20 vols. in 22 (Leipzig, 1821–33); Ideler = J. L. Ideler, *Physici et medici Graeci minores*, 2 vols. (Berlin, 1841–42); and CCAG. J. P. Heisel, *Antike Bauzeichnungen* (Darmstadt, 1993), 4–5: *Quelle, Sender, Medium, Botschaft, Empfänger*.

1 On what qualifies as a diagram, see, e.g., the critical discussion by F. Wallis, “What a Medieval Diagram Shows: A Case Study of *Computus*,” *Studies in Iconography* 36 (2015): 1–40, at 1–4.

2 LSJ; *Diccionario griego-español*, at dge.cchs.csic.es/xdge/διάγραμμα; and D. Dimitrakos, ed., *Μέγα λεξικόν ὅλης τῆς ἐλληνικῆς γλώσσης*, 9 vols. (Athens, 1936–50), 4, s.v. διάγραμμα. Other terms were also used, particularly for geometrical figures, including διαγραφή (LSJ, s.v. A.II; see also P. T. Keyser, “A Proposed Diagram in Aristotle *EN V 3*, 1131a2.4–b2.0 for Distributive Justice in Proportion,” *Apeiron* 25 [1992]: 135–44, at 136, n. 3), καταγραφή (LSJ, s.v. A), and σχῆμα (LSJ, s.v. A.8).

oblique, and vertical lines), not necessarily structured by a geometrical relationship, which may often be accompanied by individual letters, words, brief phrases, or even entire sentences. Thus, I exclude from the discussion all figurative illustrations,<sup>3</sup> such as, for example, the wonderful colored miniatures on orthopedics in the so-called codex of Niketas (Florence, Biblioteca Medicea Laurenziana, Plut.74.7, tenth century);<sup>4</sup> the personification of the four humors, qualities, and seasons in Venice, Biblioteca nazionale Marciana (hereafter Marc.), gr. Z. 516 (fol. 160r, fourteenth century);<sup>5</sup> or the depiction of the various urinary colors in the form of painted urine vials at the beginning of Theophilus's *On Urines* in Bononiensis, ms. 3632 (fol. 51r, dated 1435–53).<sup>6</sup> Furthermore, I do not include in this study diagrams depicting various kinds of amulets, although in some cases they are clearly intended to be seen as therapeutic agents.<sup>7</sup>

I have chosen to divide the material under examination into two large groups of evidence, reflecting the purpose for which the information being communicated was intended. In the first category, a diagram is in most cases used to illustrate a verbal concept in a synoptic format; I call

these examples summary diagrams. In the second case, diagrams are used to give a coherent visual representation of certain objects; I call these spatial diagrams. They include geometrical diagrams, which represent two- or three-dimensional objects but do not necessarily correspond to physical objects. There are also spatial diagrams that represent real entities related to the practice of medicine, such as a urine vial (diagrams of medical equipment) or parts of a living organism (anatomical diagrams). The last category of spatial diagrams is related to iatromathematical treatises (medico-astrological diagrams); these sometimes share common characteristics with anatomical diagrams.

### Summary Diagrams

The most unique and certainly by far the longest example of summary diagrams are the so-called *Tabulae Vindobonenses*, preserved in ÖNB, Cod. med. gr. 16 (thirteenth to fifteenth centuries), which remain unedited in their entirety.<sup>8</sup> The section in question is found on fols. 329r–359v, written by a single hand and dated to the thirteenth century.<sup>9</sup> The first group of diagrams is preceded by the title Ἀρχὴ σὺν Θεῷ τῶν διαιρέσεων πασῶν τῶν Γαληνείων πραγματειῶν ἀρχόμενος ἀπὸ τοῦ περὶ αἰρέσεων τελευτῶν δὲ εἰς τὴν θεραπευτικὴν (Beginning, with [the help of] God, of the divisions of all the Galenic treatises. Starting from *On the Sects* [for Beginners] and ending with *Therapeutic* [Method]).<sup>10</sup> The title alludes to the canon of sixteen works by Galen (129–216/17) that was taught at the “school” of medicine in

3 On Greek and Byzantine medical illustrations, see the recent critical overview by S. Lazaris, “Scientific, Medical and Technical Manuscripts,” in *A Companion to Byzantine Illustrated Manuscripts*, ed. V. Tsamakda (Leiden, 2017), 55–113, at 86–105.

4 F. Marchetti, “Le illustrazioni dei testi *Sulle Articolazioni* (Περὶ ἄρθρων πραγματεία) di Apollonio di Cizio e *Sulle Fasciature* (Περὶ ἐπιδέσμων) di Sorano di Efeso,” in *La collezione di testi chirurgici di Niceta: Firenze, Biblioteca Medicea Laurenziana, Plut. 74.7. Tradizione classica a Bizanzio*, ed. M. Bernabò (Rome, 2010), 55–90. A digital reproduction of the codex is available at <http://mss.bmlonline.it/Catalogo.aspx?Shelfmark=Plut.74.7>.

5 The latest study of this manuscript is F. Lovino, “Un miniatore nella bottega degli Astrapas? Alcune osservazioni attorno alle immagini del Tolomeo Marciano gr. Z. 516 (904),” *Hortus Artium Medievalium* 22 (2016): 384–98, esp. fig. 16. A similar illustration is also found in Mount Athos, Iviron Monastery, 218 (fol. 218r, sixteenth century); it has been reproduced in P. Bouras-Vallianatos, *Innovation in Byzantine Medicine: The Writings of John Zacharias Aktouarios (c. 1275–c. 1330)* (New York, 2020), 4.

6 The codex has been examined from a paleographical and art-historical point of view by F. Marchetti, “Le illustrazioni di uno Iatrosophion bizantino del XV secolo, cod. 3632 della Biblioteca Universitaria di Bologna” (PhD diss., Università di Bologna, 2011).

7 For examples of such diagrams, see A. Delatte, *Anecdota atheniensia*, 2 vols. (Liège, 1927–39), 1:18–21, 414–16, 604–5. On graphic signs on amulets, see I. Garipzanov, *Graphic Signs of Authority in Late Antiquity and the Early Middle Ages, 300–900* (New York, 2018), 41–49.

8 An edition of fols. 329r–332r is in O. Overwien, *Medizinische Lehrwerke aus dem spätantiken Alexandria: Die Tabulae Vindobonenses und Summaria Alexandrinorum zu Galens De sectis* (Berlin, 2019), 114–56. Some diagrams appear in the form of plain text in Naples, Biblioteca dei Gerolamini, C. F. 2.11 (*olim* XXII.1) (fols. 172r–173r, fifteenth century), in which a collection of phrases focusing on the issues of mixtures as presented in Galen's *Art of Medicine* is copied. Shared errors in the Neapolitan and Viennese manuscripts suggest a common ancestor. See A. M. Ieraci Bio, “*Dibairesis* relative all' *Ars medica* di Galeno nel Neap. Orat. Gr. CF 2. 11 (*olim* XXII-1),” *Galenos* 1 (2007): 149–61.

9 H. Hunger, *Katalog der griechischen Handschriften der Österreichischen Nationalbibliothek*, vol. 2, *Codices juridici, codices medici* (Vienna, 1969), 60–62. Unfortunately, there is no other surviving manuscript of the complete set of these diagrams, and we are unable to establish their transmission history.

10 ÖNB, Cod. med. gr. 16, fol. 329r, lines 1–2.



Alexandria (late fifth to early seventh century).<sup>11</sup> In the Viennese codex, however, we only find diagrams for the first four works of the canon, the introductory ones (*On the Sects for Beginners*, *Art of Medicine*, *Therapeutics to Glaucon*, and *On the Pulse for Beginners*), and for one of the more advanced ones, which was known by the overarching title *Περὶ αἰτίας* (On cause) and actually included four Galenic works on the differences and causes of diseases and symptoms: *On the Different Kinds of Diseases*, *On Causes of Diseases*, *On Distinctions in Symptoms*, *On Causes of Symptoms*.<sup>12</sup> More intriguing is the term

11 I put “school” in quotation marks because we have very few details on which to base an argument about whether medical teaching was taking place in an institutionalized environment. On this issue, see O. Overwien, “Der medizinische Unterricht der Iatrosophisten in der ‘Schule von Alexandria’ (5.–7. Jh. n. Chr.): Überlegungen zu seiner Organisation, seinen Inhalten und seinen Ursprüngen (erster Teil),” *Philologus* 162.1 (2018): 2–14. However, we are able to reconstruct the medical curriculum that was offered to students who already had adequate knowledge of grammar, rhetoric, and logic: it consisted of Hippocratic and Galenic works. See A. Z. Iskandar, “An Attempted Reconstruction of the Late Alexandrian Medical Curriculum,” *Medical History* 20.3 (1976): 235–58; O. Overwien, “Der medizinische Unterricht der Iatrosophisten in der ‘Schule von Alexandria’ (5.–7. Jh. n. Chr.): Überlegungen zu seiner Organisation, seinen Inhalten und seinen Ursprüngen (zweiter Teil),” *Philologus* 162.2 (2018): 265–90; and Overwien, *Medizinische Lehrwerke*, 10–18. The clearest version of the Galenic canon is given by John the Grammarian (Yahyā al-Nahwī) in the preface of his *Synopsis of the Sixteen Works of Galen*, which survives in Arabic and has been edited by I. Garofalo, “Il *sunto* di Ioannes ‘Grammatikos’ delle opere del canone di Galeno,” in *Studi su Galeno: Scienza, filosofia, retorica e filologia. Atti del seminario, Firenze, 13 novembre 1998*, ed. D. Manetti (Florence, 2000), 135–51, at 144–46. An English translation, together with an updated list of works related to the Galenic canon and surviving in Greek, Latin, and Arabic, is provided by I. Garofalo, “Galen’s Legacy in Alexandrian Texts Written in Greek, Latin, and Arabic,” in *Brill’s Companion to the Reception of Galen*, ed. P. Bouras-Vallianatos and B. Zipser (Leiden, 2019), 62–85.

12 Each group of diagrams is usually preceded and followed by the title of the relevant work marking the beginning and the end respectively, e.g., ÖNB, Cod. med. gr. 16, fol. 337r and 338v: ἀρχὴ τοῦ πρὸς Γλαύκωνα and τέλος τοῦ πρὸς Γλαύκωνα. A full list of titles is available in B. Gundert, “Die *Tabulae Vindobonenses* als Zeugnis alexandrinischer Lehrtätigkeit um 600 n. Chr.,” in *Text and Tradition: Studies in Ancient Medicine and Its Transmission. Presented to Jutta Kollesch*, ed. K.-D. Fischer, D. Nickel, and P. Potter (Leiden, 1998), 91–144, at 100. Branch diagrams also appear in the margins of Galenic manuscripts in treatises that were not necessarily connected with the Alexandrian canon. See, e.g., E. García Novo, “Les scholies marginales au traité de Galien *De inaequali intemperie* dans le manuscrit grec Phillipps 4614,” in *I testi medici greci: Tradizione e ecdotica. Atti del III Convegno internazionale, Napoli, 15–18 ottobre 1997*, ed. A. Garzya and J. Jouanna (Naples, 1999), 175–83, who examines the branch

*διαρρέσεων* (divisions), which is used for this collection of schematic representations.

The method of division (*διαίρεσις*) goes back to antiquity and refers to the classification of a certain theoretical concept by dividing and subdividing it into several components.<sup>13</sup> It became particularly important in philosophy, especially in the Middle Platonist and late Aristotelian curricula.<sup>14</sup> Galen himself also makes use of this method of division in some of his treatises.<sup>15</sup> In the next few centuries, and particularly in early Byzantine Alexandria, the method played a central role in medical teaching, as it is attested in the surviving textbooks, including commentaries, summaries, and the *Tabulae Vindobonenses*.<sup>16</sup> It remained popular throughout the Byzantine period, as is shown by the number of surviving diagrams in various medical manuscripts and also in works of other genres, including philosophy, epistolography, or even scholia on Greek tragedy.<sup>17</sup>

diagrams in the margins of a twelfth-century manuscript preserving the Galenic *On Anomalous Dyskrasia*.

13 For a concise introduction, see M. Asper, *Griechische Wissenschaftstexte: Formen, Funktionen, Differenzierungsgeschichten* (Stuttgart, 2007), 274–82. Cf. M. Talamanca, “Lo schema ‘genus-species’ nelle sistematiche dei giuristi romani,” in *La filosofia greca e il diritto romano: Colloquio italo-francese (Roma, 14–17 aprile 1973)* (Rome, 1977), 3–319.

14 J. Mansfeld, *Heresiography in Context: Hippolytus’ Elenchos as a Source for Greek Philosophy* (Leiden, 1992), 326–31.

15 J. Boulogne, “L’apport de Galien à la méthode médicale,” *REG* 110.1 (1997): 126–42, at 134–41.

16 O. Overwien, “Medizinische Lehrwerke aus dem spätantiken Alexandria,” *EtCl* 80.1–2 (2012): 157–86. A striking reference to this method and its use in medical teaching is found in Stephen’s *Commentary on Galen’s ‘Therapeutics to Glaucon’*, in *Stephanus the Philosopher and Physician*, ed. and trans. K. Dickson (Leiden, 1998), 36.10–13 and 37: “Instead, it is because this method of division is also useful [διαίρετικὴ χρησιμεύει μέθοδος] for the instruction of students, and because it is through it and through errors made with respect to it that physicians encounter the failures whose causes you asked to learn.”

17 For examples from the field of philosophy, see N. Agiotis, “Inventarisierung von Scholien, Glossen und Diagrammen der Handschriftlichen Überlieferung zu Aristoteles’ *De interpretatione* (c. 1–4),” Working Paper des SFB 980, *Episteme in Bewegung* 5 (2015): 1–117, at [http://www.sfb-episteme.de/Listen\\_Read\\_Watch/Working-Papers/No\\_5\\_Agiotis\\_Inventar/index.html](http://www.sfb-episteme.de/Listen_Read_Watch/Working-Papers/No_5_Agiotis_Inventar/index.html); and M. Cacouras, “Les schémas dans les manuscrits grecs de contenu logique: Raisons d’être, fonctions et typologie,” *Gazette du livre médiéval* 39 (2001): 21–33, at 27–32. For examples in other genres, see A. M. Ieraci Bio, “*Disiecta membra* della scuola iatrosostica Alessandrina,” in *Galenismo e medicina tardoantica: Fonti greche, latine e arabe. Atti del Seminario internazionale di Siena, Certosa di Pontignano, 9 e 10 settembre 2002*, ed. I. Garofalo and A. Roselli (Naples, 2003), 9–51, at 16, n. 36.

In the case of the *Tabulae Vindobonenses*, diagrams are used to summarize and systematize Galen's theories; quite often new elements that are not found in the relevant Galenic works are added.<sup>18</sup> They usually show similarities with other educational material derived from Alexandria, including commentaries and summaries or synopses (Ar. *jawāmi*) of the works of the Galenic canon (the so-called *Summaria Alexandrinorum*), which now survive only in Arabic.<sup>19</sup> Based on an analysis of the extant summaries and diagrams related to *On the Sects for Beginners*, Oliver Overwien has argued that both reflect actual teaching by the Alexandrian iatrosophists. The diagrams were not intended to substitute for the Galenic original but rather to complement the lecture as visual, learning aids, and they could be used subsequently as textbooks for the students when they wanted to revisit a subject.<sup>20</sup> I shall now give some examples that will help to further illustrate their content and function (Figs. 11.1–2; Diagrams 11.1–4). In the vast majority of the cases, they are branch or tree diagrams.<sup>21</sup>

The first diagram is presented in association with the source text (parts in common are underlined), which in this case is *Therapeutics to Glaucón*. The terms provided in the diagram are very close to, indeed almost identical with, those in the relevant Galenic passage. There are a few exceptions, in which we find either the use of a synonym (e.g., ἄκρα instead of κῶλα) or of a single term, ἀσιτία, rather than the five words used

in the original (e.g., οἴνου δὲ καὶ τροφῆς ἀπέχειν). Overall, the text has been summarized in seven terms or brief phrases. In the case of “abstaining from food and bathing,” the Galenic recommendation for those suffering from fever has been omitted. In another case the diagram omits one of the vegetal ingredients of the Galenic account (ὑσσωπος, hyssop). Furthermore, the diagram suggests using *melikraton* (a mixture of honey and water) with *oxymeli* (a mixture of honey and vinegar), although these are two similar potions. Perhaps it reflects the accumulated practical experience of Alexandrian physicians, who tested and updated the Galenic recommendations. One cannot, however, exclude the possibility that some parts of the diagrams might have been miscopied or revised by later scribes and readers in their long period of transmission. Unlike the first, the second diagram summarizes a longer Galenic passage extending over three pages in the Kühn edition.<sup>22</sup> Each of the three main causes of fainting is further subdivided in the codex. In this case we can attest to a close textual resemblance to the surviving Alexandrian commentary on this Galenic text (parts in common are underlined) by Stephen (fl. late sixth to early seventh century).<sup>23</sup> This does not necessarily imply that the diagram was made to accompany Stephen's commentary, but it certainly reflects the Alexandrian understanding and systematization of the corresponding Galenic theory.

The next set of diagrams is found in the section dealing with Galen's introductory text *On the Pulse for Beginners*. Diagram 11.3 focuses on the various categories of the pulse, referring to ten categories, and Diagram 11.4 shows the three kinds of pulse in the second category according to the speed of the motion (swift, slow, and balanced pulse). Examination of the pulse and urine were the most important diagnostic and prognostic techniques in the Middle Ages, and Byzantine authors devoted specialized treatises to these

18 See the various examples presented by Gundert, “Die *Tabulae Vindobonenses*,” 115–36.

19 O. Temkin, “Studies on Late Alexandrian Medicine: I. Alexandrian Commentaries on Galen's *De Sectis ad Introducendos*,” *Bulletin of the Institute of the History of Medicine* 3,6 (1935): 405–30, at 420; Gundert, “Die *Tabulae Vindobonenses*,” 114; P. Pormann, “The *Alexandrian Summary (Jawāmi)* of Galen's *On the Sects for Beginners*: Commentary or Abridgment?,” in *Philosophy, Science and Exegesis in Greek, Arabic and Latin Commentaries*, ed. P. Adamson, H. Baltussen, and M. W. F. Stone, 2 vols. (London, 2004), 2:11–33; and Overwien, *Medizinische Lehrwerke*, 47–67.

20 O. Overwien, “Zur Funktion der *Summaria Alexandrinorum* und der *Tabulae Vindobonenses*,” in *Enzyklopädie der Philologie: Themen und Methoden der Klassischen Philologie heute*, ed. U. Schmitzer (Göttingen, 2013), 187–207; and Overwien, *Medizinische Lehrwerke*, 98–107.

21 There are also a few rectangular diagrams. See Gundert, “Die *Tabulae Vindobonenses*,” 103.

22 Galen, *Therapeutics to Glaucón*, 1.15, ed. Kühn, 11:47.11–50.2.

23 On this particular diagram, see also Gundert, “Die *Tabulae Vindobonenses*,” 127–28; and P. Bouras-Vallianatos, “Reading Galen in Byzantium: The Fate of *Therapeutics to Glaucón*,” in *Greek Medical Literature and Its Readers: From Hippocrates to Islam and Byzantium*, ed. P. Bouras-Vallianatos and S. Xenophontos (Abingdon, UK, 2018), 180–229, at 191–92.

topics.<sup>24</sup> An analysis of the pulse's characteristics was attempted by medical authors who connected them with certain clinical conditions.<sup>25</sup> What is intriguing in this case is that the message carried by the diagram has noticeably deviated from the original Galenic source, reflecting the growing popularity of the ten-category scheme in the early Byzantine period.

Galen never refers to ten categories in his *On the Pulse for Beginners*.<sup>26</sup> In referring to the subject in his *On Differences of the Pulse* Galen provides us with a variety of terms used by past authorities to define the various kinds of the pulse (i.e., γένη, εἶδη, ποιότητες, and διαφοραί).<sup>27</sup> He then proceeds to describe the classes concerning a single beat, of which—according to an explicit statement at the end of his account—there are five (πέντε γένη).<sup>28</sup> In addition to these, Galen refers to at least four more classes: two concerning different characteristics of a sequence of beats and two that compare one beat to another.<sup>29</sup> In Diagram 11.3, there is one category that contains data not found in any genuine Galenic work. This is the one about the warmth of the pulse, which only features in pseudo-Galenic works such as *Medical Definitions* and *On Pulse to Antonius*.<sup>30</sup> The ten-category

scheme became the dominant theory in the area of sphygmology in Byzantium, found in the vast majority of medical works from Paul of Aegina's (late sixth century; d. after 642) influential *Epitome* to Michael Psellos's (1018–ca. 1076) didactic poem *On Medicine*.<sup>31</sup>

As for the intended purpose of these examples, it is clear that none of the diagrams can be used in isolation. Some form of text, whether the Galenic text, a commentary, or a summary, is needed in order to understand the various theories. The diagrams constitute an open invitation to the reader to turn theory into memory,<sup>32</sup> a significant element in Byzantine teaching and in medieval education more generally. They offer brief guidance in a summarized form, which could function as a sort of teaching aid to help introduce medical students to a topic. They could also have been used by someone with appropriate knowledge of the subject for purposes of revision or aids to recollection. And they might have provided the basis for composing medical questions and answers—the so-called *erotapokrisis*—a genre that was particularly popular in an educational context in the early Byzantine period.<sup>33</sup>

In addition to the above-mentioned branch diagrams, there are also a few diagrammatic lists.

24 P. Bouras-Vallianatos, "Contextualizing the Art of Healing by Byzantine Physicians," in *Life Is Short, Art Long: The Art of Healing in Byzantium*, ed. B. Pitarakis (Istanbul, 2015), 104–22, at 109–12.

25 On Galenic sphygmology theory, see C. R. S. Harris, *The Heart and the Vascular System in Ancient Greek Medicine, from Alcmaeon to Galen* (Oxford, 1973), 397–431.

26 Galen, *On the Pulse for Beginners*, 2–8, ed. Kühn, 8:455.1–462.5.

27 Galen, *On Differences of the Pulse*, 1.2, ed. Kühn, 8:498.15–17.

28 Galen, *On the Different Kinds of the Pulse*, 15, ed. Kühn, 8:509.13. According to Orly Lewis's interpretation, "Galen against Archigenes on the Pulse and What It Teaches Us about Galen's Method of Diairesis," in *Galen's Epistemology*, ed. M. Havrda and R. J. Hankinson (Cambridge, forthcoming), the variations in the pulse related to a single beat pertain to the time of the motion, the quantity of the distension, the strength that the fingers perceive at the peak of the *diastolē*, the texture of the arterial walls, and the contents of the arteries.

