Dragon's Blood or the Red Delusion: Textual Tradition, Craftsmanship, and Discovery in the Early Modern Period

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This article explores the plurality of referents associated with the term "dragon's blood" ("sanguis draconis"), a legendary substance that brings together Greco-Roman and Arabic medical knowledge, local vernacular traditions and artisanal practices, and new Spanish and Portuguese botanical discoveries. The study of dragon's blood reveals the interface between overlapping epistemic paradigms governing the definition, use, and circulation of complex material substances in early modern Europe, ranging from humanist learned discussions and artisanal experimentation to vernacular narratives of discovery, along with the shifting criteria of truth, authenticity, and value advocated by different communities of learning and practice.

INTRODUCTION

IN HIS *Rariorum Aliquot Stirpium per Hispanias Observatarum Historia* (The history of some rare plants observed in Spain, 1576), the Flemish naturalist Charles de l'Ecluse, better known as Carolus Clusius (1526–1609), inaugurates his botanical account of exotic species with a chapter on a mesmerizing tree: the *draco* (dragon tree). The opening paragraph promises to provide the reader an insight into an exceptional and little-known species, and to fill the gaps in the hitherto incomplete description ("historia") of the plant by drawing on the botanist's recent firsthand observations.[1] Clusius's beguiling diction is enhanced

I thank Sharon Strocchia, Kate Lowe, and Kate Park for their encouragement and valuable suggestions, as well as Alina Payne and the whole Villa I Tatti community, which provided the ideal academic environment for this research. I am also grateful to Alessio Assonitis (the Medici Archive Project) for his support in advancing and disseminating my work. I also appreciate the stimulating observations and useful suggestions made by the *RQ* reviewers and editors of this essay, most of which I tried to follow.

[1] Clusius, 11–15.

Renaissance Quarterly 76 (2023): 1223–71 © The Author(s), 2024. Published by Cambridge University Press on behalf of the Renaissance Society of America.
doi: 10.1017/rqx.2023.543

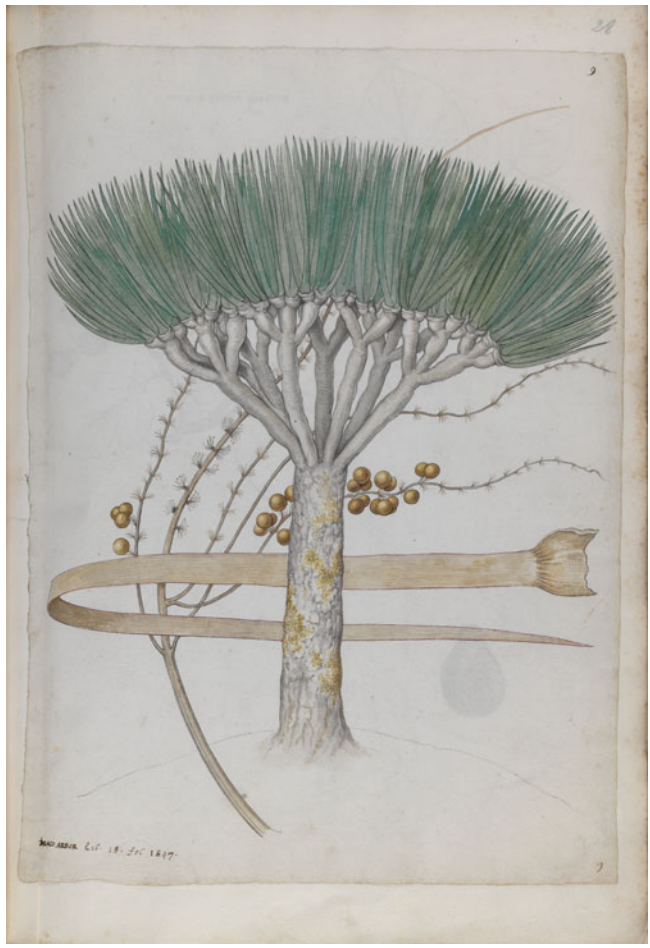

Figure 1. "Draco arbor," in *Libri Picturati* A.23.028. Watercolor. Jagiellonian Library, Kraków.

by the full-page woodcut of the dragon tree—the first realistic representation of the species in early modern print (fig. 1). Clusius's commentaries and illustration were inspired by his own travel to Lisbon in September 1564, where he contemplated the legendary dragon trees at the monastery of Nossa Senhora da Graça; collected a sample of its branches, leaves, and sap; and had it immortalized in a lifelike watercolor by his attendant, the Flemish draughtsman Pierre van der Borcht (ca. 1530–1608).[2] Clusius's account gives preeminence to

[2] The original watercolors are contained in the *Libri Picturati* A.16–31 held by the Jagiellonian Library (Kraków). Van der Borcht's dragon tree is at A.23.028[r]. On the flora

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

his own observations of the monumental trees, with their umbrella crowns, swordlike leaves, and porous bark, which exudes a sap ("humor") that becomes condensed into a red tear ("rubra lacryma") called dragon's blood ("sanguis draconis"). This miraculous sap from which the dragon tree took its name had, by the late sixteenth century, a pedigree of healing powers, legendary origins, and a wide array of practical uses that involved, among others, merchants and physicians, pharmacists and drug-mongers, dyers and painters.

In his opening chapter, after the customary citation of the ancient authorities, Clusius turns to the earlier modern reports on the dragon tree produced by Italian and French navigators, briefly touches on the astringent properties of the resin, and closes his commentary with an allusion to the best-reputed doctors of his own time, who claim that the *sanguis draconis* is the true cinnabar ("legitima cinnabaris") described by the ancient Greek medical author Pedanius Dioscorides (ca. 40–ca. 90). Clusius was the first European naturalist to accurately identify a species of evergreen subtropical tree, now classed in the genus *Dracaena*, native to western Morocco, Cape Verde, the Azores, and the Madeira Islands. At last, it seemed, the dragon tree and its legendary sap had been observed and described *ex vivo* by the Flemish naturalist, thus bringing an age-old mystification to a respectable end. However, the history of science, and early modern natural history in particular, is seldom as straightforward as one may surmise from Clusius's botanical findings. While Clusius's naturalistic observations shed light on a rare species hitherto only partially identified, they did not close the debate on dragon's blood, a substance shrouded in mystery from antiquity to the early modern period, whose inconsistent denominations were often disputed and whose nature and properties remained uncertain well into the seventeenth century.

Dragon's blood offers a rich case study to contest the teleological, compartmentalized narratives of scientific progress, and to examine the intricate, partial, and often contradictory circulation of science-related discourses, practices, and actors in the early modern period. Probably due to the exotic overtones of the name itself, *sanguis draconis* was sought, commercialized, used, prescribed, adulterated, and—not surprisingly—subject to erudite disquisitions during the fifteenth and sixteenth centuries. Yet its origin and nature were uncertain. Throughout the late medieval and early modern periods,

and gardens in Lisbon and the dragon tree as the global tree, see Jordan Gschwend and Lowe, 56–59. On the iconographic tradition of the dragon tree, see Mason, 62–89. Examples of the iconographic tradition include Michael Wohlgemut's *Liber Chronicarum* (1493) and Hieronymous Bosch's *The Garden of Earthly Delights* (ca. 1510). The tree is also depicted in Martin Schongauer's and Albrecht Dürer's engravings of the "Flight into Egypt."

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

sanguis draconis—and its various alternative or conflicting appellations in the vernacular languages—was a name tag that could conjure a plurality of meanings, referents, and connotations to different social actors. The case of dragon's blood thus forcefully calls into question the one-to-one correspondence between *res* and *verba* underpinning all forms of scientific realism, and underscores the semantic complexities of the study of materials in the history of early modern science.[3] It also reveals the interface between overlapping epistemic paradigms governing the definition, use, and circulation of complex material substances in early modern Europe, ranging from humanist learned discussions and artisanal experimentation to vernacular narratives of discovery, along with the shifting criteria of truth, authenticity, and value advocated by different communities of learning and practice.