29 The first two concern the rest/interval in the artery and the rhythm and the next two are with regard to evenness/unevenness and regularity/irregularity. On these, see Lewis, "Galen against Archigenes." It is notable that Galen does not enumerate all the classes and is not always very clear in his text. See Galen, *On Differences of the Pulse*, 1.3–9, ed. Kühn, 8:500.6–522.18.

30 Ps.-Galen, *Medical Definitions*, ed. Kühn, 19:404.1–412.15; and Ps.-Galen, *On Pulse to Antonius*, ed. Kühn, 19:634.2–637.8. See also P. Bouras-Vallianatos, "Pseudo-Galenic Texts on Urine and Pulse in Late Byzantium," in *Pseudo-Galenica: The Formation*

*of the Galenic Corpus from Antiquity to the Renaissance*, ed. C. Petit, S. Swain, and K.-D. Fischer (London, 2021), 98–128, who also discusses the development of the classification of different kinds of pulse in the Byzantine period. Cf. Gundert, "Die *Tabulae Vindobonenses*," 128–29.

31 Paul of Aegina, *Epitome*, 2.11, ed. J. L. Heiberg, *Paulus Aegineta*, vol. 1, *Libri I–IV* (Leipzig, 1921), 82.4–88.18; and Michael Psellos, *On Medicine*, 9.283–421, ed. L. Westerink, *Michaelis Pselli Poemata* (Stuttgart, 1992), 200–204.

32 On diagrams as mnemonic devices in the Middle Ages, see M. Carruthers, *The Book of Memory: A Study of Memory in Medieval Culture*, 2nd ed. (New York, 2008), 324–37. It is worth mentioning that modern research has shown that visual explanations of verbal concepts significantly facilitate the learning experience. Among the various studies on the topic, see E. Bobek and B. Tversky, "Creating Visual Explanations Improves Learning," *Cognitive Research: Principles and Implications* 1 (2016): article 27, 1–14.

33 On early Byzantine *erotapokriseis*, see Y. Papadoyannakis, "Instruction by Question and Answer: The Case of Late Antique and Byzantine *Erotapokriseis*," in *Greek Literature in Late Antiquity: Dynamism, Didacticism, Classicism*, ed. S. F. Johnson (Aldershot, UK, 2006), 91–105. On Byzantine medical *erotapokriseis*, see A. M. Ieraci Bio, "L'erotapokrisis nella letteratura medica," in *Esegesi, parafrasi e compilazione in età tardoantica: Atti del terzo Convegno dell'Associazione di studi tardoantichi*, ed. C. Moreschini (Naples, 1995), 187–207.

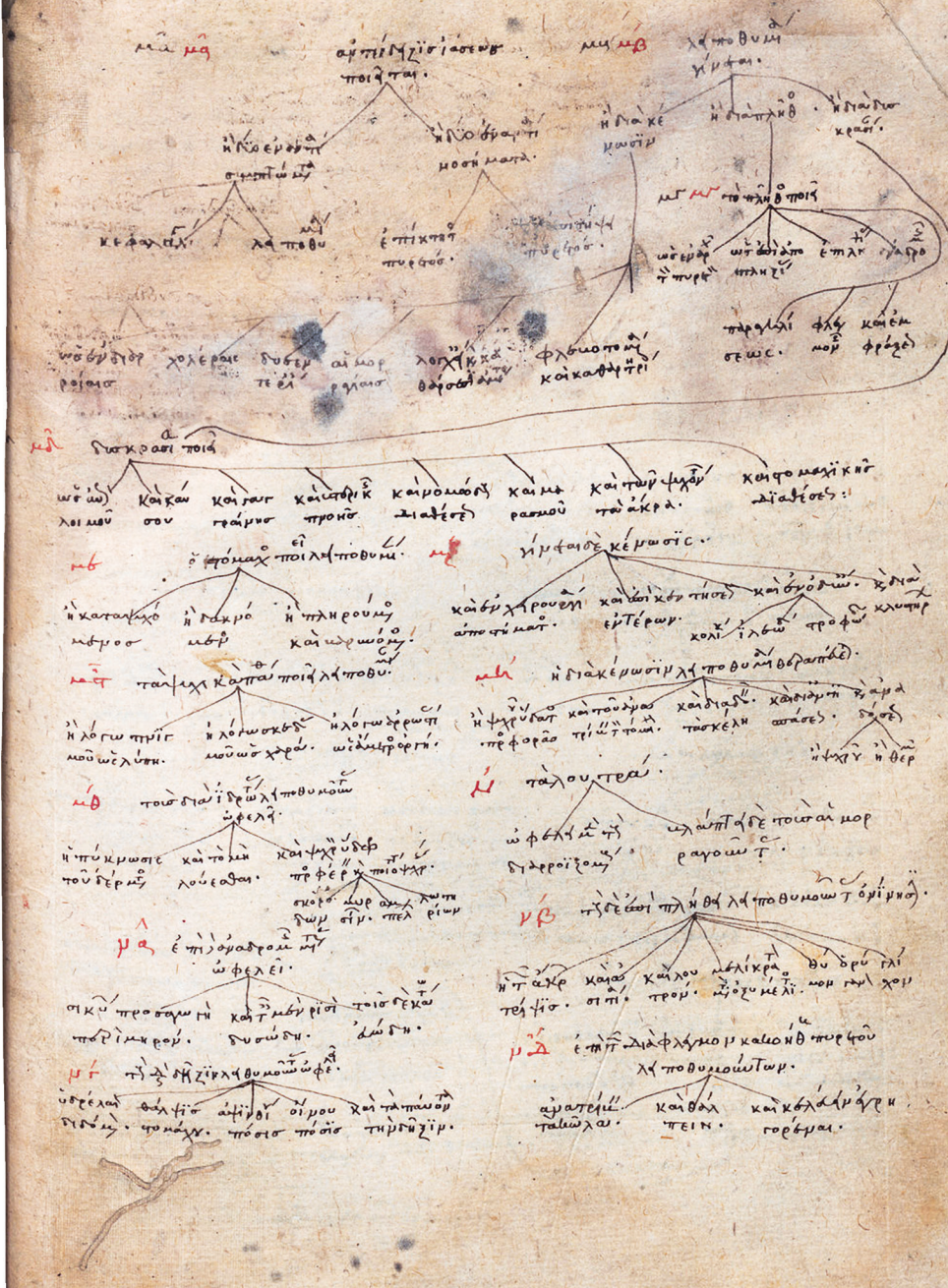
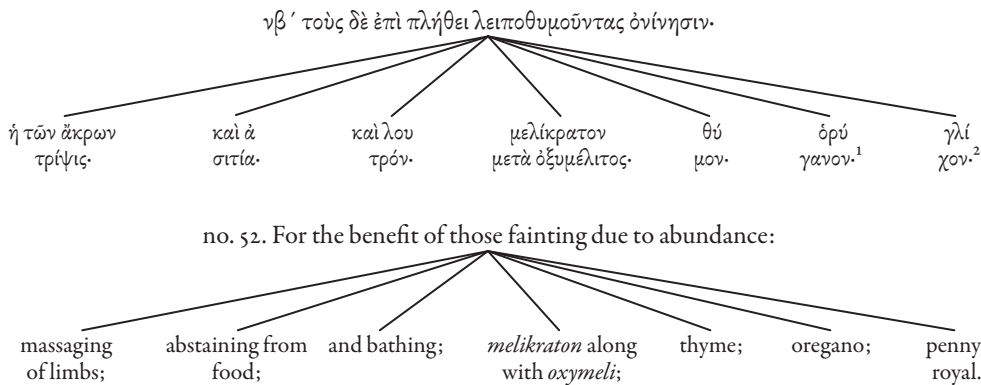


FIG. II.I. Branch diagrams associated with Galen's *Therapeutics to Glaucou*, thirteenth century. ÖNB, Cod. med. gr. 16, fol. 338r. Photo courtesy of the Österreichische Nationalbibliothek, Vienna

DIAGRAM II.1

Vienna, ÖNB, Cod. med. gr. 16, fol. 338r

Fig. II.1



Galen, *Therapeutics to Glaucou*, 1.15, ed. Kühn, 11:53.13–54.1:

τοῖς δ' ἐπὶ πλήθει οὐκ ἔσθ'<sup>3</sup> ὁμοίως, ἀλλὰ τρίβειν ἐπὶ πλείστον ἐκείνων<sup>4</sup> τὰ κῶλα καὶ θερμαίνειν καὶ διαδεῖν. οἴνου δὲ καὶ τροφῆς ἀπέχειν καὶ λουτρῶν, εἰ πυρέττοιεν· ἀρκεῖ δ' αὐτοῖς μελικράτου τε δίδοναι πόμα ἢ θύμου ἢ ὀριγάνου ἢ γλήχωνος ἢ ὕσσώπου ἔχοντος ἐναφηψημένον. ἐπιτῆδειον δὲ καὶ ὀξύμελι.

However, in those who faint due to abundance, it is not the same. Massage them a lot, and heat and bind their limbs. And if they are febrile, keep them away from wine, food, and baths. It is enough to give them *melikraton* and a drink having thyme, oregano, pennyroyal, or hyssop boiled down in it. Useful also is *oxymeli*.<sup>5</sup>

1 sc. ὀρίγανον.

2 sc. γλήχων.

3 ἔσθ' Dickson, *Stephanus the Philosopher*: ἐθ' Kühn.

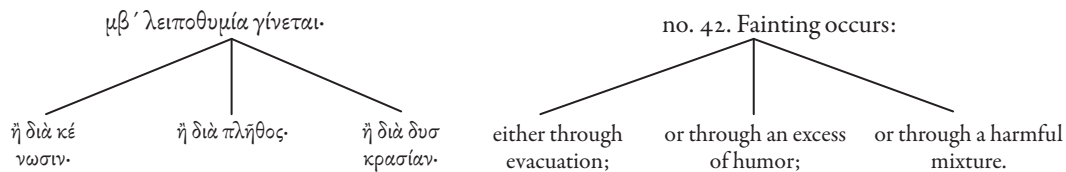
4 ἐκείνων Dickson, *Stephanus the Philosopher*: ἐπ' ἐκείνων Kühn.

5 Trans. I. Johnston, *On the Constitution of the Art of Medicine; The Art of Medicine; A Method of Medicine to Glaucou* (Cambridge, MA, 2016), 419.

DIAGRAM II.2

Vienna, ÖNB, Cod. med. gr. 16, fol. 338r

Fig. II.1



Stephen, *Commentary on Galen's Therapeutics to Glaucou*, 163, ed. and trans. Dickson, *Stephanus the Philosopher and Physician*, 202.11–15 and 203 (slightly modified):

Ἡ λειποθυμία οὐδὲν ἕτερον ἐστὶν ἢ ἀθρόα διαφόρησις τοῦ ζωτικῆς τόνου, γίνεται δ' αὕτη κατὰ γένος μὲν τριχῶς, κατὰ εἶδος δὲ ὑπὸ πολλῶν αἰτίων. γίνεται γὰρ ἢ διὰ πλήθος τῶν βάρει πνίγον τὴν δύναμιν ἢ διὰ κένωσιν ἄμετρον, συνολισθάνειν ποιοῦσαν τοῖς ἀχρήστοις καὶ τὰ χρηστά, ἢ δι' ἀθρόαν μεταβολὴν κρᾶσεως.

Fainting is nothing other than the sudden dispersal of vital tension. This happens categorically in three ways, but specifically through a great number of causes. Now, it happens either when an excess of humor chokes the faculty with its weight; or through immoderate evacuation, which makes beneficial matter slip along with the harmful matter; or else through a sudden change of mixture.

τὸ πρῶτον τῆς ἀφροσύνης καὶ τῆς τριτοῦ.

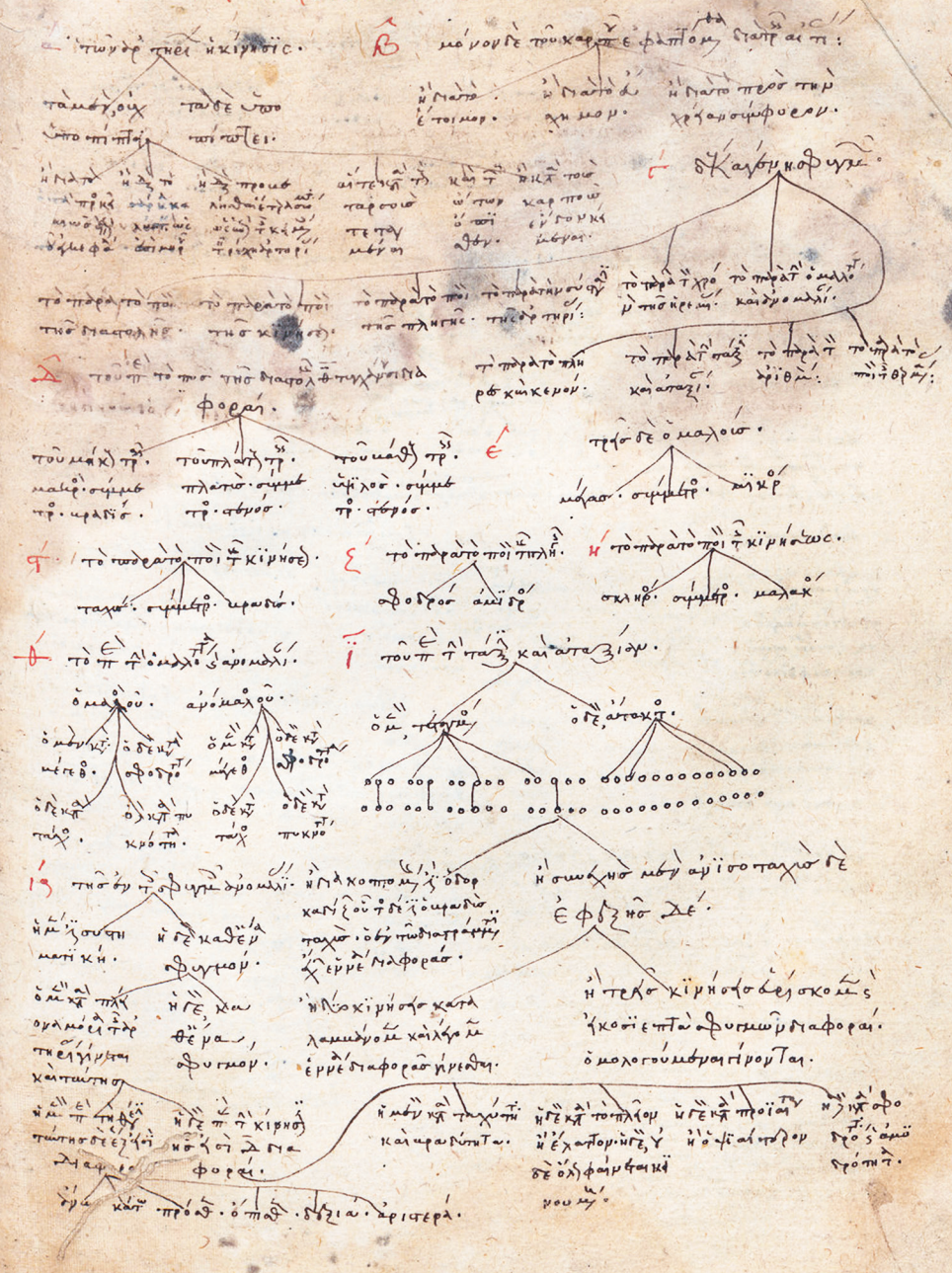
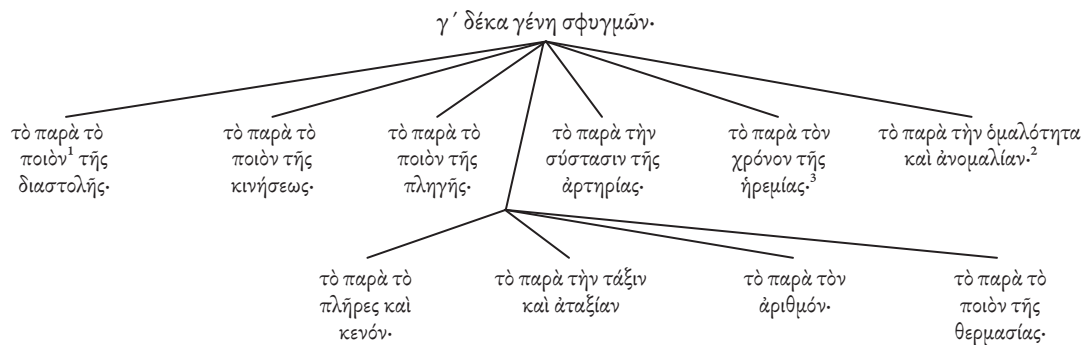


FIG. II.2. Branch diagrams associated with Galen's *On the Pulse for Beginners*, thirteenth century. ÖNB, Cod. med. gr. 16, fol. 339r. Photo courtesy of the Österreichische Nationalbibliothek, Vienna

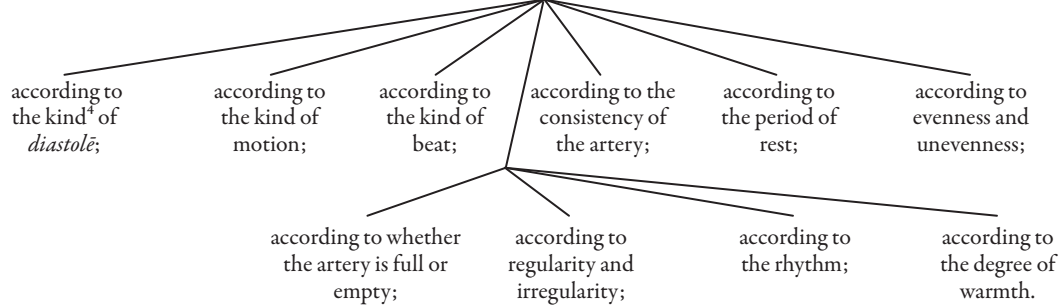
DIAGRAM II.3

Vienna, ÖNB, Cod. med. gr. 16, fol. 339r

Fig. II.2



no. 3. Ten pulse categories:



1 ποιὸν cod.: ποσὸν conl.

2 sc. ἀνωμαλίαν.

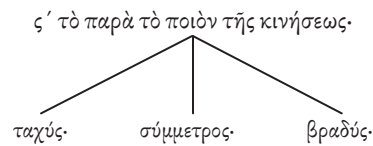
3 sc. ἡρεμίας.

4 i.e., quantity.

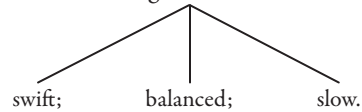
DIAGRAM II.4

Vienna, ÖNB, Cod. med. gr. 16, fol. 339r

Fig. II.2



no. 6. According to the kind of motion:



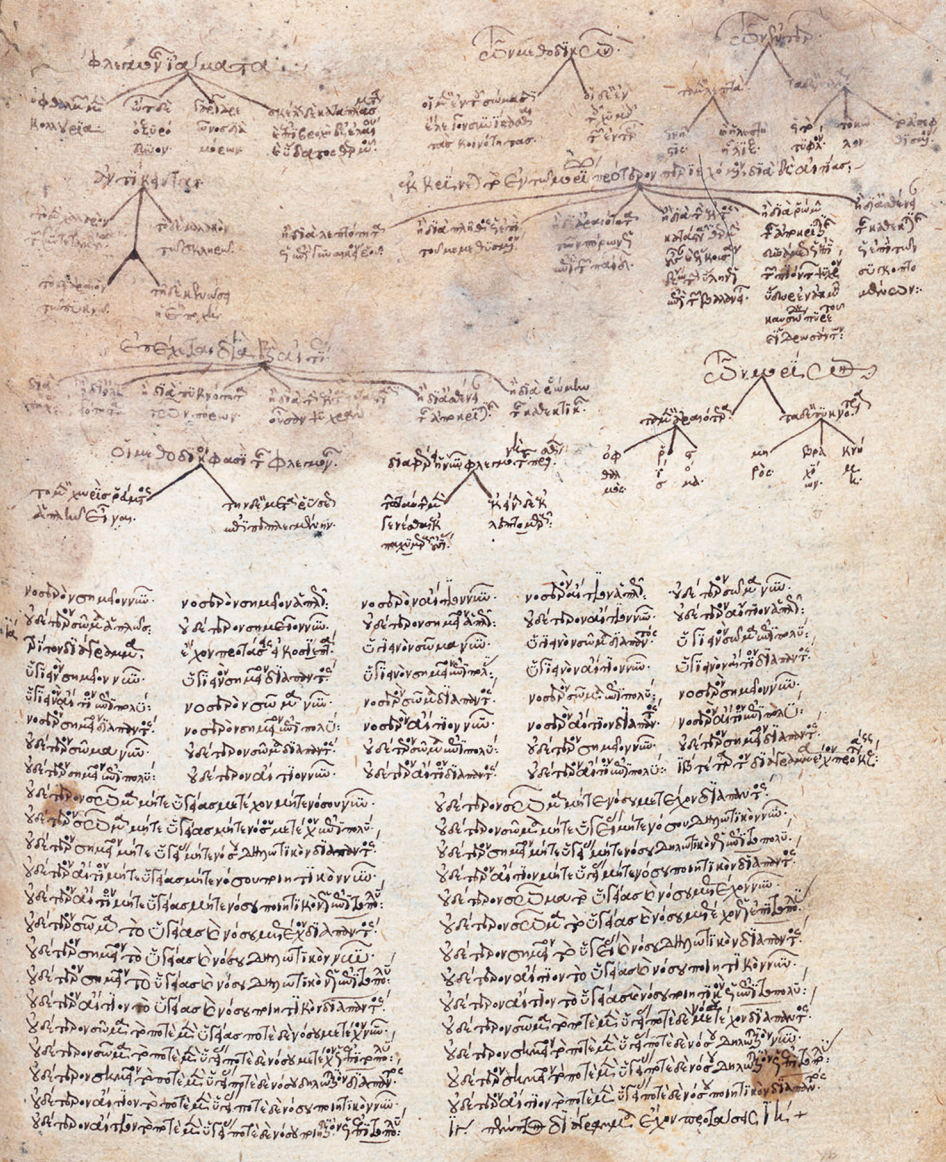


FIG. II.3. Branch diagrams and diagrammatic lists associated with Galen's *Art of Medicine*, thirteenth century. ÖNB, Cod. med. gr. 16, fol. 332r. Photo courtesy of the Österreichische Nationalbibliothek, Vienna



DIAGRAMMATIC LIST 11.1

Vienna, ÖNB, Cod. med. gr. 16, fol. 332r

Fig. 11.3 (bottom half)

ια' τρίτον διάγραμμα, ύγιεινόν σημεῖον νῦν· ύγιεινόν αἴτιον ἐπὶ πολὺ· νοσερὸν σημεῖον διὰ παντός· οὐδέτερον σῶμα νῦν· οὐδέτερον σημεῖον ἐπὶ πολὺ·	ἔχον προτάσεις εἰκοσιεπτὰ· ύγιεινόν σημεῖον δια παντός· νοσερὸν σῶμα νῦν· νοσερὸν σημεῖον ἐπὶ πολὺ· οὐδέτερον σῶμα διὰ παντός· οὐδέτερον αἴτιον νῦν·	ύγιεινόν σῶμα νῦν· ύγιεινόν σημεῖον ἐπὶ πολὺ· νοσερὸν σῶμα διὰ παντός· νοσερὸν αἴτιον νῦν· οὐδέτερον σῶμα ἐπὶ πολὺ· οὐδέτερον αἴτιον διὰ παντός·	ύγιεινόν σῶμα διὰ παντός· ύγιεινόν αἴτιον νῦν· νοσερὸν σῶμα ἐπὶ πολὺ· νοσερὸν αἴτιον διὰ παντός· οὐδέτερον σημεῖον νῦν· οὐδέτερον αἴτιον ἐπὶ πολὺ·	ύγιεινόν σῶμα ἐπὶ πολὺ· ύγιεινόν αἴτιον διὰ παντός· νοσερὸν σημεῖον νῦν· νοσερὸν αἴτιον ἐπὶ πολὺ· οὐδέτερον σημεῖον διὰ παντός·
no. 11. third diagram having	twenty-seven premises:	healthy body at the present moment;	healthy body always;	healthy body for the most part;
healthy sign at the present moment;	healthy sign always;	healthy sign for the most part;	healthy cause at the present moment;	healthy cause always;
healthy cause for the most part;	diseased body at the present moment;	diseased body always;	diseased body for the most part;	diseased sign at the present moment;
diseased sign always;	diseased sign for the most part;	diseased cause at the present moment;	diseased cause always;	diseased cause for the most part;
neutral body at the present moment;	neutral body always;	neutral body for the most part;	neutral sign at the present moment;	neutral sign always;
neutral sign for the most part;	neutral cause at the present moment;	neutral cause always;	neutral cause for the most part.	

These are not based on the method of division. They consist of various verbal combinations derived from theoretical statements in Galen's *Art of Medicine*.<sup>34</sup> Each combination is called a *πρόταση* (sentence or premise). The author calls this list a *διάγραμμα*, and this is also the term that is used by Galen throughout his corpus in citing such lists.<sup>35</sup> It was also used later on by Theophilus (seventh or ninth century) in his treatises *On Pulse* and *On Urines*.<sup>36</sup> They are not presented in

plain textual format but are set out in a schematic form consisting of several rows, without any sort of graphic component. The example (Fig. 11.3; Diagrammatic List 11.1) consists of twenty-seven premises providing all the possible combinations of the three possible states (*ύγιεινόν*, healthy; *νοσερόν*,<sup>37</sup> diseased; and *οὐδέτερον*, neither [of these], or neutral) pertaining to the "body" (*σῶμα*), "cause" (*αἴτιον*), and "sign" (*σημεῖον*), and to whether they persist "at the present moment" (*νῦν*), "for the most part" (*ἐπὶ πολὺ*), or "always" (*διὰ παντός*).<sup>38</sup> As in the case of the branch diagrams, the list cannot be used without the source. They provide a coherent picture of the various

34 Some more examples are presented briefly by Gundert, "Die *Tabulae Vindobonenses*," 125–26.

35 These are common in Galen's sphygmological treatises. See, e.g., Galen, *On the Different Kinds of the Pulse* and *On Diagnosis by the Pulse*, 1.15 and 3.3, ed. Kühn, 8:530–34, and 914–15. Among the surviving diagrammatic lists in Galenic manuscripts, see BnF, ms. gr. 2153 (fifteenth century), fols. 167v–169r. It is worth noting that in the vast majority of cases, they take the form of plain text in the surviving Greek manuscripts.

36 For example, Theophilus, *On the Pulse*, ed. F. Z. Ermerins, *Anecdota medica Graeca: E codicibus MSS. expromsit* (Leiden, 1840), 17–21. This list can be seen in BnF, ms. gr. 2184, fol. 224r (fifteenth century). On the *status quaestionis* on Theophilus's dating, see I. Grimm-Stadelmann, "Θεοφίλου περὶ τῆς τοῦ ἀνθρώπου κατασκευῆς (= Theophilus, Der Aufbau des Menschen):

Kritische Edition des Textes mit Einleitung, Übersetzung und Kommentar" (PhD diss., Ludwig-Maximilians-Universität München, 2008), 36–42.

37 Galen refers to it as *νοσῶδες*.

38 It corresponds to Galen, *Art of Medicine*, 1–8, ed. Kühn, 1:307.5–309.15 = V. Boudon-Millot, ed. and trans., *Exhortation à l'étude de la médecine: Art médical* (Paris, 2000), 276.6–278.9. On this notion, see Boudon-Millot, *Exhortation à l'étude*, 179–81, 396–99.

possibilities of the Galenic theory, clarifying it and making it more easily digestible. The main objective is not to give a synoptic visual aid but to offer a posthumous schematic expansion of the source.

Various examples of branch diagrams are often present in manuscripts preserving works by Byzantine medical authors. In the vast majority of cases, however, they cannot be connected with a particular educational context or a milieu in which they were first introduced and subsequently used. Here I discuss some examples as they appear in San Lorenzo de El Escorial, Real Biblioteca del Monasterio (hereafter Scorialensis), Φ.III.12, a paper codex of 463 folios dated 1432,<sup>39</sup> of which the greater part (fols. 12r–419v) contains the medical corpus of the early fourteenth-century Byzantine physician John Zacharias Aktouarios (*On Urines, Medical Epitome, On Psychic Pneuma*).<sup>40</sup> It also preserves some other brief treatises, including a Greek uroscopic text ascribed to Ibn Sīnā;<sup>41</sup> the Hippocratic *Aphorisms, Prognostic*, and *On Winds*; excerpts from Paul of Aegina's *Epitome* on fevers and substitute drugs; brief passages on measurements, sweats, and fevers; scattered anonymous recipes; and some brief texts on astrology.<sup>42</sup> The commissioner of the codex was certainly interested in John's medical corpus, some fundamental Hippocratic treatises, and a collection of excerpts of brief and practical information on a variety of medical topics, and he also seems to have had some slight interest in basic astrological knowledge (see also "Iatromathematical

(Medico-Astrological) Diagrams," below). Scorialensis has a considerable number of branch diagrams that can be divided into two categories according to their content and relation to certain texts: those contained within the central area of the folio that are not closely related to John's work, but whose content is related to fundamental medical theories discussed in John's corpus or other medical works of the manuscript (fols. 11r–v, 101v, 128v, 419v); and those that correspond closely to John's theories and appear in the margins near the relevant paragraph from one of his works (fols. 31v, 176r, 177v, 194v). I have edited and translated a group of representative examples (Figs. 11.4–8; Diagrams 11.5–12).

All the diagrams look much the same, but the messages they carry can vary and give the reader a different impression in each case. First, Diagram 11.8 is certainly the most impressive, with several divisions and subdivisions covering an entire folio (11v). It gives a synoptic view of the constitution of man, including references to humors, seasons, elements, qualities, organs, and the connections among them. The diagram is not associated directly with any text in the codex, and there is only a very brief description immediately below the diagram confirming its contents.<sup>43</sup> Humoral theory constituted the single most important system in the understanding and treatment of disease.<sup>44</sup> Each humor was connected with an element, an organ, a particular season, and two of the four elementary qualities (hot or cold, dry or moist). Blood was the dominant humor in spring

39 Another interesting example of branch diagrams associated with works by Byzantine authors in the early fourteenth-century, BnF, ms. gr. 1888 (fol. 156r), has been discussed by Ieraci Bio, "Disiecta membra," 18–51.

40 G. de Andrés, *Catálogo de los códices griegos de la Real Biblioteca de El Escorial*, vol. 2 (Madrid, 1965), 64, refers to "An. 1433," but, according to the scribal colophon, the manuscript was completed in October, thus it should be 1432, as we must subtract the figure 5509 (used when calculating dates that fall between September 1 and December 31) from 6941 (ϛελα'), not 5508, which is used when calculating dates that fall between January 1 and August 31. On John Zacharias Aktouarios, see P. Bouras-Vallianatos, *Innovation in Byzantine Medicine*.

41 This work survives in various versions in Greek manuscripts. See M. Lamagna, "Per l'edizione del *De Urinis* attribuito ad Avicenna: Studio complessivo della tradizione manoscritta," *Revue d'histoire des textes* n.s. 6 (2011): 27–59.

42 G. de Andrés, *Catálogo de los códices griegos*, 64–66; and Bouras-Vallianatos, *Innovation in Byzantine Medicine*, 241–42.

43 On the bottom of the folio there is one more inscription not related to the contents of the diagram, which provides biographical details about two ancient Greek physicians: Andromachus the Elder (first century CE) and Galen. It reads as follows: Ἴσθι ὅτι ὁ Ἀνδρόμαχος ὁ συνθεὶς τὴν θηριακὴν, ἦν ἀρχιτρὸς τοῦ Νέρωνος; Ὁ δὲ Γαληνός, ἦν ἀρχιτρὸς ἐν ταῖς (ἡμέραις) Αὐρηλιανοῦ τοῦ Ἀντωνίνου (Know that Andromachus, who composed the theriac, was Nero's archiater. Galen was archiater during the reign of [Marcus] Aurelius Antoninus). For Andromachus and theriac in Arabic manuscripts, see M. MacMurdie, "Proven Recipes," below.

44 On humoral theory and its reception in the Middle Ages, see V. Nutton, "Humoralism," in *Companion Encyclopedia of the History of Medicine*, ed. W. F. Bynum and R. Porter (London, 1993), 281–91; and J. Jouanna, "La postérité du traité hippocratique de la *Nature de l'homme*: La théorie des quatre humeurs," in *Ärzte und ihre Interpreten: Medizinische Fachtexte der Antike als Forschungsgegenstand der klassischen Philologie. Fachkonferenz zu Ehren von Diethard Nickel*, ed. C. W. Müller, C. Brockmann, and C. W. Brunschön (Munich, 2006), 117–41.

and was marked by the hot and moist quality, and so on. The diagram can be seen as having an introductory emblematic character given the central importance of humoral knowledge in contemporary medical practice, thus inviting the reader of the codex to appreciate its medical content from the very beginning.

Diagrams 11.5, 11.6, and 11.7 (fol. 11r), together with some more examples on urinary colors, cover an entire folio and, with Diagram 11.8, precede John's *On Urines*, which begins on fol. 12r. The diagrams aim to give the reader a clear idea about key terms for basic urinary characteristics and their various categories. In particular, Diagram 11.5 emphasizes the two most important elements in an examination: the urinary liquid and the various kinds of particles.<sup>45</sup> Further subdivisions clarify what is important in the examination process in each case: the various states of consistency and the colors in the case of the urinary liquid, as well as the place in the urine vial in the case of the particles—"clouds" (upper area), "suspension" (intermediate area), and "sediment" (lower area). These subdivisions could be seen as an introduction to the topic for the reader, who can also consult them while reading John's work to refresh his or her memory about fundamental uroscopic concepts.<sup>46</sup> Diagram 11.6 goes a step further, providing a systematization of the urinary colors. John's account of the topic is four printed pages long,<sup>47</sup> whereas the diagrams contain just thirty-one words in total. However, some of the subdivisions, as in the case of green (Diagram 11.7), clearly come from Theophilus's *On Urines*, not John's uroscopic work. Theophilus's treatise was one of the most popular texts on the subject, but it is not copied in this codex.<sup>48</sup> Diagram 11.9

(fol. 101r), which deals with the various kinds of oily urines, is found at the end of book five of the seven in John's work, set in the center of the folio. Again, the source is clearly Theophilus's account. These diagrams were probably copied in order to be used by the reader in conjunction with the corresponding parts of John's work. They both give a synoptic view of Theophilus's theories, obviating the need to include the complete text in the codex. Nevertheless, this might cause confusion to any reader who was not familiar with both works or was unaware of the aforementioned connection.

The function of Diagram 11.10 (fol. 128v), which precedes John's *On Psychic Pneuma* beginning on fol. 130r, can be assumed to be similar. The diagram refers to just three pneumata, in contrast to the four discussed in John's work. The theory of the three pneumata (psychic, vital, and natural) had been established as the main dogma in Greek medical literature by the end of the seventh century.<sup>49</sup> John's addition of a fourth pneuma, in the stomach, allows him to ascribe two qualities to each pneuma and directly connect the production and distribution of pneuma with bodily mixtures.<sup>50</sup> The diagram seems to have been inserted to give the reader an introduction to the most prevalent theory on the subject so he or she could then appreciate John's development and his introduction of the fourth pneuma.

Unlike the examples mentioned above, Diagrams 11.11 and 11.12 correspond closely with John's relevant theories and appear as paratextual elements in the margins of the related parts of his work.<sup>51</sup> The first diagram emphasizes once

45 An interesting example of branch diagrams on urinary colors is also found in BnF, ms. gr. 2307, fol. 598v (sixteenth century), right after the Greek uroscopic text ascribed to Ibn Sīnā (fols. 593r–598v).

46 There must also have been some women doctors, because the term *ἰατρῆσσα*, meaning a female physician, is sometimes found in the Byzantine sources. For a preliminary list, see H. N. Parker, "Women Doctors in Greece, Rome, and the Byzantine Empire," in *Women Healers and Physicians: Climbing a Long Hill*, ed. L. R. Furst (Lexington, KY, 1997), 131–50, at 144.

47 John Zacharias Aktouarios, *On Urines*, 1.8, ed. Ideler, 2:11.33–15.28.

48 The treatise is quite short, consists of twenty-six chapters, and has been edited by Ideler, 1:261–83. On Theophilus's

and John's accounts of urinary colors, see Bouras-Vallianatos, *Innovation in Byzantine Medicine*, 59–62, 219–224.

49 On tripartite pneumatology, see J. Rocca, "From Doubt to Certainty: Aspects of the Conceptualisation and Interpretation of Galen's Natural Pneuma," in *Blood, Sweat and Tears: The Changing Concepts of Physiology from Antiquity into Early Modern Europe*, ed. M. Horstmannshoff, H. King, and C. Zittel (Leiden, 2012), 629–59.

50 Bouras-Vallianatos, *Innovation in Byzantine Medicine*, 177–204.

51 "Paratext" was first coined by Gérard Genette to refer to the material surrounding a printed text, including titles, prefaces, introductions, and footnotes; Genette, *Paratexts: Thresholds of Interpretation*, trans. J. E. Lewin (Cambridge, 1997), 2; originally published as *Seuils* (Paris, 1987). Genette's literary interpretation has more recently been applied to the study of manuscripts. See C. E. Cooper, "What Is a Medieval Paratext?," *Marginalia*,

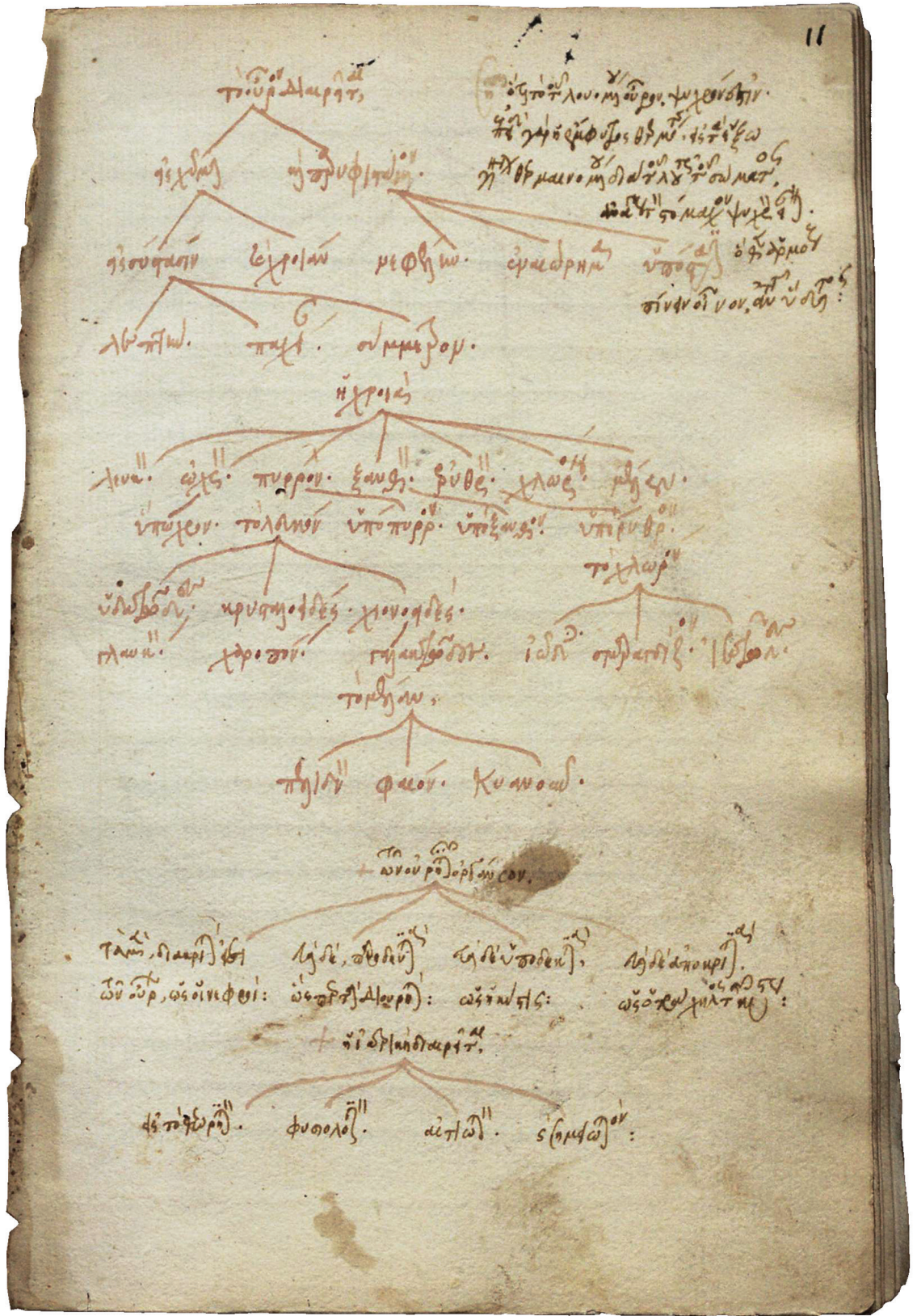
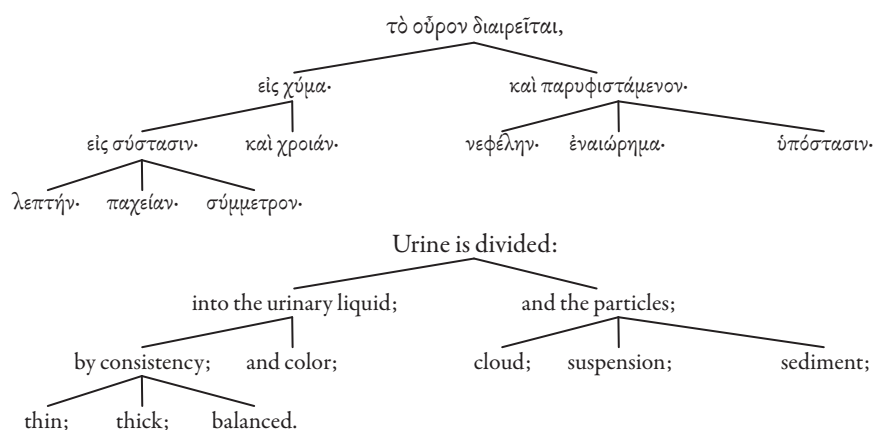


FIG. II.4. Branch diagrams on urines, 1432. San Lorenzo de El Escorial, Real Biblioteca del Monasterio, Φ.III.12, fol. 11r. Photo courtesy of the Real Biblioteca del Monasterio de El Escorial

**DIAGRAM II.5**

Scorialensis Φ.III.12, fol. 11r

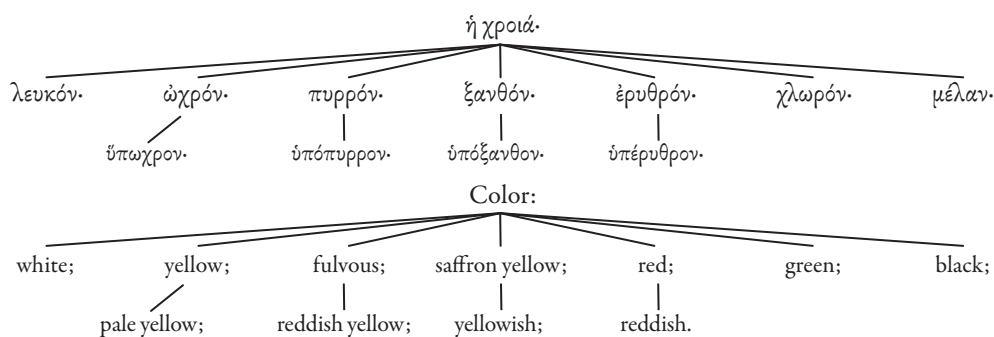
Fig. 11.4



**DIAGRAM II.6**

Scorialensis Φ.III.12, fol. 11r

Fig. 11.4



**DIAGRAM II.7**

Scorialensis Φ.III.12, fol. 11r

Fig. 11.4



Theophilus, *On Urines*, 6.14, ed. Ideler, 1:267.21–24:

Τὸ δὲ χλωρόν, ὡς πράσινον κραιμβίζον, καὶ ὡσεὶ χλοή· πλάτος δὲ ἐν αὐτῷ θεωρεῖται· τὸ γὰρ ἰώδες καὶ τὸ σμαραγδίζον καὶ τὸ ἰσατώδες. [...]

Green urine, resembling the color of green cabbage, and like the color of grass. There is a spectrum in this kind of color. For the greenish, the emerald green, and the turquoise [...].