This essay explores a selection of late fifteenth- and sixteenth-century print, manuscript, and archival sources to chart the assemblage of discursive practices revolving around *sanguis draconis* along with its various, ill-defined cognate terms. As the ensuing discussion will show, the case of dragon's blood is particularly compelling in view of its inherent ambiguity and potential ramifications. It straddles the real and the fabulous, the animal, plant, and mineral kingdoms. It brings together Greco-Roman *materia medica*, Latinized and often distorted Arab medical knowledge, and local vernacular traditions, as well as new Spanish and Portuguese botanical discoveries. Variously embedded in different textual formats and genres, dragon's blood is intertwined with medicine, pharmacy, philology, art, alchemy, and trade, summoning a diverse network of social actors, ranging from the university-trained connoisseur and the lay practitioner to the seafaring naturalist. The case study thus offers an exceptional vantage point to examine, more generally, the relation between *res* and *verba* in early modern epistemology, and to map the intersecting (and often conflicting) discursive practices and disciplinary fields competing for the definition of the *realia*, the practical implications for the actors involved, as well as the multilayered and fragmentary circulation, dissemination, and institutionalization of scientific knowledge in early modern times.

[3] In recent decades, historians of early modern science have tried to bridge the traditional scholarly divide between theory and practice by looking at the interconnections between practical expertise and learned natural inquiries around material objects and practices, along with the role played by consumption, production, and trade. On the shift toward the study of knowledge-making practices, see, among many others, Smith, 2008; on the importance of materials, see the comprehensive discussion by Klein and Spary, 1–24; on the problems of scientific nomenclature, see Daston, 153–58.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

SANGUIS DRACONIS: THE BEGINNINGS OF A PHILOLOGICAL AND MEDICAL DEBATE (1492–93)

Contrary to what Clusius's naturalistic approach may suggest, the earliest formulation of the dragon's blood enigma in Neo-Latin literature takes the form of an erudite debate among late fifteenth-century Italian humanists. It was a corollary of the wide-ranging humanist project devoted to the translation, editing, and exegesis of the Greek scientific legacy, along with the impulse to expurgate the alleged errors of the Arab tradition, and the inaccuracies in widely read encyclopedic works, such as Pliny's *Natural History*.[4] The first formulation of the predicament stems from the so-called *disputatio pliniana* (1491–1509), a heated argument over the errors in Pliny's text that divided opinion among philologists and medical humanists well into the sixteenth century.[5] It was the reputed Italian physician Niccolò Leoniceno (1428–1524) who first drew attention to the terminological inconsistencies regarding *sanguis draconis*, in his *De Plinii et Aliorum in Medicina Erroribus* (On the errors of Pliny and others in medicine, 1492), a work in which he set out to correct mistakes in Pliny's work based not only on philological criteria but also on the judgment derived from experience and medical expertise.[6] In book 1, chapter 36, Leoniceno discusses dragon's blood in close connection with other lemmas: *sideritis*, a plant described by Dioscorides, which is now generally associated with yarrow or sneezewort (*Achillea millefollium*), and two other mineral substances, cinnabar (today's mercury sulphide) and minium (today's lead tetroxide).[7]

Leoniceno opens his chapter with a citation from Pliny's *Natural History*, where cinnabar is described as the product resulting from the blood of a dragon mixed with that of an elephant engaged in mortal combat—a characterization that Leoniceno intends to refute.[8] In his discussion, the physician seeks to figure out what these individual substances actually are, although the information transmitted by Pliny and Dioscorides is contradictory.[9] While Leoniceno's explanation is not fully consistent, he succeeds in identifying two main

[4] On the strong revival of naturalistic matters in the second half of the fifteenth century, see Nutton, 1997; Findlen; Nutton, 2022, 99–103.

[5] The controversy unfolded over several years and involved leading Italian humanists such as Angelo Poliziano, Niccolò Leoniceno, Ermolao Barbaro, and Pandolfo Collenuccio. On the whole controversy, see Godman, 96–106; Ogilvie, 126–33; Gernett, 156–59.

[6] On Leoniceno's biography and works, see Mugnai Carrara; Leoniceno, 1958, 21–32; on his scientific program, see Towaide, 765–73.

[7] Leoniceno, 1532, fol. 11^{r-v}. The question is also discussed in similar terms in Leoniceno, 1532, fol. 22^{r}.

[8] Pliny the Elder, 94–95 and 97 (*Historia Naturalis* 33.115–16 and 122).

[9] Dioscorides, 3:65–66 (*De materia medica* 5.94).

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

substances. On the one hand, he distinguishes between cinnabar and minium, both red minerals used as dyes and pigments, and often confused in antiquity. This mineral cinnabar, Leoniceno writes, is equivalent to the substance called "cenabrio" in his day, and is highly poisonous. He also indicates that ground cinnabar is used to produce artificial cinnabar ("cinnabaris factitia")—that is, vermilion. Leoniceno therefore advises doctors to refrain from using "cenabrio" when they read *cynabaris* in the old recipes. On the other hand, he turns to the word *sanguis draconis*—a term that both Dioscorides and Pliny associate with *kinnabari*, an exotic pigment with various pharmaceutical properties. Leoniceno hypothesizes that Pliny's and Dioscorides's *kinnabari*—not to be confused with the metallic ores cinnabar and minium, both of which were toxic—is probably the same substance that in his day was known as *sanguis draconis*. The ancients' *kinnabari* and today's "pure dragon's blood," Leoniceno explains, share many characteristics: they are exotic, costly substances, they are used as medicine and as pigments, and they are often adulterated. Even if Leoniceno is unable to specify what kind of substance *sanguis draconis* is, he succeeds in distinguishing it from the metallic "cenabrio," which could pose a serious threat to human health. He correctly rejects the idea that dragon's blood is the sap of a plant called *sideritis* and dismisses Pliny's legendary account of the mythical fight between the elephant and dragon as the origin of the substance. Even though Leoniceno fails to articulate a solution, his discussion succeeds in framing a lexical problem in medical terms, bringing into sharp relief the mismatch between certain signifiers (*cinnabaris*, *cenabro*, *sanguis draconis*, *minium*, *sideritis*) and their real-world referents.

Leoniceno's problem is indeed a complex one. Not only are the exact nature and origin of these plural substances (mineral, plant, or animal) disputed, but their diverse and overlapping uses (as dyes, colorants, alchemical matter, and medicines), as well as their final marketable forms (ore, resin, sap, or liquid), are highly equivocal. Pliny and Dioscorides, the authorized classical sources, transmitted erroneous or incomplete information.[10] By the fifteenth century, the conundrum had been further aggravated by the Arab medical tradition, which partly rested on and partly diverged from the classical sources, by the rise of vernacular tongues that further complicated the terminology, and by new genres of technical, medical, and pharmaceutical discourses. The color red is, however, the crux of the matter. Since antiquity, cinnabar, dragon's blood, and minium were commercialized in the form of a ground, desiccated, brightly red resin. Nevertheless, the terminology was somewhat loosely attached

[10] For a comprehensive survey of the classical sources and an extensive bibliography, see Trinquier, 305–23.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

to different referents. Cinnabar was used in antiquity as a medicine, as a mineral for extracting mercury, and as a coloring substance (vermilion), and was often confused with another red mineral, minium.[11] At the time of Pliny and Dioscorides, the term *kinnabari* started to be used to designate a pigment of plant origin, dragon's blood, which was also commercialized as a red powder and used both as a tincture and a medicine. Native to the Socotra archipelago in the Arabian Sea, the dragon's blood tree (*Dracaena cinnabaris*) produces a crimson red sap from which the resin is extracted; the resin was highly prized as a cure-all in antiquity, especially in general wound healing. The fruits of other Southeast Asian species (*Calamus draco*, *Daemonorops draco*, *Daemonorops propinquus*) were also sources of the red resin. To further complicate the question, in early modern times dragon's blood could also designate the sap of another species of the *Dracaena* genus, with similar characteristics and uses: the Atlantic *Dracaena draco* described and illustrated by Clusius.[12]

In the late fifteenth century, Leoniceno was unable to make the fine distinctions between different kinds of metals and plant subspecies noted above. Yet he inaugurated a scholarly tradition that began to discuss the contradictions inherent in the Greek, Roman, and medieval sources. Indeed, Leoniceno's attack on Pliny was bitterly resented in humanist circles. Shortly after the publication of Leoniceno's work, the humanist Pandolfo Collenuccio (1444–1504) entered the contest with his *Pliniana Defensio* (Defense of Pliny, 1493), a work that intended both to vindicate Pliny and to denounce Leoniceno's incompetence. A few months later, Ermolao Barbaro (1444–93) published his *Castigationes Plinianae* (Corrections of Pliny), a lofty volume in which he set out to emend over five hundred textual errors in Pliny's text.[13] Both humanists follow up on the cinnabar/dragon's blood predicament but adopt radically different approaches. Barbaro's treatment of cinnabar is primarily lexicographic and merely arises from the lemma "militon" in Pliny's codices, which Barbaro corrects as "milton," based on the Greek word for minium, or red lead. This emendation makes him draw attention to the inconsistency between Pliny's and Dioscorides's references, but he does not offer a solution. Barbaro notes, however, that in his day a costly medicine with the name *sanguis draconis* was sold in shops ("in officinis"), and that most believed it to be the true cinnabar, even if they were unable to say what it actually was or where this was mentioned in the sources.[14] Unlike Barbaro's strictly philological approach, Collenuccio's response takes the

[11] On vermilion and cinnabar, see Gettens, Feller, and Chase.