John Zacharias Aktouarios, *On Urines*, 1.8.26, ed. Ideler, 2:14.23–24:

Τῶν τοίνυν χλωρῶν χρωμάτων τὰ μὲν κραιμβίζοντά εἰσι, τὰ δ' αὐτὸ χλοάζοντα, ἰώδη τε καὶ σμαραγδίζοντα.

Among the various kinds of green color, some have the color of green cabbage, and others the color of grass, the greenish and the emerald green.

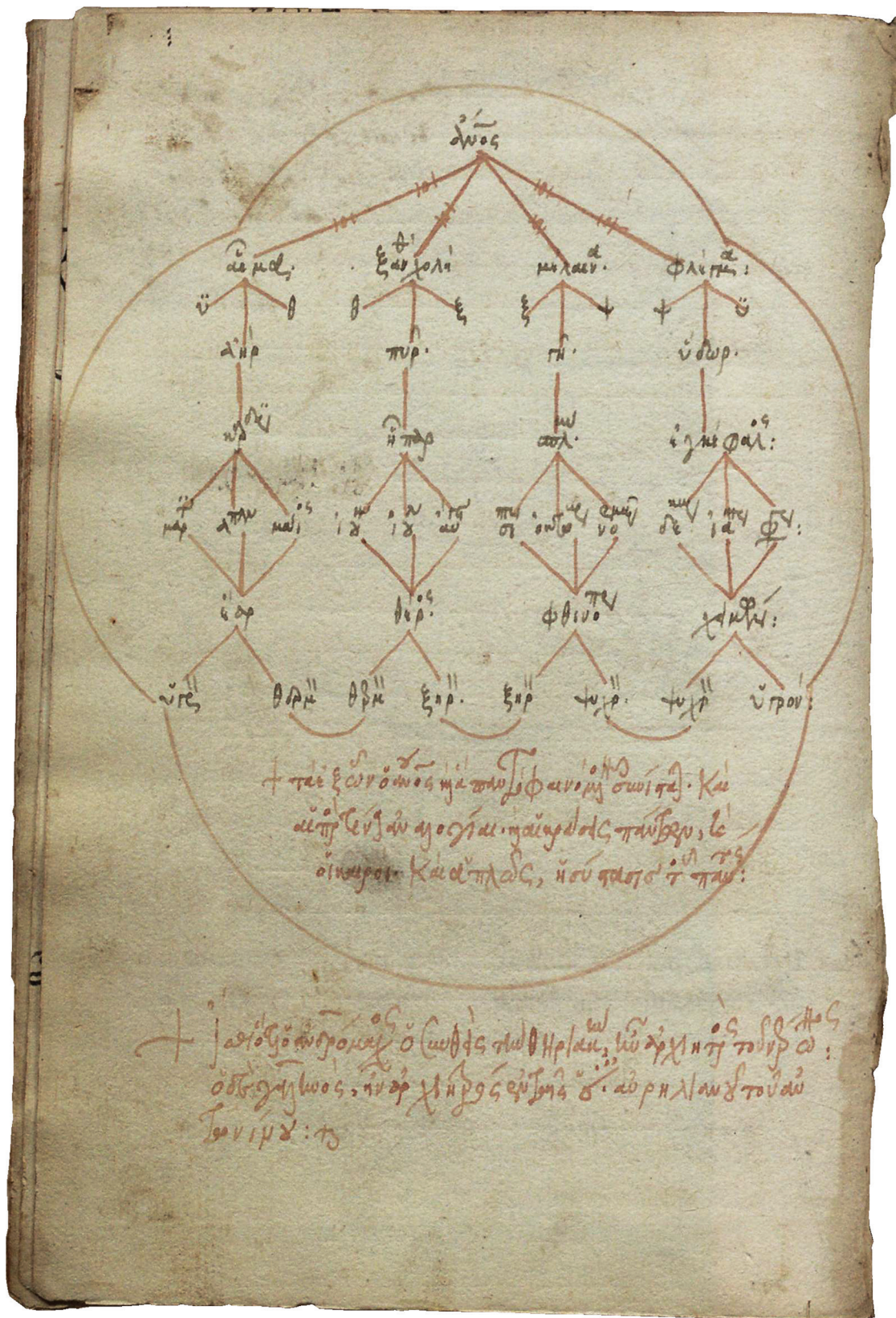
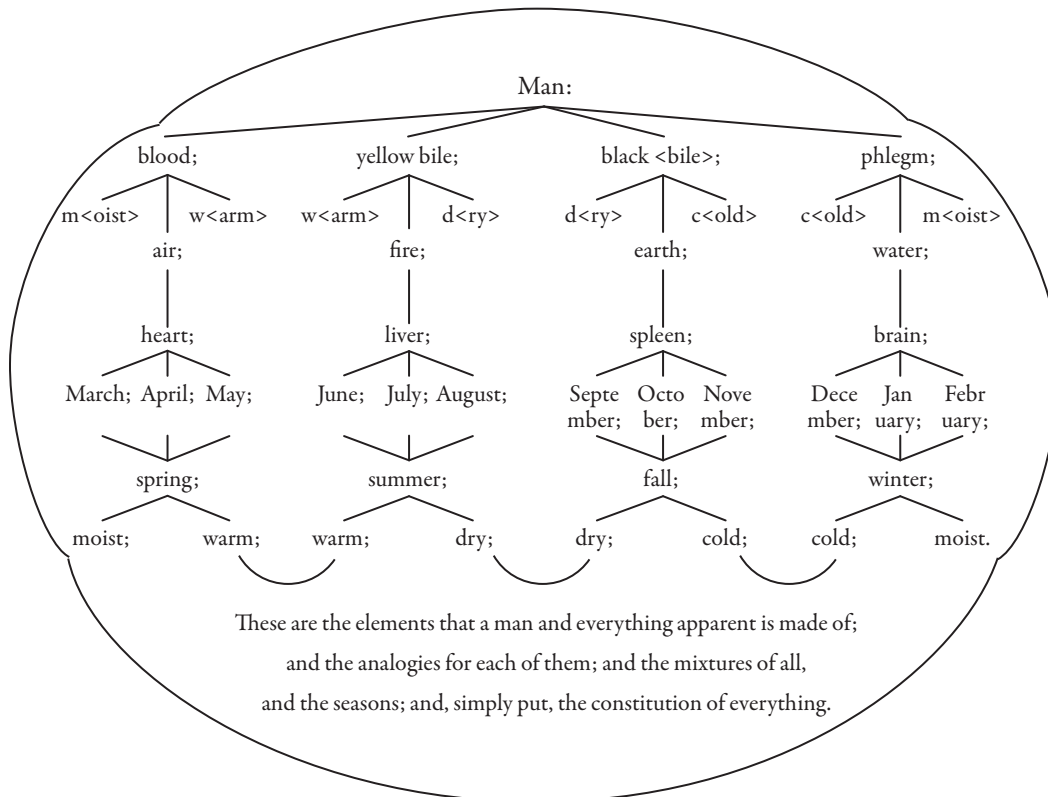
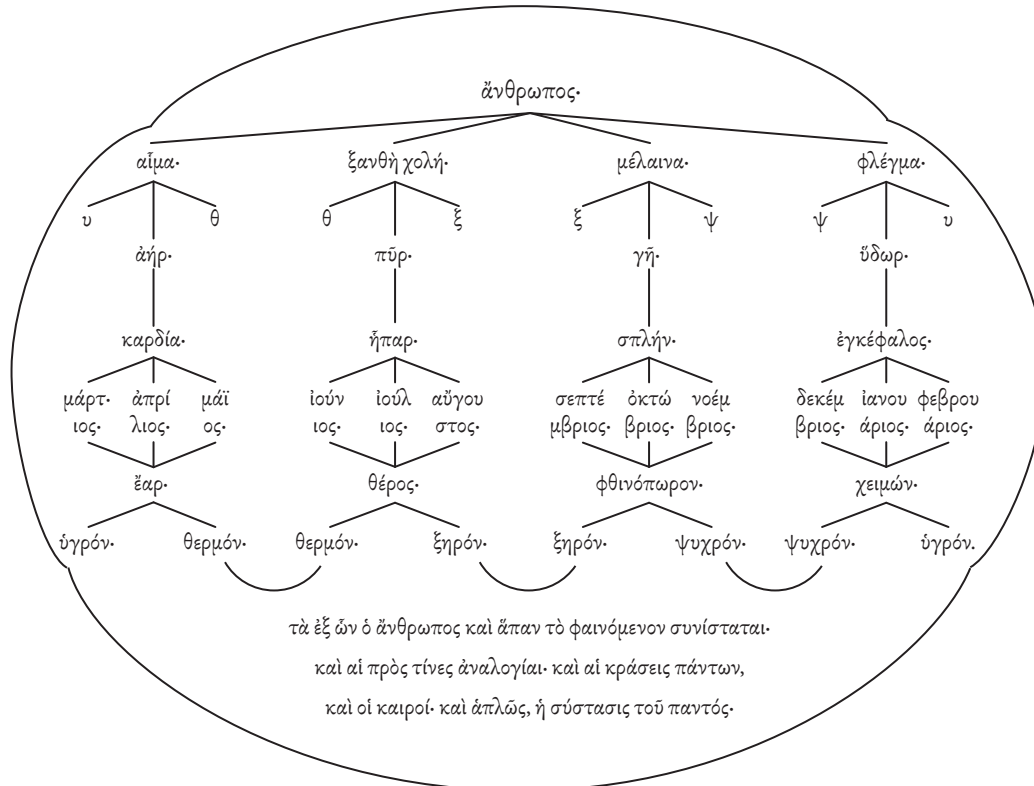


FIG. 11.5. Branch diagrams on the constitution of man, 1432. San Lorenzo de El Escorial, Real Biblioteca del Monasterio, Φ.III.12, fol. 11v. Photo courtesy of the Real Biblioteca del Monasterio de El Escorial

DIAGRAM II.8  
Scorialensis Φ.III.12, fol. 11v  
Fig. 11.5



αὐτὴ παλιντοῦ τ' ἀποθεσιν· ἰν' αὐτῇ καὶ ἡσυχία αἰσθητικῆς  
 κινδυνολογία· ἡσυχία· καὶ ἰσχυρὸν πνεῦμα φαρμακευτικόν  
 ὁφθαλμικὸν φάρμακον, πρὸς τὴν μὲν ἄκαθαρτον ἰσχυρὴν  
 ἡσυχίαν· πρὸς δὲ τοῖς ἐν τυχάνουσι αἰσθητικῶν, μετρίως φρο  
 νημιῶν· αἰσθητικῶν δὲ αἰσθητικῶν, ἀνησυχία αἰσθητικῆς· ἡσυχία  
 τέλος, τὸ περιούριον τοῦ σοφοῦ ἀποθεσιν αἰσθητικῆς·

ἡσυχία  
 ἡσυχία  
 ἡσυχία

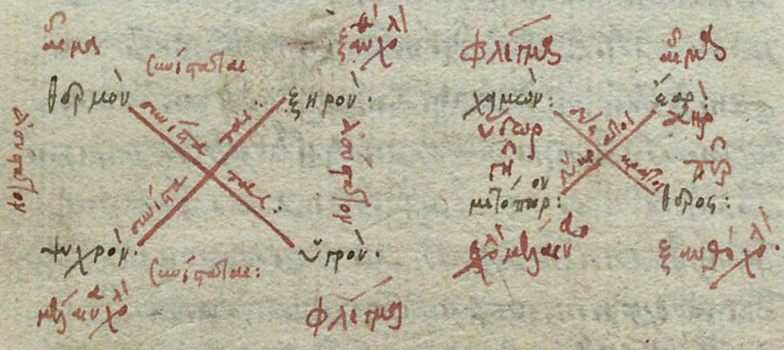
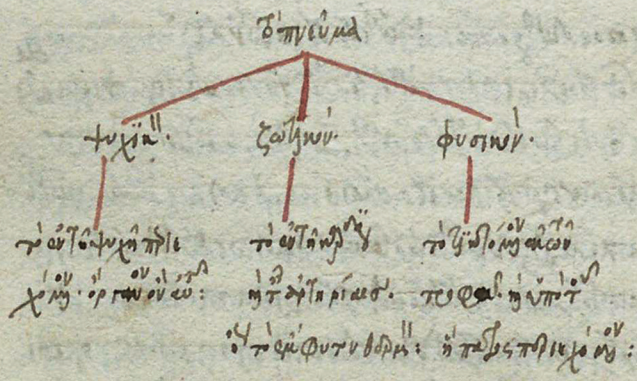
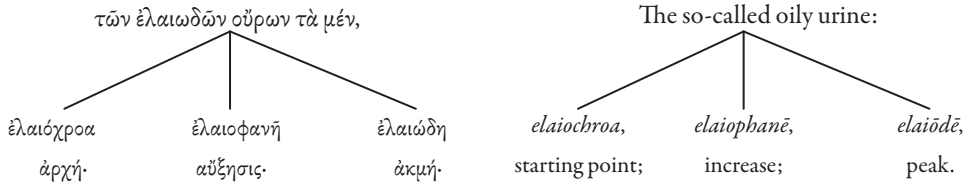


FIG. II.6. Branch diagrams on the various kinds of pneumata and on humors and primary qualities, 1432. San Lorenzo de El Escorial, Real Biblioteca del Monasterio, Φ.III.12, fol. 128v. Photo courtesy of the Real Biblioteca del Monasterio de El Escorial



**DIAGRAM II.9**  
Scorialensis Φ.III.12, fol. 101v



Theophilus, *On Urines*, 17.6, ed. Ideler, 1:279.16–18:

Τῆς ἀρχῆς μὲν τῶν ἐλαιωδῶν οὕρων, τὰ ἐλαιόχροα· τῆς δὲ αὐξήσεως, τὰ ἐλαιοφανῆ· τῆς δὲ ἀκμῆς, τὰ ἐλαιώδη.

The *elaiochroa* correspond to the starting point of oily urines; the *elaiophanē* to the increase; and the *elaiōdē* to the peak.

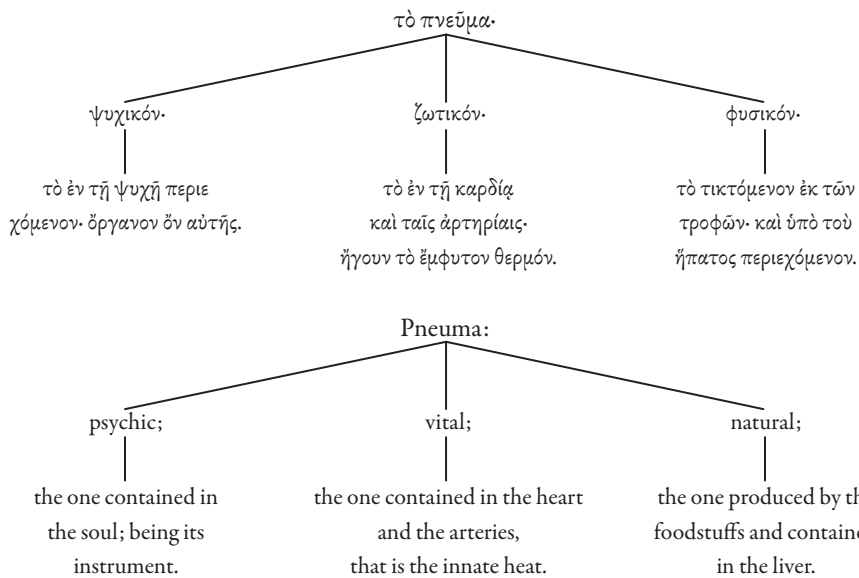
John Zacharias Aktouarios, *On Urines*, 1.8.27, ed. Ideler, 2:14.26–28:

Ἀλλὰ δὴ καὶ τῶν ἐλαιωδῶν οὕτω κοινῶ τῷ γένει καλουμένων οὕρων τὰ μὲν ἐλαιοφανῆ, τὰ δὲ ἐλαιόχροα, τὰ δ' ἐλαιώδη [...].

And the so-called category of oily urines consists of *elaiophanē*, *elaiochroa*, and *elaiōdē* [...].

**DIAGRAM II.10**  
Scorialensis Φ.III.12, fol. 128v

Fig. 11.6



**KINDS OF PNEUMATA ACCORDING TO JOHN ZACHARIAS AKTOUARIOS'S THEORY<sup>1</sup>**

PNEUMA	PLACE OF ORIGIN	QUALITIES
Unnamed ("gastric") pneuma	Stomach	Cold and moist
Natural pneuma	Liver	Warm and moist
Vital pneuma	Heart	Warm and dry
Psychic pneuma	Brain	Cold and dry

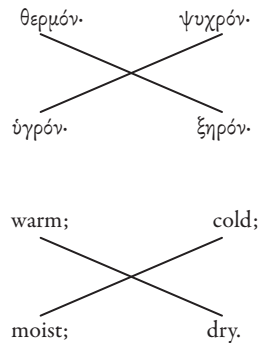
<sup>1</sup> See Bouras-Vallianatos, *Innovation in Byzantine Medicine*, 190.



DIAGRAM II.II

Scorialensis Φ.III.12, fol. 176r

Fig. II.7



John Zacharias Aktouarios, *Medical Epitome*, 1.2, ed. Ideler, 2:355.29–30:

λέγεται θερμὰ τυγχάνειν ἢ ψυχρὰ καὶ ξηρὰ καὶ υγρὰ, ὡς τὴν καθ' ἣν φαίνεται ταῦτα ποιότητα [...]

they are said to be either warm or cold or dry or moist, as is apparent according to their quality [...]

more the paramount role of the four primary qualities.<sup>52</sup> Diagram II.12 is related to John's statements on the place of the various capacities of the soul in the ventricles of the brain and is found in the margin next to the corresponding paragraph in the text.<sup>53</sup> Apart from those related to qualities, diagrams are very rare in John's works, and there is no evidence to suggest that they were introduced by him, unlike his urinal diagram discussed below (section "Spatial Diagrams: Diagrams of Medical Equipment"),

*the Journal of the Medieval Reading Group at the University of Cambridge* 19 (2015): 37–50. On paratexts in Greek manuscripts with a particular focus on colophons and annotations, see V. Lorusso, "Locating Greek Manuscripts through Paratexts: Examples from the Library of Cardinal Bessarion and Other Manuscript Collections," in *Tracing Manuscripts in Time and Space through Paratexts*, ed. G. Ciotti and H. Lin (Berlin, 2016), 223–68.

52 There are two similar diagrams in the margins on fols. 31v (*On Urines*) and 177v (*Medical Epitome*) and two more in the lower part of fol. 128v (Fig. II.6), immediately after the end of John's treatise *On Urines*. These diagrams resemble those in the margins of Galen's *On Mixtures* in BAV, gr. 282 (fols. 16v and 21v, fifteenth century).

53 On the development of the concept of ventricular localization, see T. Manzoni, "The Cerebral Ventricles, the Animal Spirits and the Dawn of Brain Localization of Function," *Archives italiennes de biologie* 136.2 (1998): 103–52.

which is certainly anthumous and complements the understanding of his corresponding theory. Diagrams II.11 and II.12 are not essential for understanding the text, and the main point is to give a synoptic visual representation, as with the *Tabulae*. They are intended to help the reader of the codex better understand and recall crucial information.

One further, final example is related to the teaching of medicine in Constantinople some years before the fall of the city in 1453. In particular, John Argyropoulos (ca. 1393/4 or ca. 1415–1487) is known to have taught a circle of students at the *Kral xenōn*, attached to the monastery of St. John the Baptist at Petra, from about 1444 to 1453.<sup>54</sup> We do not have enough information to reconstruct the medical curriculum, but surviving evidence suggests a notable intellectual engagement with Galen's *Art of Medicine*. In particular, in the five manuscripts of this Galenic work that may be associated with the circle of Argyropoulos—Marc., gr. V.9, fol. 178v; Moscow,

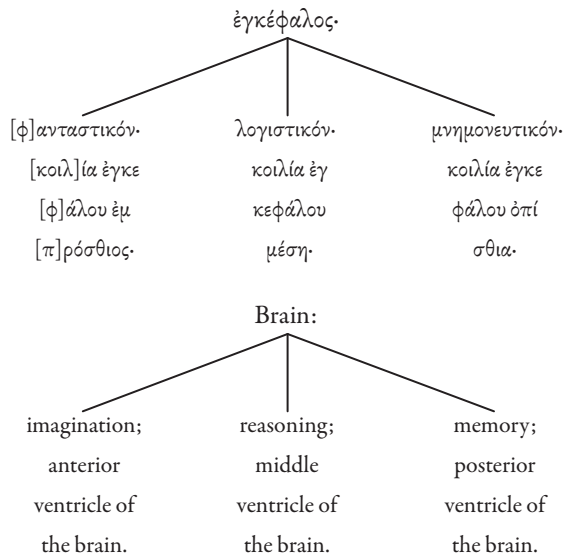
54 B. Mondrain, "Jean Argyropoulos professeur à Constantinople et ses auditeurs médecins, d'Andronic Éparque à Démétrios Angelos," in *Πολυπλευρος νους: Miscellanea für Peter Schreiner zu seinem 60. Geburtstag*, ed. C. Scholz und G. Makris (Munich, 2000), 223–50.



DIAGRAM II.12

Scorialensis Φ.III.12, fol. 194v

Fig. 11.8



John Zacharias Aktouarios, *Medical Epitome*, 1.35, ed. Ideler, 2:389.11–16:

ὡς μνήμης μὲν ἀπώλεια, τῆς ὀπισθοῦ κοιλίας πεπονθυίας τοῦ ἐγκεφάλου ἔπεται, ἥτοι ποιᾷς τινος δυσκρασίας, ἢ τινος χυμοῦ ἐκεῖ που συρρυνέντος [...] φαντασίας δέ, τῆς ἔμπροσθεν τοῦ ἐγκεφάλου κοιλίας, ὡσπερ καὶ τῆς μεταξὺ αὐτοῦ κοιλίας πεπονθυίας, τὸ λογιστικὸν μάλιστα σφάλλεται.

that the loss of memory comes about when the posterior ventricle of the brain has been affected, either due to some sort of harmful mixture or some accumulated humor somewhere there [...] whereas [the loss] of imagination [comes about] when the anterior ventricle of the brain [has been affected], just as when the ventricle in between has been affected, reasoning fails altogether.

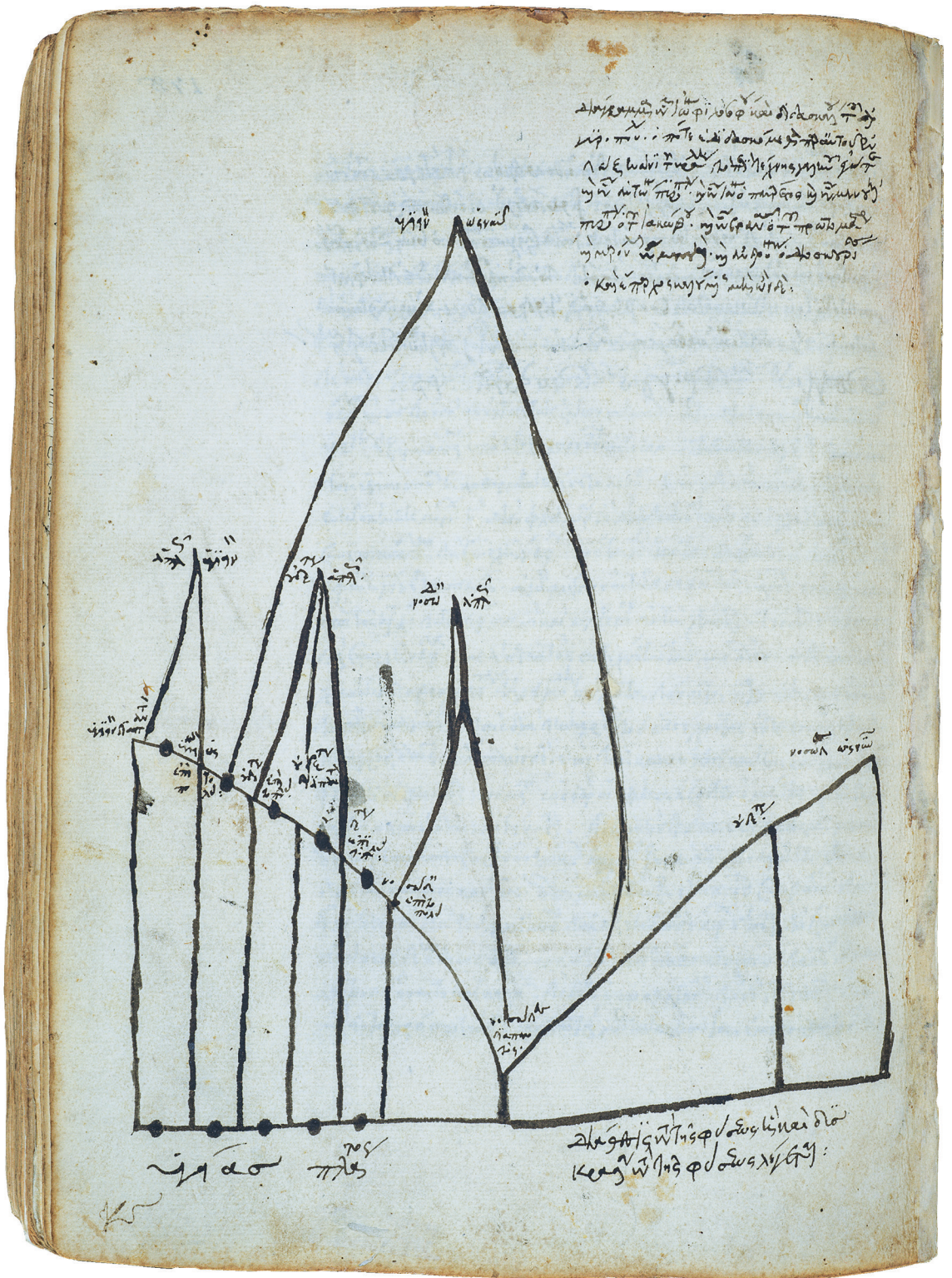
State Historical Museum, Sinod. gr. 283, fol. 175v; BnF, ms. gr. 2271, fol. 73v; Thessaloniki, Vlatadon Monastery, Cod. 14, fol. 147v; and BAV, gr. 285, fol. 80r—we can see a complicated diagram representing the notion of the “range [lit. latitude] of health” (ὕγιαιος πλάτος) in the *Art of Medicine*.<sup>55</sup> In the Venice and Moscow manuscripts (Figs. 11.9–10), there is an inscription explicitly linking the diagram with John Argyropoulos and his teaching and also reporting the names of various students attending his lectures, including Anthony Pyropoulos, Manuel Pyropoulos, Demetrios

55 Galen, *Art of Medicine*, 4, ed. Kühn, 1:316–17 = Boudon-Millot, *Exhortation à l'étude*, 284–85. On the diagram in connection with the text, with a particular focus on the Vlatadon diagram, see A. Pietrobelli, “Variation autour du *Thessalonicensis Vlatadon* 14: Un manuscrit copié au *Xénon* du Kral, peu avant la chute de Constantinople,” *REB* 68 (2010): 95–126, at 101–12.

Angelos, John Panaretos, Constantine Laskaris, and Andronikos Eparchos.<sup>56</sup>

Diagram 11.13, from Vlatadon Monastery Cod. 14 (Fig. 11.11) covers an entire folio (147v) between Galen’s *On Crises* and the *Commentary*

56 V. Boudon-Millot, “Un nouveau témoin pour l’histoire du texte de l’*Ars medica* de Galien: le *Vlatadon* 14,” in *L’Ars medica (Tegni) de Galien: Lectures antiques et médiévales*, ed. N. Palmieri (Saint-Étienne, 2008), 11–30, at 23–24. See also A. M. Ieraci Bio, “Giovanni Argiropulo e la medicina, tra l’Italia e Costantinopoli,” in *Vie per Bisanzio: VII Congresso nazionale dell’Associazione Italiana di Studi Bizantini, Venezia, 25–28 novembre 2009*, ed. A. Rigo, A. Babuin, and M. Trizio (Bari, 2013), 785–801, at 795–98, with references to the earliest studies on this. For example, Marc., Gr. V.9, fol. 178r, reads: διάγραμμα κυροῦ Ἰωάννου φιλοσόφου καὶ διδασκάλου τοῦ Ἀργυροπούλου, ὅποτε ἐδιδασκόμεθα παρ’ αὐτοῦ ἐν τῷ ξενῶνι τοῦ Κράλη τοῦ περὶ τέχνης Γαληνοῦ (Diagram by the philosopher and teacher *kyr* John Argyropoulos, at the time when we were taught by him Galen’s *Art of Medicine* at the Kral *xenōn*).



**FIG. II.9.** Diagram connected with John Argyropoulos's teaching of Galen's *Art of Medicine*, fifteenth century. Marc., gr. V.9, fol. 178v. Photo courtesy of the Ministero per i beni e le attività culturali e per il turismo, Biblioteca nazionale Marciana, Venice

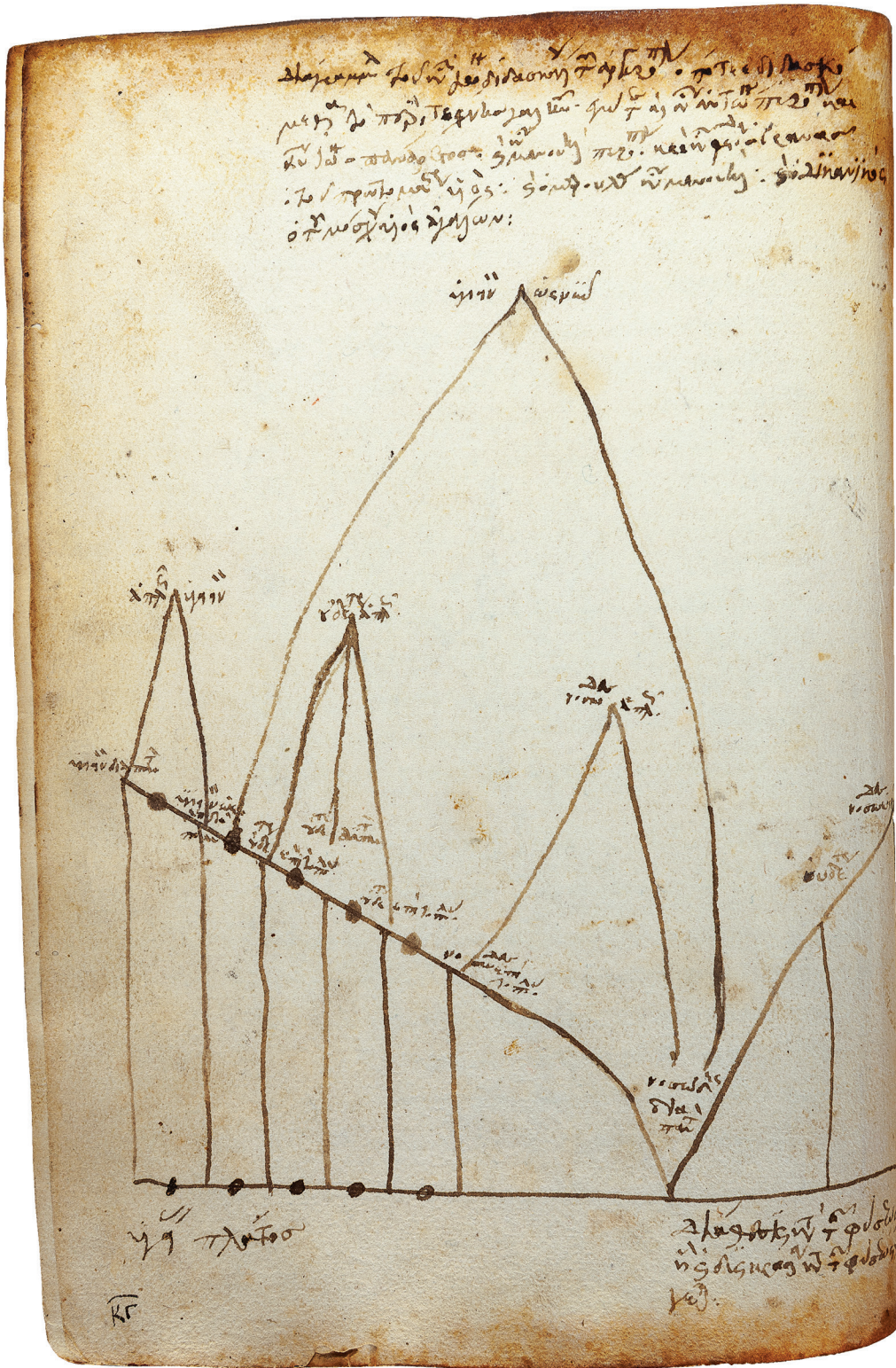
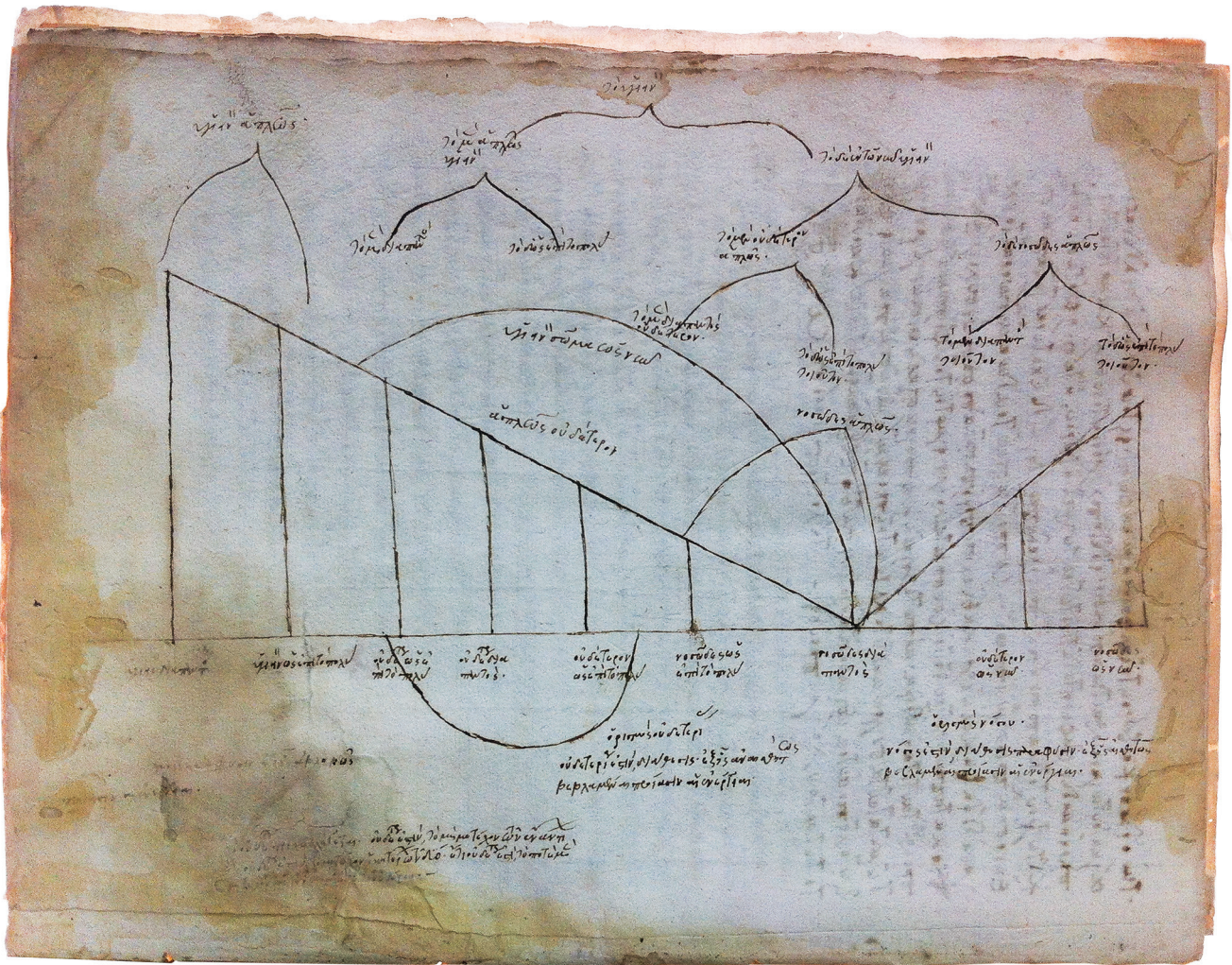


FIG. II.10. Diagram connected with John Argyropoulos's teaching of Galen's *Art of Medicine*, fifteenth century. Moscow, State Historical Museum, Sinod. gr. 283, fol. 175v. Photo courtesy of the State Historical Museum, Moscow



**FIG. II.II.** Diagram connected with John Argyropoulos's teaching of Galen's *Art of Medicine*, fifteenth century. Vlatadon Monastery, Cod. 14, fol. 147v. Photo by Petros Bouras-Vallianatos, courtesy of Bishop Nikephoros of Amorium, Abbot of the Holy Patriarchal and Stavropegic Monastery of Vlatadon in Thessaloniki, Greece

**TEXTUAL SOURCE OF DIAGRAM II.13**

John Argyropoulos, *Solution to Some Questions and Inquiries Requested by One of the Cypriot Philosophers-cum-Physicians*, 10, ed. S. P. Lampros, Ἀργυροπούλεια (Athens, 1910), 168–69:

τρεις εἰσιν αἱ φύσεις τοῦ ἀνθρωπέου σώματος, αἱ καὶ διαθέσεις φυσικαὶ τοῦ αὐτοῦ κέκληνται, ὑγεία, νόσος καὶ οὐδέτερα διαθέσεις, καθ' ἃς τὸ ἀνθρώπειον σῶμα ὑγιεινόν, νοσερόν καὶ οὐδέτερόν ἐστι [...] τέμνεται γὰρ τὸ τῆς ὑγείας πλάτος εἰς τὴν ἀπλῶς ὑγείαν καὶ εἰς τὴν ἐν τῷ νῦν. καὶ ἡ μὲν ἀπλῶς εἰς τὴν ἑσαί τε καὶ τὴν ὡς ἐπὶ τὸ πολὺ, ἡ δὲ ἐν τῷ νῦν εἰς τὴν οὐδέτεραν διάθεσιν, τὴν ἑσαί τε καὶ ὡς ἐπὶ τὸ πολὺ, καὶ εἰς τὴν νόσον ἀπλῶς, ἡ δὲ καὶ αὐτὴ ὡς ἐπὶ τὸ πολὺ τέ ἐστι καὶ διὰ παντός [...].

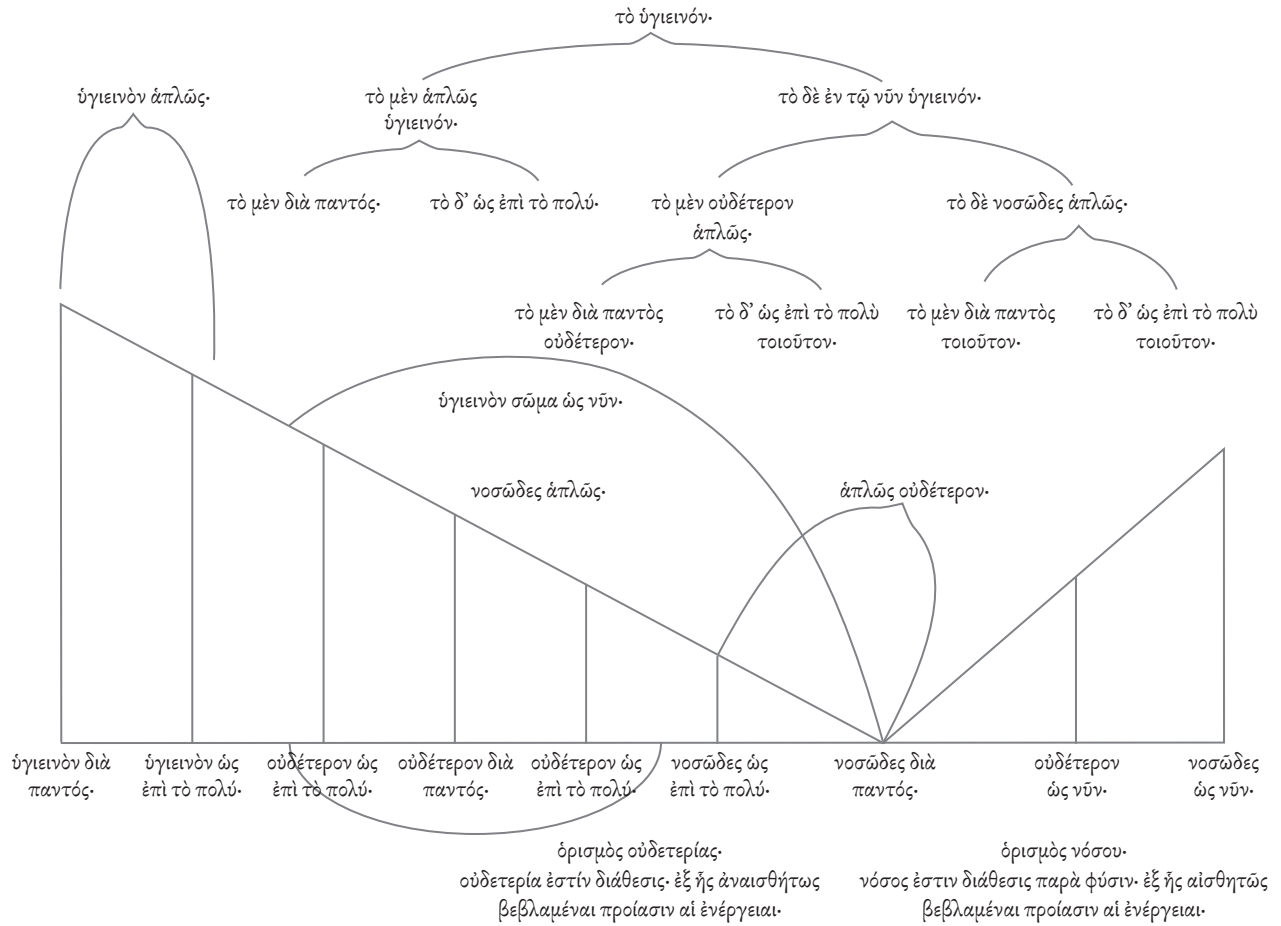
The natures of the human body are three, which are also called its natural dispositions, i.e., health, disease, and neutral disposition, according to which the human body is healthy, diseased, and neutral [...] for the “range of health” is divided into “absolute health” and “health at the present moment.” The “absolute health” is divided into “always” and “for the most part,” while the “health at the present moment” is divided into “neutral disposition,” which can be “always” and “for the most part,” and the “absolutely diseased,” which can also be “for the most part” and “always.”