[12] For a review of the dragon's blood species, see Pearson and Prendergast.

[13] On Barbaro's work, see Dilg, 232–35.

[14] Barbaro, 222–23 (*Castigationes* 33.7).

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

form of ad hominem attack, criticizing Leoniceno's reliance on Dioscorides's authority and trying to exonerate Pliny. Collenuccio reads Pliny *ad litteram* and tries to demonstrate that dragon's blood is indeed an animal product, thus falling back on the etymological and allegorical medieval tradition connecting Isidore's *Etymologies* and Rabanus Maurus's *De rerum naturis* (On the natures of things) with the information transmitted by Pliny and Solinus.[15] Collenuccio first cites Solinus's *Collectanea rerum memorabilium* (Collection of curiosities) as the authority on the legendary source of cinnabar. He then turns to the word *cinnabaris*, noting that it is not a Latin, Greek, or Libyan name but an Indian one ("indicum"), and that it etymologically stands for the admixture of elephant and dragon's blood.[16] Citing Pliny, Collenuccio states that "barro" is the foreign name for the elephant. Then, he distinguishes between two kinds of metallic cinnabar: one that is native to Libya, with the color of red hematite, and another known as "facticium," fashioned from sulfur and quicksilver. Collenuccio also provides empirical proofs to support his views, thus shedding light on the knowledge and manipulation of these substances in the late Quattrocento. He recounts, for example, that a contemporary painter of the School of Ferrara, Ercole de' Roberti (ca. 1451–96), showed him a piece of native cinnabar, which is hard to come by in Italy. Regarding the substance called *sanguis draconis* commercialized in his time, Collenuccio writes that two types ("duo genera") of dragon's blood are out in the market: a counterfeit product sold in cakes and used by veterinarians, and a slightly ruby red one, like coagulated blood, used in medicine.[17] In the last paragraph of his commentary, Collenuccio denounces Leoniceno's arrogance and restates Pliny's authority. He sees no reason to dismiss the possibility that the legendary *sanguis draconis* obtained from the mythical fight between the elephant and dragon (as widely reported by historians and naturalists) was actually used in medicine ("in usum medicinae"), as were dozens of other exotic animal substances mentioned by Pliny.[18]

The intellectual debates regarding Pliny's alleged errors brought attention to dragon's blood to the fore in late fifteenth-century Italy. In the decades that followed, medical humanists and naturalists across Europe insistently

[15] Collenuccio, 81–85. On Solinus's mention of cinnabar in connection with the battle between the dragon and the elephant, see Solinus, 113 (*Collectanea rerum memorabilium* 35.14–15). Isidore of Seville reworks the accounts made by Pliny and Solinus, and provides the etymological interpretation. See Isidore, 1995, 129 (*Etymologiae* 19.17.8–9). In his allegorical interpretation of colors, Rabanus Maurus comments on the use of red pigments to depict the pathos of Christ. See Rabanus Maurus, 563 (*De universo* 21.10).

[16] For a discussion of the etymology of the word *cinnabar*, see Rosól, 314–15.

[17] Collenuccio, 83.

[18] Collenuccio, 84–85.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

revisited the cinnabar/dragon's blood question, especially in the wide-ranging *castigationes*, *adnotationes*, and *commentaria* of the classical texts. Even though most scholars merely reproduced Leoniceno's observations in exactly the same terms, some of them gradually began to integrate approaches that departed from the collation of sources, and increasingly incorporated empirical criteria as well as nuggets of information derived from travel literature and botanical observations. However, progress was by no means steady or uncomplicated. Various epistemic paradigms, knowledge-making configurations, and discursive practices intersected in the early modern period, which rendered the identification and description of dragon's blood particularly problematic.

DEFINING DRAGON'S BLOOD: A LEARNED CONTROVERSY (1500–50)

In the sixteenth century, the dragon's blood enigma became a standard chapter in humanist debates across Europe. Leoniceno's successor in Ferrara, Giovanni Manardo (1462–1536), inaugurated a genre of medical literature, the *Epistolae Medicinales*, in which he combined philological analysis of the classical authors with incipient empirical observations to disclose the truth of botanical and pharmaceutical knowledge.[19] Even if Manardo does not address dragon's blood per se, he does touch on the minium/cinnabar quandary, which is closely related to *sanguis draconis*. He distinguishes between "minium" (a poisonous substance) and "miltos" (a remedy associated with Pliny's *rubrica*, a red earth) and thereby proposes an emendation of the lemma "milton" in Pliny, which, according to Manardo's mistaken conjecture, should be read as "amnion." He also writes that Pliny's and Dioscorides's assertions that "minium was called cinnabar" are derived from a reference in Theophrastus's *On Stones*.[20] His approach is heavily indebted to the *castigationes* genre of the previous generation, which aimed at expurgating the medical literature, especially the errors transmitted by Avicena, Serapion, Rhazes, and Mesue.

The treatment of the problem would soon extend beyond the confines of the Italian peninsula. A case in point is offered by Symphorien Champier (1471–1539), a Lyonnese physician who took an active part in the debates regarding the Islamic and Hellenic medical legacy.[21] In his *Castigationes seu Emendationes Pharmacopolarum* (Corrections or emendations of pharmacists, 1532), a work imbued by a marked anti-Arab stance, Champier reproduces verbatim

[19] On Manardo, see Nutton, 1997, 8–11; Hasse, 137–42.
[20] Manardo, 55^{v}.
[21] On Champier, see Hasse, 42–45; Petit, 1–16.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

Leoniceno's chapter, without any significant changes other than the suppression of Leoniceno's final lines.[22] A somewhat more elaborate treatment is found in his little-known *Myrouel des Appothiquaires et Pharmacopoles* (The mirror of apothecaries and pharmacists, ca. 1531), in which Champier sets out to divulge his Latin *castigationes* in the vernacular ("nostre langue gallicane"), to better admonish the pharmacists, barbers, and surgeons of his own time.[23] However, Champier's discussion of the traditional cinnabar/dragon's blood problem in the *Myrouel* is highly misleading. In his discussion he depends on subtle lexical distinctions that are not found in the classical sources and that complicate the matter even further. He differentiates *cinabaris*, which he calls "sanguis draconis naturel"—a substance used by doctors to restrain blood ("pour restraindre le sang") and by painters to change colors ("varier les couleurs")—from *cinabrium* or *cynabre*, a metal that he identifies with artificial vermilion, and describes as being made of lead ("faict de plomb") and poisonous ("venimeulx").[24] However, Champier seems unable to correctly determine the origin (metallic or plant) of the simples in question.