DIAGRAM II.13

Thessaloniki, Vlatadon Monastery, cod. 14, fol. 147v

Fig. II.11



TRANSLATION OF TERMS AND PHRASES IN DIAGRAM II.13

τὸ ὑγιεινόν·	healthy	ὑγιεινὸν διὰ παντός·	always healthy
τὸ μὲν ἀπλῶς ὑγιεινόν·	absolutely healthy	ὑγιεινὸν ὡς ἐπὶ τὸ πολὺ·	healthy for the most part
τὸ μὲν διὰ παντός·	always [healthy]	οὐδέτερον ὡς ἐπὶ τὸ πολὺ·	neutral for the most part
τὸ δ' ὡς ἐπὶ τὸ πολὺ·	[healthy] for the most part	οὐδέτερον διὰ παντός·	always neutral
τὸ δὲ ἐν τῷ νῦν ὑγιεινόν·	healthy at the present moment	νοσῶδες ὡς ἐπὶ τὸ πολὺ·	diseased for the most part
τὸ μὲν οὐδέτερον ἀπλῶς·	absolutely neutral	νοσῶδες διὰ παντός·	always diseased
τὸ μὲν διὰ παντός οὐδέτερον·	always neutral	οὐδέτερον ὡς νῦν·	neutral at the present moment
τὸ δ' ὡς ἐπὶ τὸ πολὺ τοιοῦτον·	[neutral] for the most part	νοσῶδες ὡς νῦν·	diseased at the present moment
τὸ δὲ νοσῶδες ἀπλῶς·	absolutely diseased	ὄρισμός οὐδετερίας·	definition of neutrality: neutrality is the disposition from which the functions become imperceptibly damaged.
τὸ μὲν διὰ παντός τοιοῦτον·	always [diseased]	οὐδετερία ἐστὶν διάθεσις· ἐξ ἧς ἀναισθητῶς βεβλαμμένα προίασιν αἱ ἐνέργειαι·	
τὸ δ' ὡς ἐπὶ τὸ πολὺ τοιοῦτον·	[diseased] for the most part	ὄρισμός νόσου·	definition of disease: disease is an unnatural disposition from which the functions become perceptibly damaged.
ὑγιεινὸν ἀπλῶς·	absolutely healthy	νόσος ἐστὶν διάθεσις παρὰ φύσιν· ἐξ ἧς αἰσθητῶς βεβλαμμένα προίασιν αἱ ἐνέργειαι·	
ὑγιεινὸν σῶμα ὡς νῦν·	healthy body at the present moment		
ἀπλῶς οὐδέτερον·	absolutely neutral		
νοσῶδες ἀπλῶς·	absolutely diseased		

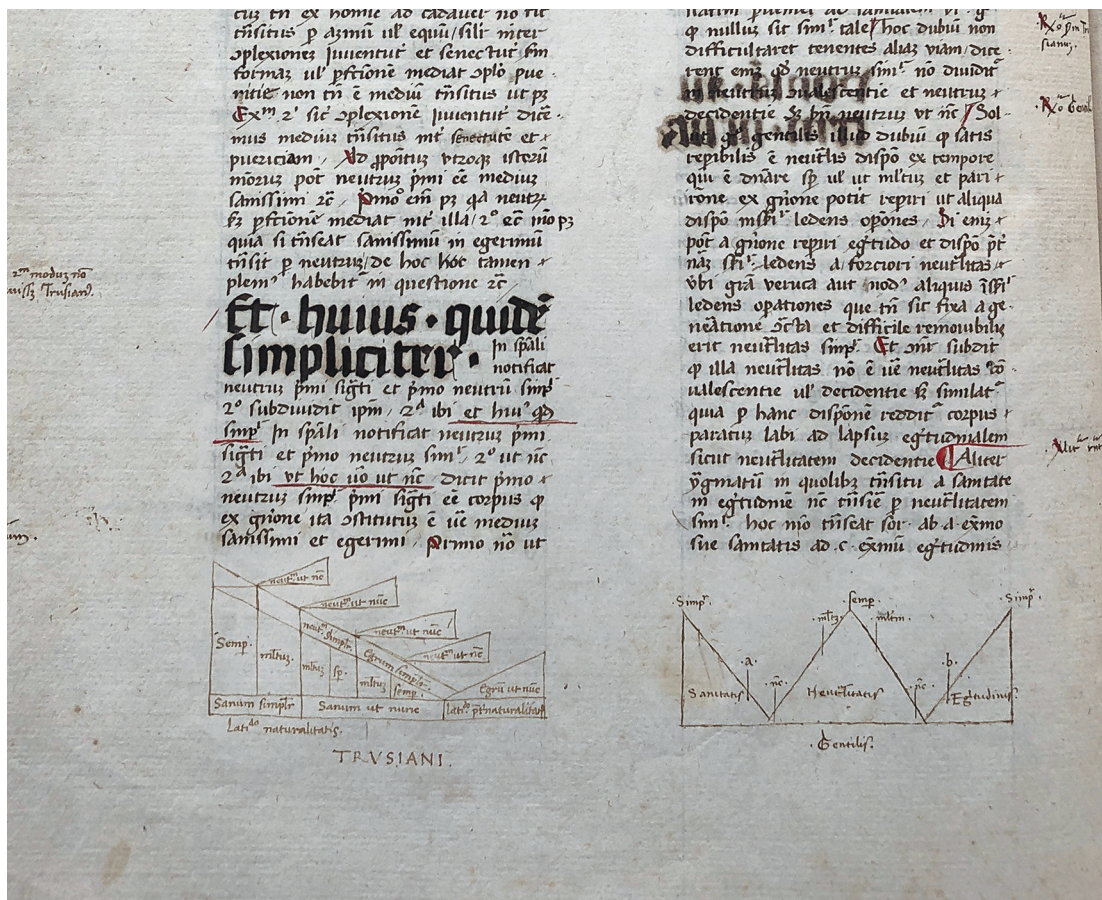


FIG. II.12. Diagram related to Pietro Torrigiano de' Torrigiani's and Gentile da Foligno's interpretations of Galen's *Art of Medicine*, fifteenth century. Bodleian, MS Canon. misc. 446, fol. 6v. Photo by Petros Bouras-Vallianatos, courtesy of the Bodleian Libraries, University of Oxford

on Hippocrates' *Regimen in Acute Diseases*.<sup>57</sup> Compared with the others, this manuscript preserves a more elaborate version, combining some elements of branch diagrams (upper section)

57 For a description of the manuscript and its contents, see Pietrobelli, "Variation autour du *Thessalonicensis Vlatadon 14*," 97–101, 115. Pietrobelli, "Variation autour du *Thessalonicensis Vlatadon 14*," 114, has identified Constantine Laskaris as the scribe of this diagram. This identification has been questioned by D. Speranzi, "Du due codici greci filelfiani e un loro lettore (con alcune osservazioni sullo Strabone Ambr. G 93 sup.)," in *Philelfiana: Nuove prospettive di ricerca sulla figura di Francesco Filelfo. Atti del seminario di studi (Macerata, 6–7 novembre 2013)*, ed. S. Fiaschi (Florence, 2015), 83–117, at 113–14, n. 88. A transcription of the verbal statements in the diagram on the basis of Marc., gr. V.9, BnF, ms. gr. 2271, Vlatadon Monastery Cod. 14, and BAV, gr. 285 is available in V. Boudon-Millot and A. Pietrobelli, "De l'arabe au grec: Un nouveau témoin du texte de Galien (le *Vlatadon 14*)," *CRAI* 149.2 (2005): 497–534, at 505.

and geometrical diagrams (lower section).<sup>58</sup> The diagram first summarizes the main theory with the use of divisions, which corresponds to one of the solutions (no. 10) of Argyropoulos's collection of twelve brief *erotapokriseis*, *Solution to Some Questions and Inquiries Requested by One of the Cypriot Philosophers-cum-Physicians*. Having been given a synoptic form of the theory, the reader is directed to an active discourse on its source through a visualization of the complex connections between states of health and disease using such geometrical shapes as semicircles and trapeziums. There is no surviving precedent for

58 According to Pietrobelli, "Variation autour du *Thessalonicensis Vlatadon 14*," 104, the differences among the diagrams are not due to variations caused by copying from an original model, but rather bear witness to the actual notes taken by different students during the lectures of the same course.

such a diagram in the Greek tradition. Antoine Pietrobelli has shown that the lower section (geometrical diagrams) displays important similarities with the examples presented in the lower margin of the fifteenth-century Oxford, Bodleian Library, MS Canon. misc. 446 (fol. 6v; Fig. 11.12),<sup>59</sup> by Pietro Torrigiano de' Torrigiani (d. 1320) and Gentile da Foligno (d. 1348).<sup>60</sup> The diagram may have been adopted by Argyropoulos during his studies at the University of Padua from 1441 to 1444, in which case it would constitute an extraordinary case of cross-fertilization between Byzantium and the West.

### Spatial Diagrams

#### Geometrical Diagrams

Geometrical diagrams are most common in mathematical treatises.<sup>61</sup> Among the surviving examples in Greek manuscripts, the most notable are those in Galen's *On the Function of the Parts of the Body*, particularly in his account of the visual field. In discussing the path of light through the eyes, he uses diagrams to show the field loss when each eye closes in turn, but leading to the normal binocular field when both eyes are open.<sup>62</sup> At the end, with reference to his account, Galen states, "demonstrations by means of lines" (ταῖς διὰ τῶν γραμμῶν ἀποδείξεις).<sup>63</sup> The term ἀπόδειξις here

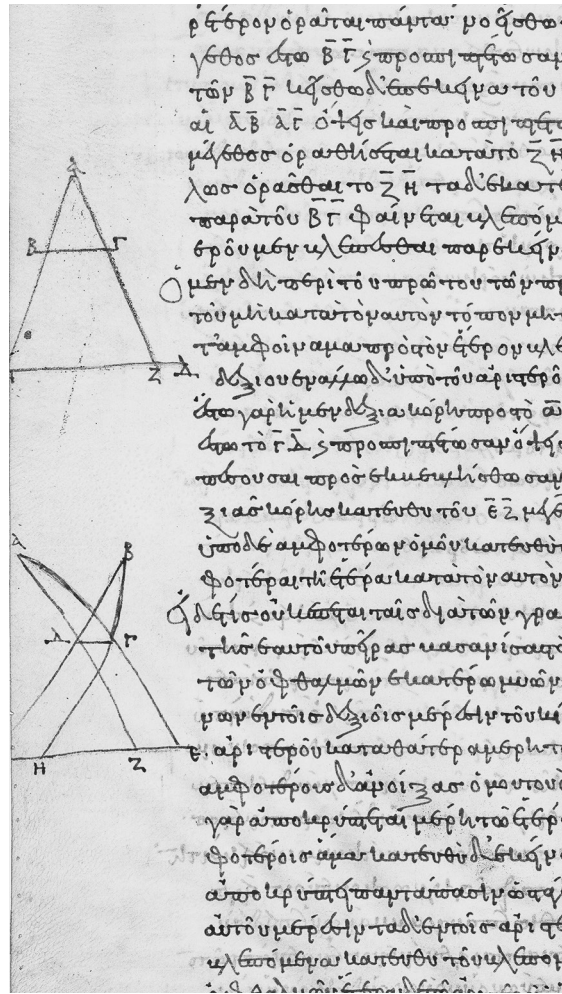


FIG. 11.13. Diagrams of the path of light through the eyes in Galen's *On the Function of the Parts of the Body*, tenth/eleventh century. BAV, Urb. gr. 69, fol. 123v. Photo © Biblioteca Apostolica Vaticana, Vatican City

alludes to its use by Greek mathematicians when referring to the prose portion of a geometrical demonstration.<sup>64</sup> The two earliest surviving manuscripts of the work—BAV, Urb. gr. 69, fol. 123v, tenth/eleventh century (Fig. 11.13); and BnF, ms.

59 H. O. Coxe, *Codices graecos et latinos Canonicianos complectens* (Oxford, 1854), 769.

60 Pietrobelli, "Variation autour du *Thessalonicensis Vlatadon* 14," 108–12. Further evidence of Italian influence on Argyropoulos in light of an unpublished short commentary on the prologue of Galen's *Art of Medicine* in BAV, gr. 285, has been presented by A. M. Ieraci Bio, "Giovanni Argiropulo e un inedito commento anonimo a Galeno (ars. med. 1, 1a–b7) nel Vat. gr. 285," in *Storia della tradizione e edizione dei medici greci: Atti del VI Colloquio internazionale, Paris, 12–14 aprile 2008*, ed. V. Boudon-Millot et al. (Naples, 2010), 271–90. See also eadem, "Giovanni Argiropulo e la medicina," 798–802.

61 C. Roby, "Diagrams, Mathematical," in *The Encyclopedia of Ancient History*, ed. R. S. Bagnall et al., 13 vols. (Malden, MA, 2013), 2068–69.

62 On the Galenic theory of vision in connection with geometrical diagrams, see V. Boudon-Millot, "Illustrer les médecins grecs à la Renaissance: Les schémas d'optique galénique," in *Lire les médecins grecs à la Renaissance: Aux origines de l'édition médicale*, ed. V. Boudon-Millot and G. Cobolet (Paris, 2004), 209–32. Cf. R. E. Siegel, *Galen on Sense Perception . . .* (Basel, 1970), 86–117.

63 Galen, *On the Function of the Parts of the Body*, 10.12, ed. Kühn, 3:820–22 = G. Helmreich, ed., *Galen De usu partium libri XVII*, 2 vols. (Leipzig, 1907–9), 2:98–99. For geometrical

demonstrations in Galen, see G. E. R. Lloyd, "Mathematics as a Model of Method in Galen," in *Philosophy and the Sciences in Antiquity*, ed. R. W. Sharples (Aldershot, UK, 2005), 110–30; and A. Pietrobelli, "Le modèle des démonstrations géométriques dans la médecine de Galien," *BullBudé* 2 (2009): 110–30.

64 P. Catton and C. Montelle, "To Diagram, to Demonstrate: To Do, To See, and To Judge in Greek Geometry," *Philosophia Mathematica* 20.1 (2012): 25–57, at 27.

gr. 2253, fol. 163v, eleventh/twelfth century—have diagrams in the margins of the relevant chapter on the physiology of the eye.<sup>65</sup> They are essential, complementary paratextual elements that help the author-transmitter contextualize his message by use of a visual medium.

### *Diagrams of Medical Equipment*

The most common item of medical equipment shown in diagrammatic form in Greek manuscripts is the vial that was used to examine urine samples. Unlike today, when a urine vial is used as a container to collect and store urine, in medieval times it also constituted an integral component of the examination, because the place of particles in the vial played an important role in the process of diagnosis and prognosis.<sup>66</sup> A fifteenth-century medical miscellany that contains a large number of brief anonymous uroscopic works (Wellcome, MS.MSL.60) provides an example of a regular urine vial (fol. 186r; Fig. 11.14).<sup>67</sup> In the section in question, the manuscript preserves a list of contents of *On Urines*, the long uroscopic work by John Zacharias Aktouarios, which consists of seven books. After the list of contents of the second book, there is a urine vial (ἀμίς) with the traditional division into three areas. Another inscription runs down the two sides of the vial: ὅλον τοῦτο λέγεται χῦμα (all this is called *chyma* [urinary liquid]). The diagram of the vial is followed by the section of John's work that introduces the three main areas of the vial,<sup>68</sup> which in turn is followed by the list of contents of book three. This particular diagram does not appear in any manuscript of John's *On Urines*, in which one usually sees his detailed, uniquely graduated urine vial.

65 According to V. Boudon-Millot, "Illustrer les médecins," 221, the most correct version of these diagrams is that in the Vatican manuscript. The diagrams also appear in the twelfth- or thirteenth-century Cambridge, Gonville and Caius College, MS 47, fols. 40r–v.

66 On medieval uroscopy, see L. Moulinier-Brogé, *L'uroscopie au Moyen Âge: "Lire dans un verre la nature de l'homme"* (Paris, 2012).

67 P. Bouras-Vallianatos, "Greek Manuscripts at the Wellcome Library in London: A Descriptive Catalogue," *Medical History* 59.2 (2015): 275–326, at 292–302.

68 John Zacharias Aktouarios, *On Urines*, 1.12.10, ed. Ideler, 2:19.21–34.

John subdivides the three main areas of the vial into eleven subareas. Particles found in subareas 2 to 4 are considered sediments, the space between subareas 6 and 8 is connected with suspended particles, while clouds may be located in subareas 10, 11, or 1. Subareas 5 and 9 are theoretical spaces between the three kinds of particles. John clarifies that the normal place for sediment and suspended particles is in the third and seventh subareas respectively. For each of them there are two additional places (subareas 2 and 4, and 6 and 8, respectively) for those sediments and suspended parts that have settled down or remain elevated. In the case of clouds, the symmetrical ones are found in subarea 11, those that have settled are in subarea 10, whereas those that are super-elevated are in subarea 1.<sup>69</sup> This new theory has a particular role in the field of prognosis, especially in the theory of the analogies between the parts of the urine vial and those of the human body. For example, various kinds of clouds are connected with diseases of the head, those in the middle of the vial are related to diseases of the general gastrointestinal area, and so on.<sup>70</sup> The theory seems to have been introduced into Byzantium from the West,<sup>71</sup> but John was the first medieval medical expert to include such detailed subdivisions, which enabled physicians to make precise judgments in debatable cases where, for example, a certain particle might be somewhere between the points of suspension and cloud.<sup>72</sup>

At the end of his account of the new vial, John points his readers to his diagram, which gives a clear view of the abovementioned subareas, stating, "and you may perceive [these] from

69 John Zacharias Aktouarios, *On Urines*, 1.13.1–12, ed. Ideler, 2:20.3–21.19.

70 See, e.g., *ibid.*, 6.13.16–17, ed. Ideler, 2:166.19–27.

71 The earliest surviving reference to the theory of the urine vial and analogies to parts of the human body is found in Maurus of Salerno's (ca. 1130–1214) *Rules on Urine (Regulae urinarum)*, ed. S. de Renzi, *Collectio Salernitana: Ossia documenti inediti, e trattati di medicina appartenenti alla scuola medica Salernitana*, 5 vols. (Naples, 1852–59), 3:41.10–16. On Maurus, see F. Wallis, "Maurus of Salerno," in *Medieval Science, Technology, and Medicine: An Encyclopedia*, ed. T. Glick, S. J. Livesey, and F. Wallis (New York, 2005), 334–35.

72 For a detailed description of John's theory and its widespread reception in the Renaissance West, see Bouras-Vallianatos, *Innovation in Byzantine Medicine*, 62–67, 209–11.

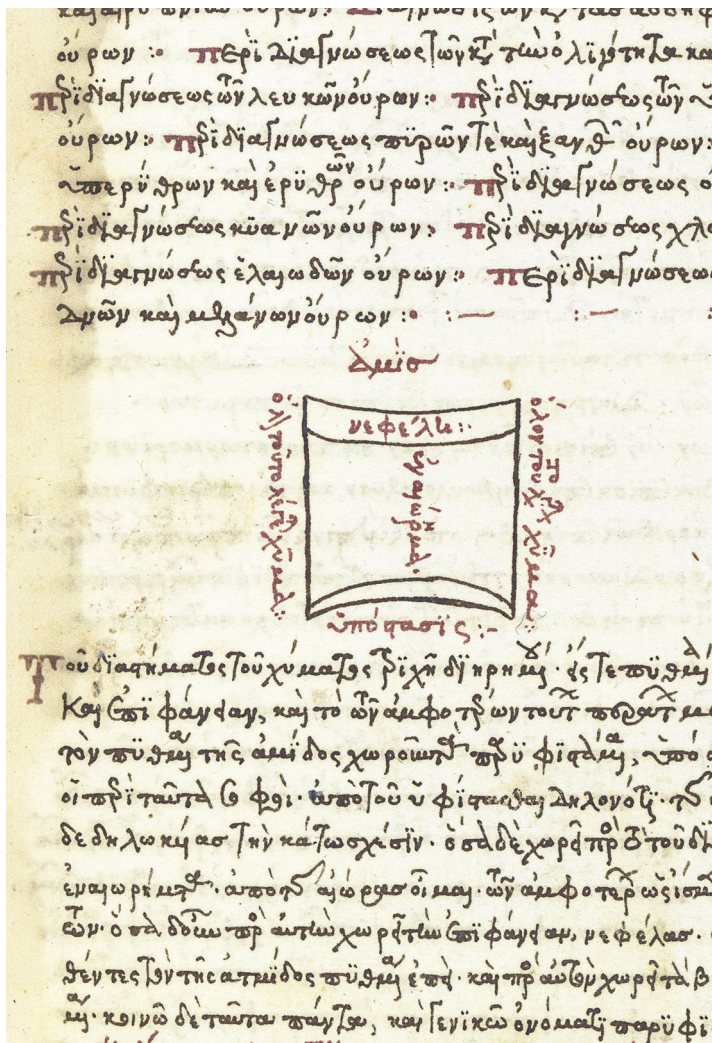


FIG. 11.14.  
Urine vial, fifteenth century.  
Wellcome, MS.MSL.60  
fol. 186r. Photo courtesy of the  
Wellcome Library, London

the diagram (διαγράμματος).<sup>73</sup> It appears in the margins of twenty-three of the surviving forty-one manuscripts of the work or parts thereof.<sup>74</sup> The diagram is itself an object of transmission in the manuscript tradition.<sup>75</sup> There are basically

two types of diagrams. In the first (e.g., Wellcome, MS.MSL.52, fol. 54r, fifteenth century; Fig. 11.15), subareas 5 and 9 (the two subareas between the three main ones) are wider than the other bands, with some minor variations from one manuscript to another. In the second case (e.g., Krakow, Jagiellonian Library, ex-Berolinensis gr. fol. 7, fol. 6r, sixteenth century; Fig. 11.16), which also corresponds closely to John's description,<sup>76</sup> each subarea is followed by the next one without any extra space between some of them.<sup>77</sup>

73 John Zacharias Aktouarios, *On Urines*, 1.13.13, ed. Ideler, 2:21.21.

74 For a detailed list of the witnesses, see Bouras-Vallianatos, *Innovation in Byzantine Medicine*, 225–31.

75 On the transmission of diagrams in Greek scientific works and the need for critical editions, see K. Saito and N. Sidoli, "Diagrams and Arguments in Ancient Greek Mathematics: Lessons Drawn from Comparisons of the Manuscript Diagrams with Those in Modern Critical Editions," in *The History of Mathematical Proof in Ancient Traditions*, ed. K. Chemla (New York, 2012), 135–62. On the reconstruction of diagrams in the Aristotelian *Mechanics*, see J. van Leeuwen, *The Aristotelian Mechanics: Text and Diagrams* (Cham, Switzerland, 2016), 73–138.

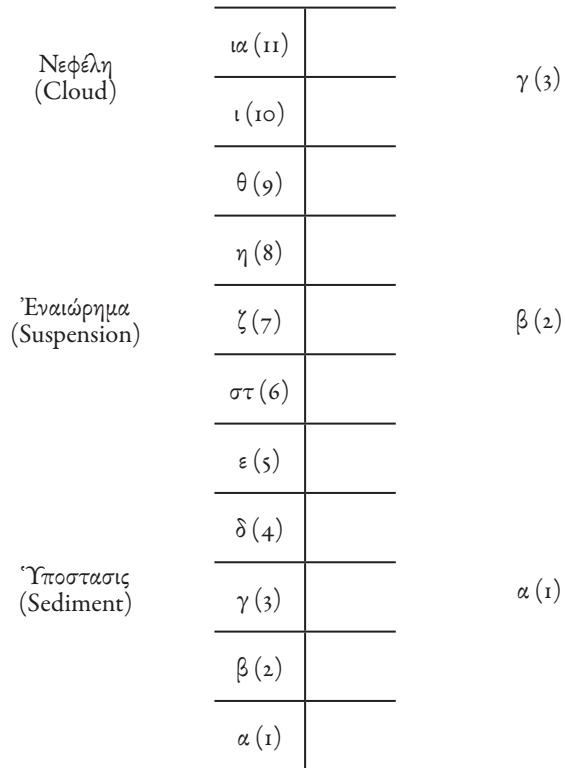
76 John Zacharias Aktouarios, *On Urines*, 1.13.9, ed. Ideler, 2:20.36–21.1, states that each of the subareas has the width of a finger (δάκτυλος).

77 The second type appears in only two manuscripts: Florence, Biblioteca Medicea Laurenziana, Plut.74.13, fol. 108v (fifteenth century); and Krakow, Jagiellonian Library, ex-Berolinensis gr. fol. 7, fol. 6r (sixteenth century). The Florence manuscript



DIAGRAM II.14

Reconstruction of John's urine vial by P. Bouras-Vallianatos<sup>1</sup>



<sup>1</sup> This diagram was first published in Bouras-Vallianatos, *Innovation in Byzantine Medicine*, 63.