The primarily philological approach used by Leoniceno, Manardo, and Champier endured as a strand of bookish inquiry, which, nonetheless, failed to yield convincing results in the long term. Concomitantly, other contemporary medical humanists and naturalists broached new avenues by adopting a more tangible empirical footing or by incorporating other sources of information. A student of Leoniceno and Manardo in Ferrara, the physician and botanist Antonio Musa Brasavola (1500–55) discusses dragon's blood from a perspective that foregrounds the pharmaceutical praxis of his time, through direct observation of the products sold in pharmacies.[25] In his early publication *Examen Omnium Simplicium Medicamentorum, quorum in Officinis Usus Est* (An examination of all the simple medicines used in pharmacies, 1536), written in dialogue form, he distinguishes three types of *sanguis draconis*: one is sold by apothecaries in Ferrara wrapped up in little balls ("in rotulas circumvolutus"), and counterfeited from pseudo-Armenian bole and earth, or ground sorbs and goat blood; another is the tear-sap ("lachryma") of a certain tree; and the third is the gum of this same tree.[26] Brasavola shows that the *sanguis draconis* commercialized in his time is not an animal product (as held by Pliny), nor a plant (technically, the fourth species of *sideritis* described by Dioscorides and Galen). He finally warns the interlocutor against mistaking Pliny's cinnabar

[22] Champier, 1532, 46^{v}– 47^{v}.
[23] Champier, 1894, 24.
[24] Champier, 1894, 34–35.
[25] Brasavola, 354–56.
[26] Brasavola, 355.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

(a poison) for dragon's blood, as many doctors do ("ut plures medici faciunt"). To conclude, he admits he is not able to say what kind of gum this is ("cuius generis gummi sit") or from what tree the tears exude ("ex qua arbore lachryma emanet").[27] Despite the persisting uncertainties, Brasavola revisits the question by focusing on the product commercialized as *sanguis draconis*, rather than by unraveling the maze of conflicting descriptions in the classical sources. Other scholars, in turn, will begin to combine the traditional textual exegesis with snippets of information drawn from recent travel literature and from cross-referencing contemporary publications.

By the 1530s, the view that the *sanguis draconis* on the market was not to be confused with the metallic cinnabar and that it was more likely the sap of a plant (different from Dioscorides's *sideritis*) began to take shape. The German botanist Leonhart Fuchs (1501–66), for example, in his *Paradoxorum Medicinae Libri Tres* (Three books on the paradoxes of medicine, 1535), categorically rejects the common view that dragon's blood is the juice of Dioscorides's *sideritis* and distinguishes between two kinds ("genera") of dragon's blood: one that is red ("rubens") as sandarach or minium, and is natural ("syncerum") and unadulterated, a costly substance used by painters to recreate blood color and by doctors in antidotes; and another that is black ("atrum") and corresponds to the tears ("lacrimae") of a tree described by the Venetian traveler Alvise Cadamosto (1430–83).[28] Fuchs is incorporating here information derived from early modern travelers' accounts, thus broadening the scope of the traditional debate. Interestingly, the last section of Fuchs's chapter is a paraphrase of a passage from Georgius Agricola's *Bermannus, sive de Re Metallica* (Bermannus, or on the nature of metals), published in 1530. The *Bermannus* was written by Agricola in Jáchymov, where the humanist was attracted by the developing mining town. In this dialogue, Ancon, Naevius, and Bermannus discuss the nature, composition, and nomenclature of the minerals they encounter. At some point, Ancon mentions that he heard from a merchant ("mercator quidam") about the sap ("lachryma") of a large tree growing in Libya and neighboring regions. These trees exude dragon's blood, just like a resin exudate from the larch tree among the Raetians. This resin (dragon's blood), Ancon explains, is sold in Italy in place of terebinth or turpentine-tree resin.[29] While declaredly drawing on Agricola's text in this section of the *Paradoxorum Medicinae*, Fuchs makes an original move: he associates the second type of dragon's blood with the resin

[27] Brasavola, 356.
[28] Fuchs, 36–38.
[29] Agricola, 111–14.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

from the tree described by the Venetian Cadamosto, a detail that is not explicitly mentioned in Agricola's text.

The botanical data derived from the travelers' literature significantly reshaped the discussion toward the mid-sixteenth century. Indeed, the identification of dragon's blood as the sap of a tree rather than a metallic ore shaped up more prominently during the 1540s. The German physician and pharmacist Valerius Cordus (1515–44) provides a good example of a systematic empirical framing of the question. In his *Annotationes in Dioscoridis* (Annotations on Dioscorides), first published posthumously in 1549, Cordus opens his chapter 89, titled "De cinnabari, id est, sanguine draconis," with a straightforward definition: "Cinnabar, or dragon's blood as it is still called today, is the tear of a certain tree that grows in Africa, and certainly not the bloody matter from the fallen elephant and dragon engaged in a fabulous combat, as merchants announced in time past with their specious displays, and as Pliny believed."[30] In his chapter, Cordus provides a sound description of dragon's blood as a pharmaceutical product by outlining its physical form, color, and taste. Furthermore, he explains how to distinguish between the genuine and adulterated *cinnabaris* based on specific markers, such as color, texture, and taste. Cordus notes that the product is often adulterated by mixing a small quantity of genuine dragon's blood with red earth ("rubrica") and dry rosin ("colophonia"), which is worked into large lozenges or oblong bundles of turbid color and no flavor.[31] Surprisingly, though, he does not indicate the therapeutic uses of the drug. However, unlike his predecessors, Cordus succeeds in adequately determining dragon's blood as the sap of a tree and providing a pharmaceutical description of the commercialized product in his time.

The ne plus ultra in the identification of dragon's blood is attested in Pietro Andrea Mattioli's (1501–ca. 1577) *Discorsi* on Dioscorides's *De materia medica*, published in Venice in 1544. The Italian physician and botanist provides the first cogent discussion based on a close reading of the classical sources, his own experience ("esperienza"), and reasonable inference ("coniettura"). At the outset, Mattioli boldly declares that the identification of Dioscorides's cinnabar can only be made by conjecture ("per conietture") since the Greek botanist does not state what it is or where exactly it is to be found. Mattioli's achievements are, nonetheless, truly impressive. He shows that the *sangue di drago in lachryma* is a liquid gum obtained from the tree described by Cadamosto and that it

[30] "Cinnabari, seu ut hodie adhuc uocatur Sanguis draconis, nascentis in Aphrica arboris cuiusdam lachryma est, et nequaquam Elephantorum Draconumque in fabulosa pugna occumbentium sanies, ut olim hominibus inculcauerunt suis uenditationibus mercatores, et ut Plinius credidit." Cordus, 207$^{r–v}$ (*Annotationes* 4.89).

[31] Cordus, 207^{v}.

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ought to be distinguished from the worthless sham ("sofistico") sold as cakes ("in pani") in his time. He also indicates the various ways in which dragon's blood was adulterated by mixing in red substances such as ram's blood, ground bricks, red earth, and dried sorbs. Regarding the terminological confusion, Mattioli makes accurate inferences. To begin with, he dismisses Pliny's legendary account from a logical angle: the dry, fetid, and mud-plastered blood of a reptile would not preserve its pristine, rubicund color, as dragon's blood actually does. He also deftly interprets the metonymic shift in Dioscorides's text: due to its ruby color, the *sangue di drago* was often called cinnabar in the past, although it was an altogether different substance. He outlines the differences between the ordinary cinnabar ("vulgar cinabro"), which is corrosive, ulcerative, and venomous, and Dioscorides's cinnabar (the tree sap), which has healing properties. Moreover, he differentiates between the mineral cinnabar, which he saw excavated from Hidria, and the artificial one, produced by distilling sulfur and quicksilver. He notes that none of these ought to be administered orally, though the mineral cinnabar can be used externally in the preparation of perfumes and unguents. Drawing on his experiences in the quarries in Hidria, which confirm Dioscorides's reports on the toxicity of the substance, Mattioli concludes that the mineral cinnabar is probably Dioscorides's minium. Yet he points out that in his time apothecaries and painters use the word "minio" to designate "piombo" (lead).[32]

By drawing on Cadamosto's report and making sound conjectures, Mattioli succeeds in identifying dragon's blood as the sap of a tree (today's *Dracaena draco*). The Oriental species from which the red resin was commercialized in antiquity were only later associated with dragon's blood. Writing some years later, the German botanist Adam Lonitzer (1528–86), in his *Naturalis Historiae Opus Novum* (A new work on natural history, 1551), assertively states that dragon's blood is the gum or tear of a certain tree from Africa.[33] Even more precisely, the polymath Gerolamo Cardano, in the plant section of his encyclopedic work *De Subtilitate* (On subtlety, 1550), describes both species of sap-producing trees.[34] The "sanguis draconis arbor," he writes, is an admirable, cone-shaped, lofty tree that produces a noble and beautiful red sap ("lacryma") and grows on the island of Socotra. The second one, which he mistakenly calls "lacea arbor," also produces a glowing red *lachryma*, which exudes spontaneously or through man-made incisions on the tree, and grows on the island of Portus Sanctus. Consumed in the form of lozenges, the sap was believed to strengthen the teeth. Despite certain inaccuracies, the brief descriptions provided by

[32] Mattioli, 411–13.
[33] Lonitzer, 335^{v}.
[34] Cardano, 308.

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Cardano roughly match the two main species of *dracaena* from which the red sap was extracted and shipped to Europe in early modern times.

By the mid-fifteenth century, dragon's blood was increasingly seen as the sap of an exotic tree, rather than the product of the autochthonous flora, an animal substance, or a mineral ore. While the life-threatening confusion with cinnabar and minium had been cleared up (in theory, at least), a new challenge lay ahead: identifying the tree(s) from which the sap was extracted. The correlation between *res* and *verba* was now complicated by the plurality of referents that dragon's blood could adopt, as the text-based approaches were supplemented by empirical observations, commercial practices were examined, and snippets of new information were drawn piecemeal from travelers' accounts. A compelling example is offered by the renowned physician Gabriele Falloppio (1523–62). In his treatise *De Mettalis et Fossilibus* (On metals and fossils), published in 1564 but written seven years earlier in the form of lectures delivered in Padua, Falloppio undertakes a titanic effort at systematizing the referential values attached to the lemmas *cinnabaris* and *sanguis draconis*.[35] Organized as a series of *quaestiones* in the Scholastic manner, Falloppio's taxonomy addresses the various ways in which the individual terms designate different *realia*. Thus, he distinguishes four types ("quatuor species") of dragon's blood: first, the sap of a type of *sideritis*, as transmitted by the Avicenna and Serapio (which is not dragon's blood, strictly speaking); second, a substance used by reckless veterinarians, mixed with other products, to heal fractures; third, *sanguis draconis in lachryma factitius*, an adulterated decoction of sandalwood, red wood, and certain gums; and, finally, the *verus* and *naturalis sanguis draconis in lachryma*, extracted from a tree that grows in Africa mentioned by Arrian, which corresponds to Dioscorides's *indicus cinnabaris*.[36]

DRAGON'S BLOOD IN USE: ARTISANAL PRACTICES AND VERNACULAR KNOWLEDGE

The intellectual debates regarding the exact identification of dragon's blood only partially tallied with the conception and manipulation of substances in the realm of medico-pharmaceutical practice. The knowledge of *sanguis draconis* was partly determined by snippets of misleading information culled from the

[35] Falloppio, 1584, 385–87.

[36] The discussion continued in the seventeenth century. In 1636, Bernardo Cesio, in his *Mineralogia*, 190–94, summarizes the state of the art in the form of seven *quaestiones*, organizing the information into classes of dragon's blood and multiplying the bibliographical references.

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standard medieval *materia medica*, pharmacopeias, and artisanal handbooks, which could have informed the *ministerium* of trained physicians, but primarily rested on knowledge derived from practical experimentation with materials within a predominantly artisanal culture. Dragon's blood in particular stood at the crossroads of various artisanal traditions. When describing the true *sanguis draconis* in his *De Mettalis et Fossilibus,* Gabriele Falloppio remarks, "Moreover, Dioscorides's cinnabaris was a pigment, as is our sanguis draconis in lachryma, which is also used as a pigment. When painters want to depict the blood trickling from the wounds of our Savior Jesus Christ, they use nothing other than sanguis draconis in lachryma, which is a rare kind of pigment."[37]

Falloppio's comment is highly suggestive. Rather than common vermilion, painters would use the exotic dragon's blood to reproduce the holy blood of Jesus Christ and, thus, one may infer, faithfully depict his pathos on the cross.[38] Falloppio's observation draws attention to an artisanal tradition that dealt with red substances throughout the Middle Ages, intersecting such seemingly disparate fields of knowledge as medicine, painting, death, and even alchemy.[39] The color red, associated with the cinnabar/dragon's blood portmanteau, is at the heart of a web of associations that carried religious and symbolic meanings, straddling the mineral, animal, and plant kingdoms.

An examination of published and manuscript early modern sources, comprising pharmacopeias, recipe books, books of secrets, and handbooks for the preparation of colors and dyes, reveals the manifold uses and practical associations of dragon's blood. The manipulation and commercialization of red substances by practicing doctors, apothecaries, painters, and alchemists reveals an experience-based understanding of dragon's blood, which is not reducible to its essence (*quid sit*) but to its practical use and, often, to its symbolic resonances.[40] Indeed, the medieval "artisanal epistemology," to borrow Pamela Smith's concept, relied on a distinctly metonymic and metaphoric conception of language and the world, which ruled out the search for one-to-one correspondences between *res* and *verba* typical of the humanist debates. The name *sanguis draconis* in particular was prone to conjuring a wide

[37] "Praeterea cinnabaris Dioscoridis erat pigmentum, ita et noster sanguis draconis, in lachryma est in usu, pro pigmento: quando enim pictores volunt exprimere sanguinem manentem ex plagis Saluatoris nostri Iesu Christi, nihil aliud adhibetur, quam sanguinem draconis in lachryma, et est pigmenti genus rarum": Falloppio, 1584, 386.

[38] For the identification of dragon's blood in artworks, see Baumer and Dietemann.

[39] On the interactions between medicine and other technical crafts, and the underlying philosophical framework (theory of humors, tempering of opposites) in the early modern period, see Smith, 2011, 55–56.

[40] On artisanal epistemology, see Smith, 2004, 59–93; on vernacular philosophy, see Smith, 2011, 60.

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range of such associations: a color (red); a mythical creature (dragon) or a reptile (viper); the red sap of a plant; a mineral resin (cinnabar, vermilion); alchemical mercury or, more figuratively, vivification (blood); and even the blood of Christ.[41] The highly metaphoric language of alchemy was most likely at the core of the manifold magic, esoteric, and religious associations of the term "dragon's blood" in the vernacular artisanal tradition.[42] Indeed, alchemical experimentation and sophisticated encryption may also have reinforced the confusion between the metallic cinnabar and the vegetal dragon's blood.

The medieval metallurgic and alchemical literature deriving from the Hellenistic works of Zosimus of Panopolis offers a starting point to examine the practical and symbolic associations in the tradition of the *artes mechanicae*. Composed between the eleventh and twelfth centuries, the medieval *Compendium de coloribus* (A compendium of colors) provides a good example of the intersection between the animal, mineral, and plant kingdoms at the root of the cinnabar/dragon's blood predicament. Among the three different procedures for obtaining cinnabar, the *Compendium* mentions artificial cinnabar, made by combustion, as well as "cinabrium elementale," produced by combining different substances. Interestingly, the text also mentions a "cinabrium animale," which is identified as the mixture of the elephant's and the dragon's blood, as traditionally recounted by Pliny.[43] One could argue that the existence of an animal cinnabar is justified by etymological reasoning: the juxtaposition of *draco* (serpent) and *barrus* (elephant), as explained by Isidore of Seville.[44] However, the *Compendium* presents cinnabar as a red matter lithely straddling the animal, plant, and mineral kingdoms. As evidenced in these alchemical texts, the idea of transmutation is central to the artisanal conception of nature, a principle that seems to preclude the identification of a single and unambiguous origin of a material substance.

[41] On the symbolism of red, see Bucklow, 2016, 21–64. The popular association of red with blood, life, and serpents in antiquity is discussed by Trinquier, 323–31. For the early modern period, see Smith, 2011, 58–63; Smith, 2010.

[42] The alchemical associations are manifold. The prime matters of the *opus alchymicum*, philosophical sulphur (male, hot, and dry) and philosophical quicksilver (female, cold, and moist), were often compared to two dragons, one winged and the other wingless (Abraham, 59). The winged dragon could also symbolize the *rubedo*, or reddening phase (Bucklow, 2009, 141–72 and 280; Stratford, 28). Blood was a synonym for Mercurius, the philosopher's stone, the red tincture, or elixir (Abraham, 28–29). Dragon's blood (or the blood of the dragon) was associated with cinnabar (native mercury sulphide) in alchemy, and could also stand as a synonym for the philosopher's stone. For a detailed discussion of the alchemical associations of dragon's blood, see Bauer, 2014, 74–80.

[43] See Baroni and Piccardi, 24–27.

[44] Isidore, 2006.