Diagram II.14 adopts the structure of the latter diagram and shows my reconstruction, based on John's text in association with evidence from all the surviving manuscripts of the work.

Unlike the branch diagrams discussed above (Scorialensis Φ.III.12), this diagram is an essential paratextual element added by the author himself, complementing his textual description. Aware of the novel character of his vial, John wants to help his readers visualize his new theory. The role of this diagram is not to summarize but to provide significantly more information than the text by showing the vial's actual outline.<sup>78</sup>

(reproduced in Bouras-Vallianatos, *Innovation in Byzantine Medicine*, 229) presents only ten subareas, compared to the Krakow one, which correctly shows eleven subdivisions.

<sup>78</sup> The essential supplementation of the verbal description with a visual depiction, as seen in the case of the urine vial, is comparable to the need for diagrams in ancient and medieval

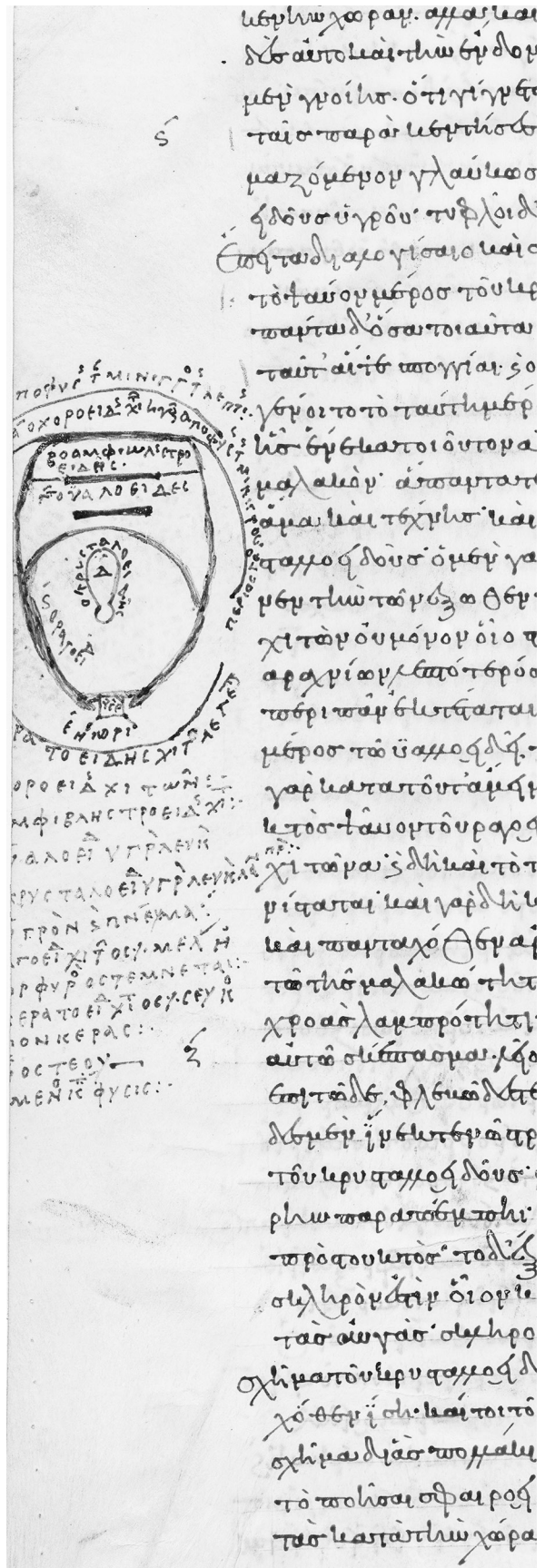
### Anatomical Diagrams

Diagrams that depict parts of the human body are rare in Greek manuscripts. Among the most interesting are those that represent the eyeball. For example, in the earliest manuscript of Galen's *On the Function of the Parts of the Body*, mentioned above (BAV, Urb. gr. 69, fol. 119v; Fig. II.17), there is a diagram dealing with the physiology of the eye and its various parts, including the tunics, the concentric coverings of the eyeball.<sup>79</sup> Galen does

treatises on constructing machines. On the use of such diagrams, see C. Roby, *Technical Ekphrasis in Greek and Roman Science and Literature: The Written Machine between Alexandria and Rome* (Cambridge, 2016), 152–91.

<sup>79</sup> Galen, *On the Function of the Parts of the Body*, 10.1–6, ed. Kühn, 3:760–88 = Helmreich, 2:54–76. On Galen's anatomy of the eye and theory of vision, see Siegel, *Galen on Sense Perception*, 40–78. On Galenic anatomy in particular, see also B. Zipser and K.-D. Fischer, "Neue Quellen zur antiken Augenheilkunde: Der lateinische Aphorismenkommentar Lat-A, the Syriac Book

**FIG. II.17.**  
 Diagram of the eyeball  
 associated with Galen's  
*On the Function of the  
 Parts of the Body*, tenth/  
 eleventh century. BAV,  
 Urb. gr. 69, fol. 118v.  
 Photo © Biblioteca  
 Apostolica Vaticana,  
 Vatican City





not refer to any diagram, and this is most likely a later paratextual addition to the text.<sup>80</sup>

A set of anatomical diagrams that remains unedited and, indeed, unexamined to date is found in a manuscript that preserves Arabic medical works in Greek translation (ÖNB, Cod. med. gr. 21), which Herbert Hunger dated to the second half of the fourteenth century.<sup>81</sup> The first half of the codex contains a medical handbook, including physiological and anatomical information, diagnostics and prognostics with a particular focus on the pulse and the examination of urines (fols. 11r–81r), regimen (fols. 82r–105r), and treatment of diseases starting from those affecting the head, followed by a long section on simple drugs (fols. 106r–145r). The title on fol. 1r reads: Βιβλος ἀ΄ ιατρικῆς τέχνης, εἰς τὰς καθόλου μεθόδους καὶ σημεῖα καὶ κερσοσκοπία<sup>82</sup> καὶ ἐρμηνία<sup>83</sup> σώματος καταλεπτόν· καὶ ἀλλα<sup>84</sup> τινὰ πλοίστα<sup>85</sup> (First book of the medical art, on the general methods and signs and the prognostication[?] and the interpretation of the body in detail, and on many other [topics]), while in the lower margin there is the following annotation: ἀ΄ τοῦ Ὁμπέντουλλά (First [book] by Hompentoulla).<sup>86</sup> Dimitri Gutas has suggested that the author might be identified with ‘Ubayd Allāh ibn Bukhtīshū’ (d. after 1058).<sup>87</sup> The majority of Ibn

of Medicines und Theophilus Protospatharios,” *Testi medici su papiro: Atti del Seminario di studio, Firenze, 3–4 giugno 2002*, ed. I. Andorlini (Florence, 2004), 3–28, at 13–18.

80 In two more manuscripts of Galenic works (BAV, gr. 285, fol. 80v, and BnF, ms. gr. 2271, fol. 73v), there are almost identical, detailed diagrams of the eyeball. Here the diagrams cover one folio and half a folio respectively, in the central area of the page; they are not directly connected with any Galenic work in the codices.

81 Hunger, *Katalog der griechischen Handschriften*, 66–67.

82 sc. καιροσκοπία.

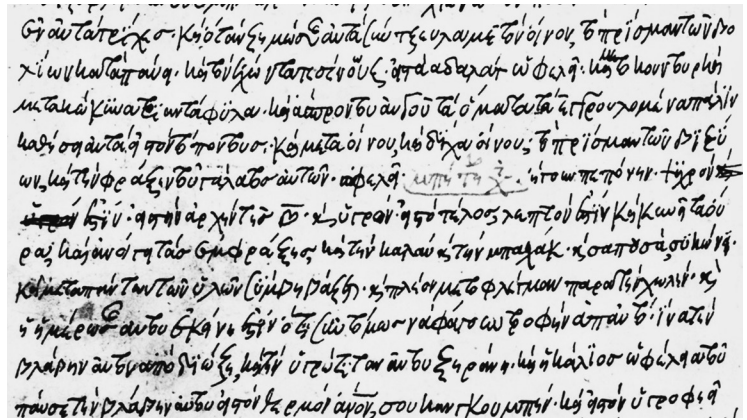
83 sc. ἐρμηνεία.

84 sc. ἄλλα.

85 sc. πλείστα.

86 Note also the annotations in the lower margins on fol. 82r and 106r, respectively: “ἀ΄ τοῦ μπουρχάν” and “Δ τοῦ μπουρχάν.”

87 D. Gutas, “Arabic into Byzantine Greek: Introducing a Survey of the Translations,” in *Knotenpunkt Byzanz: Wissensformen und kulturelle Wechselbeziehungen*, ed. A. Speer and P. Steinkrüger (Berlin, 2012), 246–64, at 253–54. Gutas has identified that the second half of the codex contains a translation of works by Najīb al-Dīn al-Samarqandī (d. 1222), as follows: fols. 146r–185v (Ἀρχὴ τοῦ βιβλίου τοῦ οὐσοῦληταρακηπ· ἡγουν μέθοδος τῶν βωτανῶν πῶς δεῖ σύνθεσιν ποιεῖν ἀσφαλτον μεταυτῶν εἰς τὰς χρεῖας ἀπαντας, incip. Λέγει ὁ φυλόσωφως καὶ μαθηματικῶς



Bukhtīshū’s works have not been edited or do not survive, so a secure identification is not currently possible.<sup>88</sup> The Greek text is full of orthographic errors. Furthermore, in many cases the translator provides both the Greek and the Arabic term in Greek transliteration, including the indication of a certain Arabic letter where there is no equivalent Greek letter. For example, on fol. 114v, line 23 (Fig. 11.18), the translator gives the Greek transliteration of “melon,” i.e.,

τεχνήτις καὶ ιατρὸς ἄριστος ὁ Νετζήπουρντίν Συμαρκατί [...], i.e., *Kitāb usūl tarkīb al-adwiyā* (The book on the principles of the compounding of drugs); fols. 186r–206r (Ἀταματουλμαρδάου τὰ φαγία τῶν ἀσθενῶν καὶ οἱ ποτοί, incip. Χρῆ γινώσκειν ὅτι ἀπὸ πάντων τῶν μαθημάτων τῶν ὠφελούντων τοὺς ἀνθρώπους [...]), i.e., *Kitāb af’imat al-mardā* (The book on diet for patients); and fols. 207r–278v (Βιβλος πᾶνι ὠφέλιμος εἰς τὴν ιατρικὴν τέχνην περιέχουσα τὰ τροφὰς ἀπάσας καὶ τοὺς ποτοὺς, καὶ τὴν ἐστίν αὐτῶν ἢ φύσις καὶ ἡ ἐνέργεια, incip. Χρῆ γινώσκειν ὅτι ἐταν ἐποίησεν ὁ Θεὸς πάντα τὰ ζῶα [...]), i.e., *Kitāb al-aghdhīya wa-l-ashriba* (The book on foods and drinks). There is also a brief opusculum on measurements (fols. 278v–279r) and an anonymous recipe for a composite drug (fol. 279v) at the end of the codex. On al-Samarqandī’s corpus, see A. Z. Iskandar, “A Study of al-Samarqandī’s Medical Writings...,” *Le Muséon* 85.3–4 (1972): 451–79.

88 For a list of Ibn Bukhtīshū’s known works, see O. Kahl, ‘Ubaydallāh Ibn Buhtīshū’ *On Apparent Death: The Kitāb Tahrim dafn al-ahyā*, *Arabic Edition and English Translation, with a Hebrew Supplement* by G. Bos (Leiden, 2018), 4–6. Ibn Bukhtīshū is known to have written a long medical handbook, *Tadbkirat al-hādīr wa-zād al-musāfir* (The memento for the sedentary and provision for the traveler), which is now lost. His *al-Rawḍa al-ṭibbiyya* (The medical garden) (ed. P. Spath, *Le jardin médical* [Cairo, 1927]) is probably an extract from his *Tadbkira*, but it does not have a structure similar to the translation in ÖNB, Cod. med. gr. 21. On *Tadbkirat al-hādīr* and *al-Rawḍa*, see M. Meyerhof, “An Arabic Compendium of Medico-Philosophical Definitions,” *Isis* 10.2 (1928): 340–49. It is worth mentioning that there are other members of the Bukhtīshū family named ‘Ubayd Allāh (see M. Ullmann, *Die Medizin im Islam* [Leiden, 1970], 108–12), and we should not exclude the possibility that the Byzantine translation could be a pseudonymous work of Ibn Bukhtīshū’.

FIG. 11.18.

Arabic letters above Greek transliteration of Arabic terms, second half of the fourteenth century. ÖNB, Cod. med. gr. 21, fol. 114v. Photo courtesy of the Österreichische Nationalbibliothek, Vienna

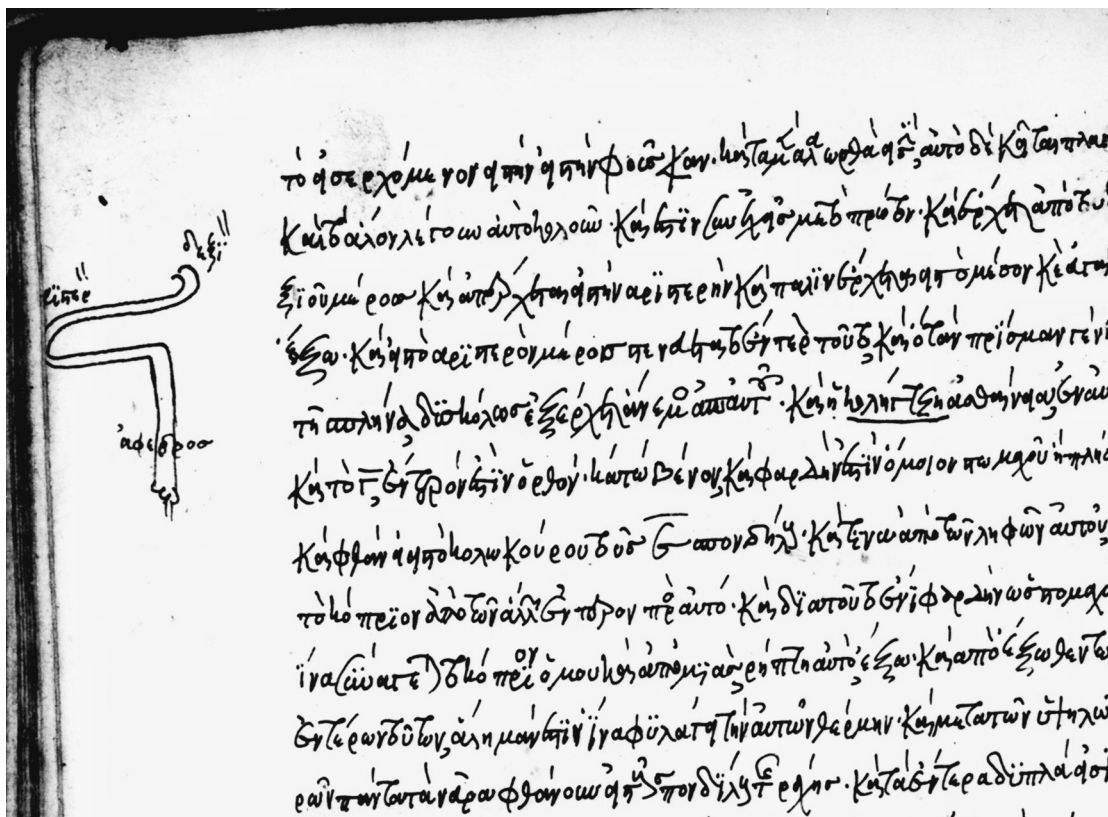


FIG. 11.19. Diagram of the intestines, second half of the fourteenth century. ÖNB, Cod. med. gr. 21, fol. 18v. Photo courtesy of the Österreichische Nationalbibliothek, Vienna

μπήτηχ for بَيْطِيح (bittīkh), writing the Arabic letters ط (tā) and ح (khā) above the Greek τ and χ, followed by the relevant Greek term, πεπόνην.

In some places there are marginal anatomical diagrams corresponding to the main text. For example, on fol. 18v (Fig. 11.19), the text deals with the various stages of human digestion and in particular with the passing of the digested food through the intestines, first from the right part (δεξιόν) and then from the left ([ἀ]ριστερόν), before it ends up in the anus (ἄφεδρος<sup>89</sup>).<sup>90</sup> It should be noted that, due to the rather amateurish execution, this diagram does not actually help much in understanding the verbal description.

89 sc. ἄφεδρος. Cf. E. L. de Stefani, ed., *Etymologicum Gudianum quod vocatur* (Leipzig, 1909–20), s.v. ὁ Ἄφεδρών και ἡ ἄφεδρος.

90 ÖNB, Cod. med. gr. 21, fol. 18v, lines 2–4: και ἔρχεται ἀπὸ τοῦ δεξιοῦ μέρους και ἀπέρχεται εἰς τὴν ἀριστερὴν και πάλιν ἔρχεται εἰς τὸ μέσον και εὐγαίνει ἔξω (and it comes from the right part and exits into the left part and it comes again to the middle and then it goes out).

Perhaps the most interesting example occurs on fol. 34v (Fig. 11.20).<sup>91</sup> At this point the text discusses how one perceives the pulse in different fingers and gives the Arabic terms in Greek transliteration,<sup>92</sup> which also appear in the marginal diagram of the hand. It is notable that in this case the translator does not provide the Greek equivalent word. The Arabic terms are transliterated as follows: ἡμπχάμ for إِبْهَام (ibhām, thumb); μουσάμπηχά for مُسَبِّحَة<sup>93</sup> (musabbīha, index finger); ουστά for وَسْطَى (wustā, middle

91 There is another, similar anatomical diagram in which one can see a visual representation of the penis and the uterus in the right margin of fol. 20r. There is also a branch diagram on fol. 67v. Finally, some very interesting diagrams give visual form to various characteristics of the pulse (fols. 28v, 32f, 33v), such as its intensity and frequency (fol. 32r).

92 E.g., ÖNB, Cod. med. gr. 21, fol. 34v, lines 23–24: και ὁ γινόμενος εἰς ἕναν σφημόν, οὕτως γίνεται ὁ δάκτυλος ὁ χηντζήρ δυνατὸν σφημόν εὐρίσκει.

93 See E. W. Lane, *Arabic–English Lexicon* (Edinburgh, 1863), 1.1:1291c: “The index [...] so called because it is like the glorifier when one makes a sign with it when declaring the divine essence.”

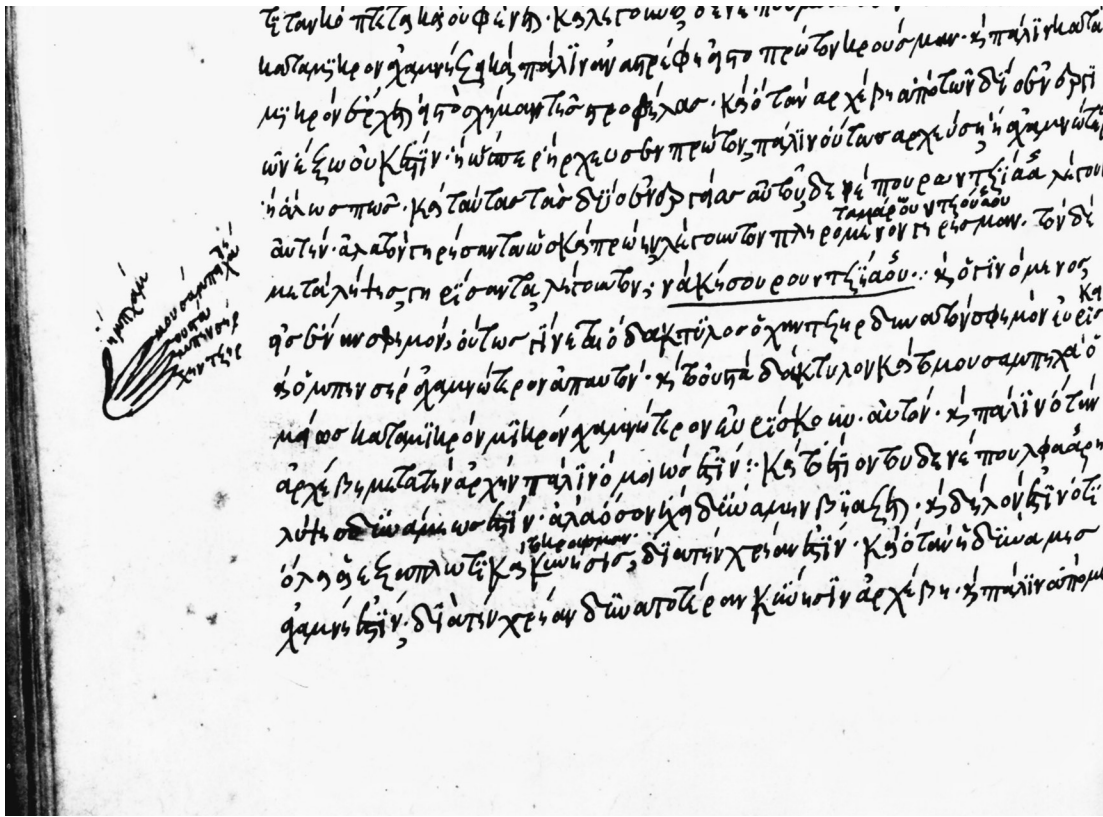


FIG. II.20. Diagram of the hand, second half of the fourteenth century. ÖNB, Cod. med. gr. 21, fol. 34v. Photo courtesy of the Österreichische Nationalbibliothek, Vienna

finger); μπηνησήρ for *binṣir* (ring finger); and χηνητήρ for *khinṣir* (little finger). This diagram, unlike the first one, might have had a significant didactic function for any Greek-speaking reader of the treatise who was not very familiar or entirely unfamiliar with the Arabic terms for fingers. Although it is not entirely clear, the lack of references to both diagrams in the main text tends to suggest that they do not derive from the original source.

### Iatromathematical (Medico-Astrological) Diagrams

The last category of diagrams are those connected with medico-astrological perceptions of the body, or iatromathematics.<sup>94</sup> The connection of particular

planets with parts of the body, primary qualities, humors, and clinical conditions is known from the ancient world, featuring, for example, in Ptolemy's (fl. 147–170 CE) *Tetrabiblos*.<sup>95</sup> The so-called melothesia, the correlation of zodiac names with parts of the human body, is a closely related technique.<sup>96</sup>

Antiquity and the Byzantine Period," *Medicina nei secoli* 11.2 (1999): 357–76.