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The early medieval tradition of craft recipes—beginning with the *Compositiones lucenses* (Compositions from Lucca)[45] and continuing through partly interrelated works such as the *Liber sacerdotum* (The book of priests), the *Mappae clavicula* (The little key to the small cloth), and the *Schedula diuersarum atrium* (A leaf of paper on various arts) of Theophilus (Rugerus)—mentions dragon's blood sparsely, often in connection with vermilion and other substances used for preparing red paint or ink, as a stain for coloring varnishes or for illuminating parchment and glass.[46] In the *Liber de coloribus illuminatoriis seu pictoriis* (Book on the colors of illuminators and painters), for example, dragon's blood is used as a more opaque red hue in combination with other red colors, like vermilion, to create shades, or mixed with other colors, such as white lead and orpiment. It is also listed along with other transparent and opaque colors ("clari et spisci colores") in the illumination of parchment.[47] The *Mappae clavicula* mentions Indian dragon's blood ("sanguine draconis indici") as a substance that is dissolved with gold at a high temperature to produce a writing ink.[48] Dragon's blood, among other pigments, was also used by manuscript illuminators in combination with egg white or glair ("clarea").[49] In the *Tabula de vocabulis synonymis et equivocis* of Jehan Le Begue's manuscript compilation of works on painting (1431), dragon's blood is defined by its distinctive dark brown ("morellus") or dark red color ("rubeus obscurus").[50] Cennino Cennini (1370–ca. 1440) devotes only a few lines to this pigment in his *Libro dellarte*, highlighting its limited use in illumination and underrating its importance.[51] In the medieval artisanal tradition, the reference to dragon's blood was fairly ubiquitous, but its actual use appeared to have been quite limited. It was largely defined by its characteristic opaque, translucent, and glossy tinge; by its combination with other pigments; and by its practical application, rather than its nature or origin. An exception to this general rule is found in the anonymous *Liber Diversarum Arcium* (The book of various arts, ca. 1430), the most comprehensive medieval technical recipe book, preserved in MS H 277, Bibliothèque interuniveristaire, section médicine, Montpellier, fols. 81^{v}–101^{v}: "Some say that dragonsblood is

[45] The recipe book transmitted by the Lucca 490 manuscript has been given different names, including *Compositiones ad tingenda musiva*, *Compositiones Variae*, and *Compositiones Lucenses*. See Frison and Brun, 2; Long, 82–88.

[46] See Wallert and van Bommel, 75–76.

[47] British Library, MS Sloane 1754, fol. 145^{v}.

[48] Baroni, Pizzigoni, and Travaglio, 106–07.

[49] Straub, 94.

[50] Bibliothèque Nationale de France, MS Parisinus Latinus 6741, fol. 13^{r}. See Merrifield, 1:25.

[51] Cennini, 28.

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juice of a herb: that is silly; it is, on the contrary, the 'gum' of a tree which originates in Persia and in India; they call it dragonsblood, because it imitates blood, and truly that which is reddish, and with an interior like minium, is chosen. Tempering. Its tempering should be done with glaire or gum Arabic and water, as described for brazil."[52]

Unlike the previous sources, the *Liber Diversarium Arcium* provides precise details about the etiology of the pigment, both its description as the "gum of a tree" and its phyto-geographic origin in Persia and India. A close analysis of the passage reveals that the compiler-author was supplementing the sparse information on dragon's blood available in the artisanal handbooks with details drawn from medical manuals.[53] More concretely, he seems to be reworking into this section information drawn verbatim from the twelfth-century Latin compilation on medicinal herbs titled *Circa instans* (The book of simple medicines) and attributed to the Salerno physician Matthaeus Platearius, or from some other derivative source.[54] Interestingly, the compiler-author of the *Liber Diversarium Arcium* abridges Platearius's text and excises the medical technicalities of the *Circa instans*, notably the opening line, which classifies *sanguis draconis* as "cold and dry in third degree" ("frigidus est et siccus in tertio gradu"), and the final section, which lists the therapeutic properties and uses. He thus only retains the information that is pertinent to the art of painting, merely substituting the word "falsum" in the medical handbook for "frivolus" as an appropriation strategy.[55]

The information on dragon's blood provided by the *Liber Diversarium Arcium* reveals the interfaces between artisanal practices in medieval times (as physicians, apothecaries, and painters dealt with similar resinous materials) as well as the intertextual and fragmentary mechanisms of knowledge transfer in a manuscript culture. More importantly, it evinces the haphazard ways in which certain errors were reproduced in the textual tradition, while accurate information became obliterated. It is hard to hypothesize why the incorrect

[52] Bibliothèque interuniversitaire, section médicine, Montpellier, MS H 277, fol. 86$^{v–a}$. The translation is from Clarke, 110.

[53] See Clarke, 14–16. The *Liber Diversarum Arcium* is embedded in a manuscript otherwise entirely composed of medical texts. This was a common practice in the transmission of medieval artists' recipes. Besides sharing many common raw materials and technical procedures for the preparation of simples and pigments, physicians and painters met at the apothecary (*speziale*) to purchase their goods. Moreover, the MS H 277 was apparently owned by a Venetian doctor. See Clarke, 5 and 314.

[54] See Platearius, 36$^{v–a}$. The text is also reproduced in the fourteenth-century illustrated *Tractatus de herbis*, 714–15, and in the *Historia plantarum*, fol. 229^{r}. On the terminological definitions, see Zwink, 548.

[55] Platearius, fol. 36$^{v–a}$.

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version prevailed. What we do know is that the alternative account—namely, that dragon's blood is "the juice of a plant"—which is rectified by the compiler of the *Liber Diversarium Arcium* based on the *Circa instans*, was also in circulation in the Salernitan medical circles in the eleventh and twelfth centuries. The *Alphita*, for example, an anonymous medical botanical glossary from the school of Salerno, transmits precisely this other version: "dragon's blood is the juice of a plant, and not blood, as some falsely report."[56] The existence of two conflicting versions is certainly not unexpected in view of the convoluted circulation of medico-pharmaceutical information in Southern Italy, which was a result of an amalgam of Greek and Latin sources, and the translation of Arabic medical literature made by Constantine the African (d. ca. 1087). Indeed, the source of the more correct version circulated by the *Circa instans* can be traced in Constantine's *De gradibus* (On degrees), which reports that *sanguis draconis* is obtained from a tree originating in Persia and Armenia and explains its various hemostatic properties in similar terms.[57] Constantine, in turn, was deriving this reference from the tenth-century Arab physician Ibn al-Jazzâr (d. 979). In his *Book on Simple Drugs*, Ibn al-Jazzâr writes about a resin-producing tree that grows in Ḫurāsān and Armenia—which he calls *dam al-ahawayn* (lit. "the blood of the two brothers"), or *dam at-tu'ban* ("dragon's blood")—and describes the same wound-healing properties as Constantine does.[58] In general, scholars have shown that the early medieval Arab sources provide a sound phyto-geographic identification of dragon's blood and a detailed description of the therapeutic uses of its sap, which correspond to those identified today as the resin of the *Draceana* species.[59] Moreover, the Arab texts show no terminological confusion with cinnabar, as was the case with the Western tradition.[60] Nevertheless, as mentioned above, the version that prevailed in the medical literature in Europe was that dragon's blood was the juice of a certain plant, which soon became identified with Dioscorides's *sideritis.*

University-trained health practitioners would have only had access to incomplete or erroneous information on dragon's blood transmitted by the canonical medical and pharmaceutical literature. Two seminal Arabic works

[56] "Sanguis draconis succus est cuiusdam herbe, non sanguis, ut quidam mentiuntur": *Alphita*, 287.

[57] Constantinus Africanus, fol. 84$^{v–b}$ (in *Practica Pantegni* II, "De gradibus").

[58] See Ibn al-Jazzār, 1985, 132. For a Spanish translation of this passage and other early Arab sources mentioning dragon's blood, see Cabo González and Bustamente Costa, 338. Elsewhere, Ibn al-Jazzār also provides examples of the therapeutic properties of dragon's blood for the treatment of genital diseases. See Ibn al-Jazzār, 1997, 273, 282.

[59] See Amar and Lev, 90–92.

[60] See Cabo González and Bustamente Costa, 329–30.

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turned into Latin in the twelfth century, Avicenna's (980–1037) encyclopedic *Canon of Medicine*, translated by Gerard of Cremona, and Pseudo-Serapion's *Liber aggregatus in medicinis simplicibus*, or *Liber de simplici medicina* (Book of simple medicaments), both of which were routinely cited in medieval pharmaceutical compendia through the thirteenth and fifteenth centuries, reproduce flawed or vague information. Avicenna merely describes dragon's blood as a red juice ("succus rubeus notus") and reiterates its customary hemostatic properties.[61] Pseudo-Serapion's book, in turn, identifies the plant as Dioscorides's *sidrichis et egilos* (that is, *sideritis* and *achillea*) and reproduces the description of this wound-healing species provided in Dioscorides's *De materia medica*.[62] The same information, with slight variations, is transmitted in highly influential Latin medical glossaries cross-referencing Latin, Greek, and Arab terminology, such as the *Clavis sanationis* (The key to healing) written by Simon of Genoa in the thirteenth century, and the early fourteenth-century *Pandectae medicinae* (Encyclopedia of medicine), compiled by the Salernitan Matteo Silvatico (ca. 1280–ca. 1342).[63] Other botanical and pharmaceutical texts replicate the same error. The *Hortus Sanitatis* (The garden of health), a Latin natural history encyclopedia decorated with hand-illuminated woodcuts published in Mainz (1491), equates *sanguis draconis* with *sideritis*, illustrating the species with a woodcut of a delicate plant with slender leaves (fig. 2).[64] The first printed pharmacopeia, Giovanni Giacomo Manlio del Bosco's *Luminare Maius* (The leading light, 1494), defines *sanguis draconis* as the juice of a plant ("succus plantae") and provides a standard number of recipes where the substance is used in the preparation of troches, unguents, powders, and poultices.[65] A few years later, the *Nuovo Ricettario Fiorentino* (The new

[61] Avicenna, 161^{v} ("De sanguine draconis, id est, Achillea" II.ii.609).

[62] Pseudo-Serapion, 98r$^{a–b}$. Pseudo-Serapion gives the term *demalochochen* as a synonym for *sanguis draconis*—a flawed transliteration of the Arabic *dam alaḫwayn* ("blood of the two brothers") used to designate the dracaena's red resin—but immediately associates it with Dioscorides's *sideritis*. The confusion did not stem from an orthographic or phonetic resemblance between the terms in Arabic and Greek, but from the juxtaposition of species that shared similar therapeutic properties. Well known to various Muslim botanists and physicians, true dragon's blood (the *Dracaena* species), however, was not explicitly listed in Dioscorides's *Dematería medica*. A surrogate species with comparable hemostatic properties, Dioscorides's *sideritis*, was thus early paired with dragon's blood and incorporated into the Latin medical tradition.

[63] Simon of Genoa, 53$^{v–b}$, s.v. "sanguis draconis"; *Pandectae medicinae*, 68$^{r–a}$. See also Guy de Chauliac, 1:457.

[64] *Hortus Sanitatis*, 197^{v}–98^{r} (chapter 422).

[65] The author identifies *sanguis draconis* as a *succus plantae* (Dioscorides's *sideritis*), though he admits that many different plants are given the name *sideritis*; he cites Pseudo-Serapion and

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Figure 2. "Sanguis draconis," in *Hortus Sanitatis* (ch. 422). Mainz: Jacob Meydenbach, 23 June 1491, fol. 197. Woodcut. Courtesy of the Wellcome Collection.

Florentine recipe book, 1499), issued by the local guild of apothecaries and physicians as the official civic pharmacopeia, significantly cut down the number of preparations incorporating dragon's blood, as compared to the earlier printed

Avicenna: Manlio, fol. $22^{v–a}$. The substance is listed in various recipes: see fols. 22^{r}, 23^{r}, 25^{v}, $26^{r–v}$, $27^{v–a}$, 41^{r}, $57^{v–a}$, $58^{r–a}$, $72^{r–b}$, $79^{r–b}$, $81^{r–a}$, $86^{r–b}$, $107^{v–a}$, $108^{r–a}$, $109^{v–a}$, $153^{r–a}$, and $153^{r–v}$.

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pharmacopeias and the still more miscellaneous and rambling manuscript tradition.[66] In the preliminary classification of simples in the *Ricettario*, the so-called *sangue di dragho* is rather hastily included under the rubric of the ordinary juices (*sughi usuali*), without a clear indication of its precise origin. While the evidence shows that dragon's blood was commonly believed to be the "juice of a plant," the loose categorization in the first official pharmacopeia is indicative of the uncertain status of the substance in the early modern period.

The medical manuscript tradition reveals an increasingly complex use of dragon's blood, which does not tally with the fairly limited uses in the 1499 edition of the *Ricettario*, nor those reproduced in the subsequent ones.[67] Such diversity in the classification, use, and combination of *sanguis draconis* in the *ricettari* both justifies Leoniceno's admonition against certain deadly errors in the manipulation of simples and accounts, more largely, for the publication of an official pharmacopeia with standardized medicinal preparations. Recipe collections provide evidence of the interactions between theoretical and vernacular medicine, and the ways in which dragon's blood in particular cut across interlocking epistemic discourses and practices.[68] The various pragmatic combinations, contradictory assemblages, and therapeutic uses recorded in recipe books also reveal the multiple associations in the vernacular culture.

In the Scholastic, Galenic-oriented classification of simples, dragon's blood was consistently regarded as a cold ("frigidus") and dry ("siccus") substance with primarily hemostatic properties.[69] This classification pattern was often

[66] See the *Nuovo Ricettario Fiorentino*, from the Biblioteca Nazionale Centrale di Firenze (hereafter BNF), MS Palatino (hereafter Pal.) E. 6.1.27. "Sangue di dragho" is loosely classed among the "sughi usuali" (usual juices; fol. $16^{r–a}$) and not as a gum. "Cinabro" does not appear on the lists. Dragon's blood is listed in eleven recipes, including eye salves, plasters, unguents, pills, and powders: fols. $32^{r–b}$, $48^{v–b}$, $50^{v–a}$, $53^{r–a}$, $60^{v–b}$, 62^{r}, $62^{v–b}$, $66^{r–a}$, $70^{v–a}$, and $71^{v–b}$.

[67] Subsequent editions include those published by Lorenzo Torrentino in 1550 and 1562; and by Giunti in 1567, 1574, and 1597. On recipes as a genre of technical know-how or experimentation, see Eamon, 1994, 126–33. On the recipe book tradition as a vernacular genre, see Stannard, 49; Crisciani, 23–25; Cifuentes, 103–51.

[68] On the interactions between folk medicine and professional theoretical medicine, see Park, 48–54; Stannard; Gentilcore. On non-professional "medical agents," see Green; on the metaphor of the kaleidoscope to describe the wide range of health practitioners, see Nutton, 2022, 173.

[69] For example, the *Liber novae traditionis per tabulas*, attributed to the Salernitan Pietro Marango (1281–1313) in the Biblioteca Riccardiana (hereafter BR), MS Riccardianus (hereafter Ricc.) 878, fol. 19^{v}, lists *sanguis draconis* as cold in the third degree ("sicca in 3° gradu"), and later on under the astringent substances (fol. 20^{r}). The text is also transmitted

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transmitted in the manuscript tradition well into the eighteenth century—as shown, for example, in the list of medicines ("elenchus medicamentorum"), culled from various authors and preserved in the *Riccardianus* 956.[70] However, the pragmatically oriented manuscript tradition of recipe books provides a glimpse into a system of arrangement of individual simples that often brings into relief the metonymic associations of the name *sanguis draconis* as an organizing criterion. Ingredients were generally listed in groups based on the quantity needed for the preparation through the apothecaries' system of measurement units (pound, ounce, dram, scruple, and grain), and organized in decreasing order. When the same quantity was needed, several simples were lumped together and the Greek word *ana* was used. However, recipe books show that the quantity of simples grouped together may have been partly determined by the quality associated with certain names and their metonymic connotations.

A remarkable example of this web of associations evoked by dragon's blood is to be found in an Italian book of antidotes (*antidotarium*) attributed to (Master) Niccolò[71] and transmitted by a fifteenth-century codex, the Riccardianus 2168 (fols. 107^{r}–136^{v}). On folio 108^{r}, "sanghu di draghone" is grouped together with other red substances (fig. 3); on folio 109,^{r} "sanghue di dragone" closes a list of herbs for a preparation (fig. 4); on folio 126,^{v} it is lumped together with animal blood (fig. 5).[72] The association of dragon's blood with animal blood or red substances more generally, which can be traced in various recipe books, is indicative of a vernacular way of organizing medical knowledge that is driven by metonymic displacements rather than by unambiguous referential ascriptions to one type of *realia* (typical of the Scholastic discussions of university-trained

in two other manuscripts: Jagiellonian Library, MS 825, fols. 251^{v}–54^{r}, and the Biblioteca Estense Universitaria, Modena, MS Lat. 175 (alfa.0.6.8), fols. 99^{r}–105^{v}. On the therapeutic uses of dragon's blood, see Casper, 18–21; Gupta et al., 362–63.