95 See Ptolemy, *Tetrabiblos*, 1.5. and 3.13, ed. W. Hübner, *Claudii Ptolemaei opera quae exstant omnia*, vol. 3.1, *Apotelesmatika* (Stuttgart, 1998), 26, 232–48. On ancient astrology and medicine, see G. M. Cooper, "Astrology: The Science of Signs in the Heavens," in *The Oxford Handbook of Science and Medicine in the Classical World*, ed. P. T. Keyser and J. Scarborough (New York, 2018), 381–407, at 392–93.

96 On melothesia, see A. Bouché-Leclercq, *L'astrologie grecque* (Paris, 1899), 319–23; V. Stegemann, "Eine Beobachtung zum Text der *Εισαγωγή εις την αποτελεσματικήν του Πτολεμαίου* des Porphyrios," *WSt* 60 (1942): 37–42; and H. Gundel, "Zodiakos," *RE* 10A.19:581–82. See also the discussion of Byzantine examples by O. Neugebauer, "Melothesia and Dodecatemoria," *Analecta Biblica* 12 (1959): 270–74; and O. Schissel von Fleschenberg, "Eine kosmische Ausdeutung des menschlichen Körpers," *WSt* 61–62 (1943–47): 88–97.

I would like to thank Fabian Käs for helping me to identify this term. Another term in Arabic for index finger is *sabbāba* (سبابة).

94 For a broad overview of Byzantine iatromathematics, see M. Papathanassiou, "Iatromathematica (Medical Astrology) in Late

The earliest surviving written account of this theory is found in a Latin work by the astrologer poet Marcus Manilius (fl. 10–30),<sup>97</sup> while in the Greek tradition it is reported by Sextus Empiricus (fl. ca. 200) in his *Against the Mathematicians*.<sup>98</sup> It subsequently featured in a large number of Greek and Byzantine treatises, including several brief anonymous opuscles scattered throughout various manuscripts.<sup>99</sup>

The first diagram under discussion occurs in the previously mentioned medical manuscript Scorialensis Φ.III.12, fol. 10r (Fig. 11.21), immediately in front of the other diagrams on fundamental medical theories (fols. 11r–v), examined above; it is not directly related to any text in the codex.<sup>100</sup> The diagram is spherical, resembling the place of the constellations in the universe. Each sign is connected with a particular month, two qualities, an element, a season, a humor, different kinds of fevers, and age. For example, Aries is dominant in spring (ἔαρ), and in particular in March (Μάρτιος), is moist (ὑγρόν), and is connected with the blood (αἷμα), continuous fevers (συνεχεῖς πυρετοί), and children (ἡλικία παιδῶν).<sup>101</sup> Perhaps the most extraordinary diagrams of astrological medicine are the two examples of the so-called Zodiac Man in Bononiensis

3632 (fols. 312r and 321v; Figs. 11.22–23).<sup>102</sup> This manuscript contains an interesting collection of medical, magical, astrological, iatromathematical, and cosmological texts and was partly copied by the otherwise unknown physician John of Aron (fols. 344r–350v).<sup>103</sup> Both diagrams present a similar anatomical projection of the entire body in which specific parts are associated with a sign of the zodiac. In both cases there is a brief text reporting the various connections (see Table 1). Interestingly, the second text assigns authorship to Ptolemy, although there is no mention of zodiac signs in this respect in his genuine corpus. Neither of these anatomical diagrams is essential for the understanding of the text, in which the terms define obvious and clearly located anatomical places on the body. They were probably used to give emphasis and perhaps to function as agents of recollection for the reader.

97 Marcus Manilius, *Astronomica*, 2.453–65, 4.704–9; ed. R. Scarcia, E. Flores, and S. Feraboli, *Manilio: Il poema degli astri (Astronomica)*, 2 vols. (Milan, 1996–2001), 1:140, 2:144.

98 Sextus Empiricus, *Against the Mathematicians*, 5.21, ed. J. Mau and H. Mutschmann, *Sexti Empirici opera* (Leipzig, 1961), 3:144.28–145.4, reports that this theory comes from the Chaldeans, thus indicating an eastern origin. Cf. E. Rovati, “Die ‘Iatromathematika’ des Hermes Trismegistos: Einleitung, Text, Übersetzung,” *Technai* 9 (2018): 9–132, at 19–25. The theory of melothesia may go back to Babylonian astrology; see J. Z. Wee, “Discovery of the Zodiac Man in Cuneiform,” *Journal of Cuneiform Studies* 67 (2015): 217–33.

99 Wee, “Discovery of the Zodiac Man,” 221–24, who presents many examples.

100 There are a few basic details on the zodiac signs on fols. 394v–395r, which, however, do not contain any information on astrological medicine.

101 One of the most elaborated lists of such correlations is found in Rome, Biblioteca Angelica, gr. 29, fol. 213r, dated 1388. For a detailed list of contents of this manuscript, see *CCAG* 5.1:4–57. See also the elaborated illustration in BnF, ms. gr. 36, fol. 218r, and the relevant discussion by I. Antonopoulos, “Πάντα ἀτελῆ, καὶ ἀβλία καὶ ἀχρηστὰ: Κώδιξ Parisinus Graecus 36 (1405–1505 αἰ.), Γραφόμενα καὶ ζωγραφούμενα,” *Ἰόνιος Λόγος* 1 (2007): 15–42.

102 I am aware of one more anatomical diagram of a Zodiac Man, in BnF, ms. gr. 2180, fol. 108r (second half of the fifteenth century). There is also an elaborated version of the Zodiac Man in BnF, ms. gr. 2419 (fifteenth century), fol. 1r. In this case, however, it is in circular form, including illustrations for each of the zodiac signs and a central male figure, holding a club and a lion’s skin that resemble those of Hercules. See F. Cumont, “Astrologica,” *RA*, 5th ser., 3 (1916): 1–22, at 7–9. The Zodiac Man is quite common in Western medieval manuscripts. The most comprehensive work on the subject is by C. W. Clark, “The Zodiac Man in Medieval Medical Astrology” (PhD diss., University of Colorado, 1979). See also the recent study by M. Winiarczyk, “*Homo Signorum*: Looking to God or Looking to the Stars? The Role of the Body in Medieval Christianity,” in *Charming Intentions: Occultism, Magic and the History of Art. Select Papers from the Conference at the University of Cambridge, 3–4 December 2012*, ed. D. Zamani (special issue, *Abraxas* 1 [2013]), 42–52; and S. Öberg Strådal, “Utility beyond Function,” below. For a list of manuscripts containing a Zodiac Man, see L. C. MacKinney, *Medical Illustrations in Medieval Manuscripts* (London, 1965), 105–85, passim. On astrological medicine in the medieval West, see R. French, “Astrology in Medical Practice,” in *Practical Medicine from Salerno to the Black Death*, ed. L. García-Ballester et al. (Cambridge, 1994), 30–59.

103 For an edition of some opuscles of astrological and magical content, see *CCAG* 8.1:20–48. See also C. C. McCown, *The Testament of Solomon . . .* (Leipzig, 1922), 21–25; and F. Marchetti, “Un manoscritto ‘senza pari’: Le illustrazioni,” in *BUB: Ricerche e cataloghi sui fondi della Biblioteca Universitaria di Bologna* 2 (2010): 41–63. On the world map and the cosmological treatises featuring in this manuscript, see A.-L. Caudano, “‘These Are the Only Four Seas’: The World Map of Bologna, University Library, Codex 3632,” *DOP* 70 (2016): 167–90.

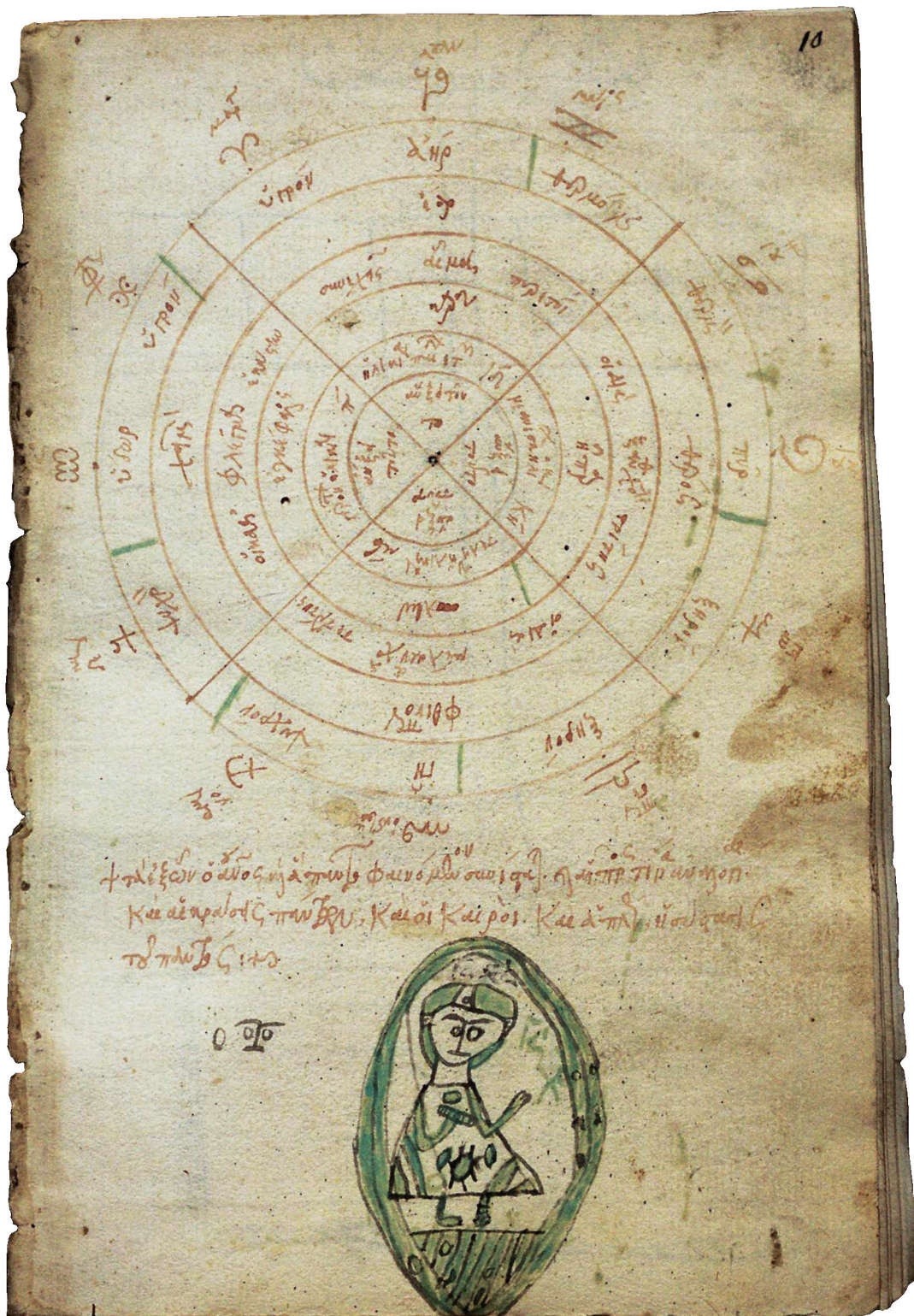
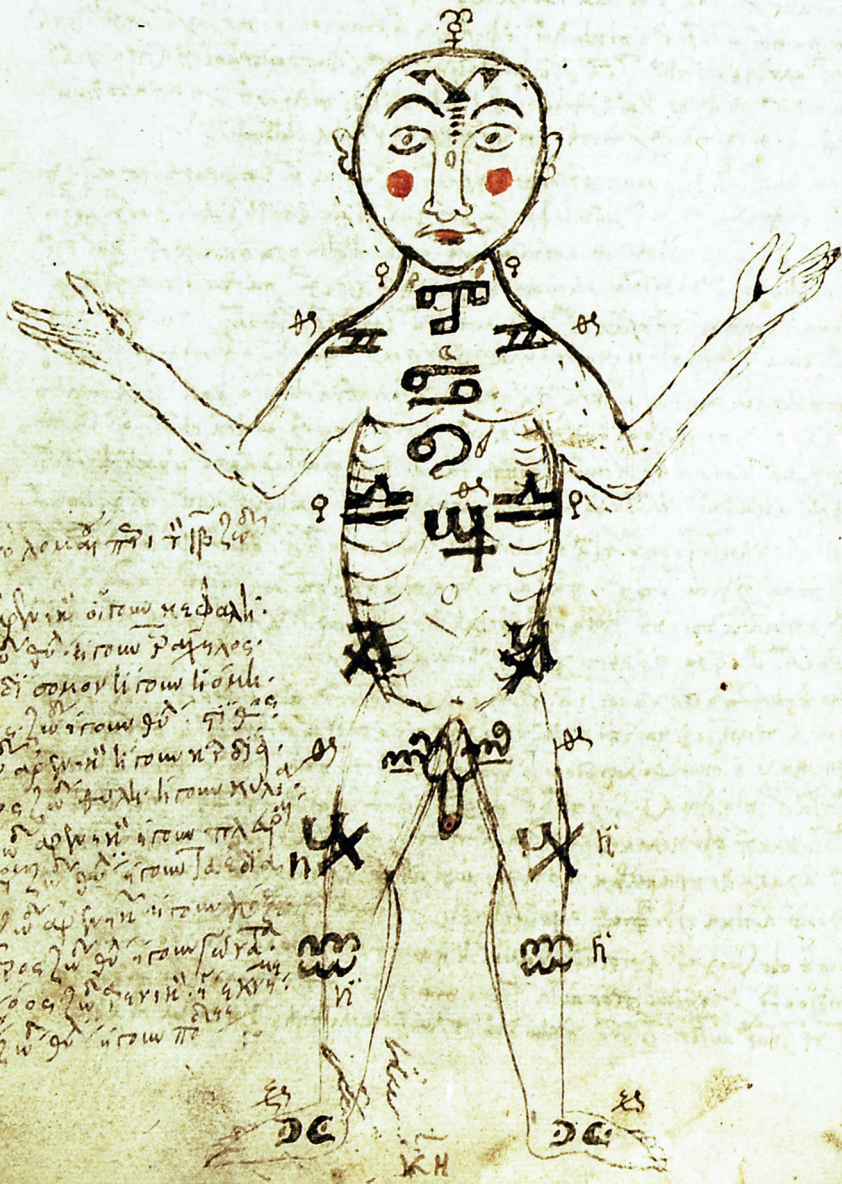


FIG. II.21. Medico-astrological diagram, 1432. San Lorenzo de El Escorial, Real Biblioteca del Monasterio, Φ.III.12, fol. 10r. Photo courtesy of the Real Biblioteca del Monasterio de El Escorial



FIG. II.22. Zodiac Man, 1435-53. Bologna, Biblioteca Universitaria, ms. 3632, fol. 312r. Photo courtesy of the Alma Mater Studiorum Università di Bologna, Biblioteca Universitaria di Bologna






ἐπὶ σφύρι· ὁ φύτιος ὁ κνήμιος· Ζυγὸς ἐπὶ τῆς πρὸ τοῦ ἰσθμοῦ ἀμπληγῆς ἢ ὁ κνήμιος·  
 καὶ ὁ δὲ σφύριος ἀπὸ τοῦ κνήμιος· Ζυγὸς ἐπὶ τῆς πρὸ τοῦ ἰσθμοῦ ἀμπληγῆς ἢ ὁ κνήμιος·  
 καὶ φλόγος· ὁ δὲ σφύριος ἀπὸ τοῦ κνήμιος· Ζυγὸς ἐπὶ τῆς πρὸ τοῦ ἰσθμοῦ ἀμπληγῆς ἢ ὁ κνήμιος·  
 κνήμιος τῆς χάσματος ὁ φύτιος ἀπὸ τοῦ κνήμιος· Ζυγὸς ἐπὶ τῆς πρὸ τοῦ ἰσθμοῦ ἀμπληγῆς ἢ ὁ κνήμιος·



Π πολεμίου πρὸ τοῦ  
 ἔριος ἀπὸ τοῦ κεφαλῆ·  
 Τ αὐτοῦ ἀπὸ τοῦ ῥαχίος·  
 Διδίμος διὰ σπονδύλων ἰσθμίου·  
 Κνήμιος ἀπὸ τοῦ σφύριος·  
 Λέων ἀπὸ τοῦ ἰσθμίου καὶ διὰ  
 Πρὸ τοῦ σφύριος ἰσθμίου καὶ  
 Ζυγὸς ἀπὸ τοῦ πλάγιος  
 Σκορπιὸς ἀπὸ τοῦ ἰσθμίου καὶ  
 Τόξος ἀπὸ τοῦ ἰσθμίου καὶ  
 Ἐρως ἀπὸ τοῦ ἰσθμίου καὶ  
 Ἰσθμίου ἀπὸ τοῦ ἰσθμίου καὶ  
 Ἰχθύς ἀπὸ τοῦ ἰσθμίου καὶ

FIG. II.23. Zodiac Man, 1435–53. Bologna, Biblioteca Universitaria, ms. 3632, fol. 32iv. Photo © Alma Mater Studiorum Università di Bologna, Biblioteca Universitaria di Bologna

TABLE I. Connections between Zodiac Signs and Parts of the Body in Bononiensis 3632

SYMBOL	SIGN	FOL. 321V		PART OF THE BODY
		FOL. 312F	ΠΤΟΛΟΜΑΙΟΥ <sup>1</sup> ΠΕΡΙ ΤΟΝ <sup>2</sup> ΙΒ' ΖΩΔΙΩΝ·	
	Aries	καίφαλη <sup>3</sup> ἀρενικός <sup>4</sup>	κριός ζώδιον ἀρενικόν <sup>5</sup> οἴγουν <sup>6</sup> κεφαλή·	head
	Taurus	τράχηλ <sup>7</sup> θύλ <sup>8</sup>	ταύρος ζώδιον θύλη· ἤγουν τράχηλος·	neck
	Gemini	δίδιμος <sup>9</sup> ὠμη <sup>10</sup> δίσωμος <sup>11</sup>	δίδιμος δίσωμον <sup>12</sup> ἤγουν ἡ ὀμη <sup>13</sup>	shoulders
	Cancer	καρκίνος στίθος <sup>14</sup> ἤγουν <sup>15</sup> θύλ	καρκήνος <sup>16</sup> ζώδιον ἤγουν θύλη· στίθος·	breast
	Leo	καρδία ἀρενικῶν <sup>17</sup>	λέων ζώδιον ἀρενικόν ἤγουν καρδία·	heart
	Virgo	παρθένος κυλία <sup>18</sup> θύλη·	παρθένος ζώδιον θύλη· ἤγουν κυλία·	belly
	Libra	ζηγός <sup>19</sup> ἀρενηκῶν ἤγουν πλευρά[?]	ζυγός ζώδιον ἀρενικόν ἤγουν πλευρά[?].	side
	Scorpio	σκορπίος θήλυ ἤγουν τα εδία <sup>20</sup> ψῶλος	σκορπίος ζώδιον θύλ ἤγουν τα εδία·	genitalia
	Sagittarius	τοξώτης <sup>21</sup> ἀρενηκῶν κόξε <sup>22</sup>	τοξώτης ζώδιον ἀρενηκῶν· ἤγουν κόξε·	hip
	Capricorn	εγώκερος <sup>23</sup> θύλη ἤγουν γόνατα <sup>24</sup>	εγώκερος ζώδιον θύλ ἤγουν γόνατα·	knees
	Aquarius	ἡδριχός <sup>25</sup> ἀρεν <sup>26</sup> ἤγουν κνήμη	υδροχός ζώδιον ἀρενικόν· ἤγουν κνήμη·	lower leg
	Pisces	ιχθίεις <sup>27</sup> θήλη ἤγουν πόδες·	ιχθίας ζώδιον θύλ ἤγουν πόδες·	feet

1 sc. Πτολεμαίου.

2 sc. τῶν.

3 sc. κεφαλή.

4 sc. ἀρρενικός.

5 sc. ἀρρενικόν.

6 sc. ἤγουν.

7 sc. τράχηλος.

8 sc. θήλυ. I do not repeat the correction where a term is misspelled in the same way more than once.

9 sc. δίδυμος.

10 sc. ὠμοί.

11 sc. δίσωμος.

12 sc. δίσωμον.

13 sc. οἱ ὠμοί.

14 sc. στῆθος.

15 sc. ἤγουν.

16 sc. καρκίνος.

17 sc. ἀρρενικόν.

18 sc. κοιλία.

19 sc. ζυγός.

20 sc. τὰ αἰδοῖα.

21 sc. τοξότης.

22 This is a misspelling of κόξα, plural of κόξα, from the Latin *coxa*. See Dimitrakos, *Μέγα Λεξικόν* 8 (1950); and E. Trapp, ed., *Lexikon zur byzantinischen Gräzität: Besonders des 9.–12. Jahrhunderts*, vol. 4 (Vienna, 2001), s.v. κόξα.

23 sc. αἰγόκερως.

24 sc. γόνατα.

25 sc. ὑδροχός.

26 sc. ἀρρεν.

27 sc. ιχθύες.



## Conclusion

All diagrams are potential instruments of thought. In the case of summary diagrams, they constitute essential visual aids in various educational contexts ranging from early Byzantine Alexandria to late Byzantine Constantinople. They make it easy to pick out what one must learn and memorize, enhance the process of recollection, and could have been used as quick reference material. Furthermore, they facilitate the decoding of a complex theoretical concept through, for example, the amplification of the source in the tangible format of a diagrammatic list. The diagram may also become the instrument through which an update of or addition to the original source can be transmitted to the recipient, including several layers of intermediation and intervention. The role of the transmitter is shared between the original author of the source and the later generations of interpreters, who adjust the message in line with contemporary needs.

At other times, diagrams provide a coherent spatial representation of knowledge, lending iconic form to a certain object or parts of

the human body, much as anatomy textbooks are supplemented with high-resolution images today. In some cases their use is complementary and they have a highly practical purpose, as in John Zacharias Aktouarios's urine vial, a schematic explication of the source devised by the author-transmitter himself. An important point that emerges from this investigation is the importance of studying and comparing diagrams from the same treatise in different manuscripts, since they were constantly revised and transformed by scribes and readers as part of their long path of transmission. Diagrams are also essential media that facilitate the communication of newly introduced medical knowledge in the Byzantine world, as in the case of the Greek translations of Arabic works in ÖNB, Cod. med. gr. 21. Lastly, in the case of astrological medicine, a diagram has the power to give readers a sense of the celestial sphere and a better understanding of the correlation between the microcosm (man) and the macrocosm (the universe). The specific source of the Zodiac Man might not be directly traceable, but these diagrams reflect the accumulated knowledge on the subject and transmit some symbolic meaning to the recipient.