[70] BR MS Ricc. 956. *Sanguis draconis* is included within the group "frigidus et siccus" (cold and dry; fol. 9^{r}) and listed as "epulotica medicina" (epulotic medicine; fol. 32^{r}) and "fluxus sistentia" (for stopping the flow of blood; fols. 75^{v}–76^{v}). See also BNF MS Mag. XV 9, fol. 157v: "Sangue di draghone e freddo e secho in 3° grado. El sangue ristringe per percussione di ferro e la piagha sana" (Dragon's blood is cold and dry in the third degree. It restricts the blood caused by striking iron, and the wound heals).

[71] On the *Antidotarium Nicolai*, see Ventura, 34–35.

[72] Other red substances include "ematite, coralli rossi, costo, bolio": BR MS Ricc. 2168, fol. 108^{r}. List of herbs: "agaricho, coloquintida, elebero nero, polipodie et cassia, brettonica, canedreos, polio amomi, leuistico, sanghue di dragone": BR MS Ricc. 2168, fol. 109^{r}. Animal blood: "sanghue di dragone, coagolo delipre, coagolo dagniello, coagolo dicapriuolo, coagolo diuitello, fiele dorso, sangue danatra": BR MS Ricc. 2168, fol. 126^{v}.

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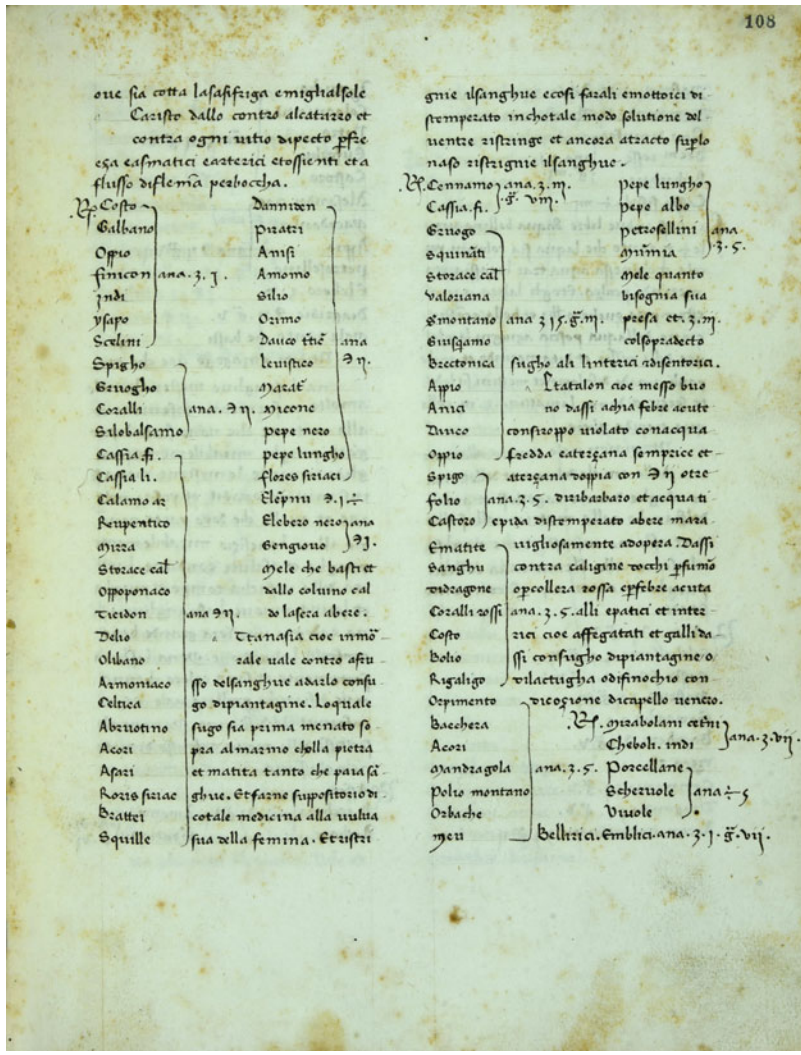

Figure 3. "Sangu didragone" and other red substances, in Biblioteca Riccardiana, Florence, MS Riccardianus 2168, fol. 108r. S. XV. Courtesy of the Biblioteca Riccardiana, Ministero della Cultura.

physicians discussed above). In practice, this meant that the true origin of dragon's blood was unclear and, if anything, lay beyond the trial-and-tweaking artisanal approach to healing. This form of metonymic connection, prototypical of medical folklore, is also at the root of the doctrine of signatures, which assumes that the physical characteristics of plants (or parts thereof) correlate with their therapeutic uses. In this respect, dragon's blood red sap (whether liquid or in the form of a

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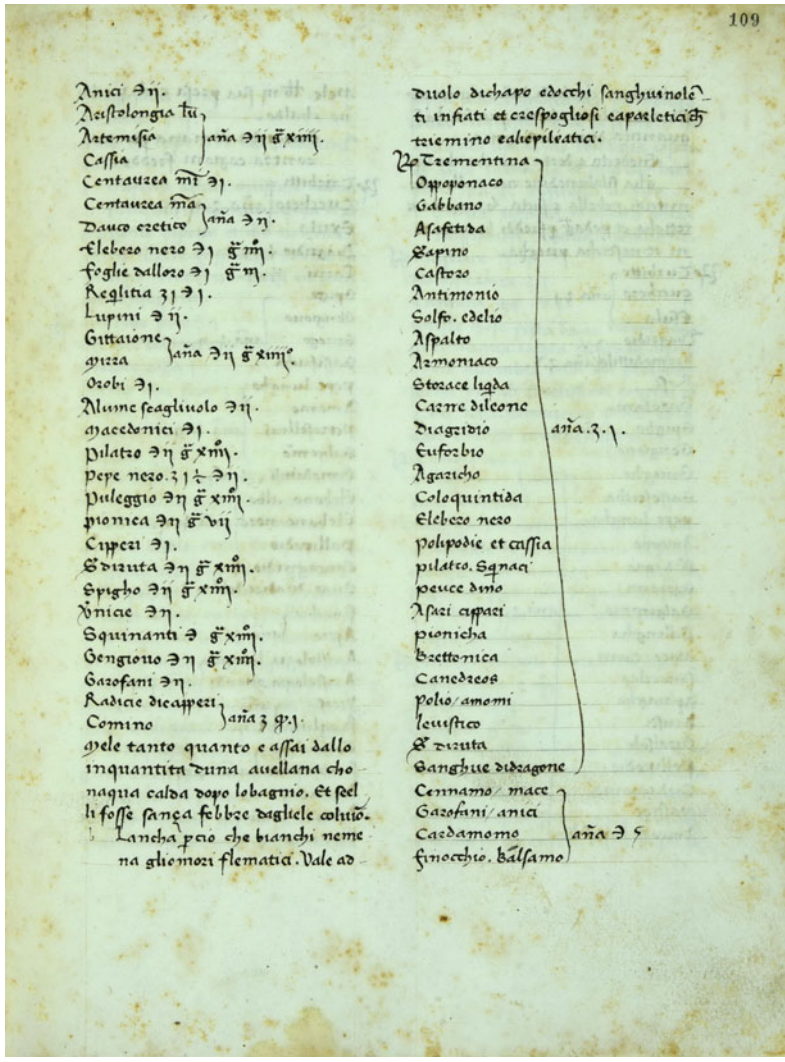

Figure 4. "Sangue didragone" and other herbs, in Biblioteca Riccardiana, Florence, MS Riccardianus 2168, fol. 109[r]. S. XV. Courtesy of the Biblioteca Riccardiana, Ministero della Cultura.

powder or resin) conforms to the Paracelsian principle of *similia similibus curantur* (like cures like), since it was primarily used to treat symptoms such as hemorrhaging, eye inflammation, and menstruation.[73]

[73] On the doctrine of signatures in general, see Bennett; Stannard, 47. On the Paracelsian doctrine of signatures, see Bianchi, 63–65; Webster, 151.

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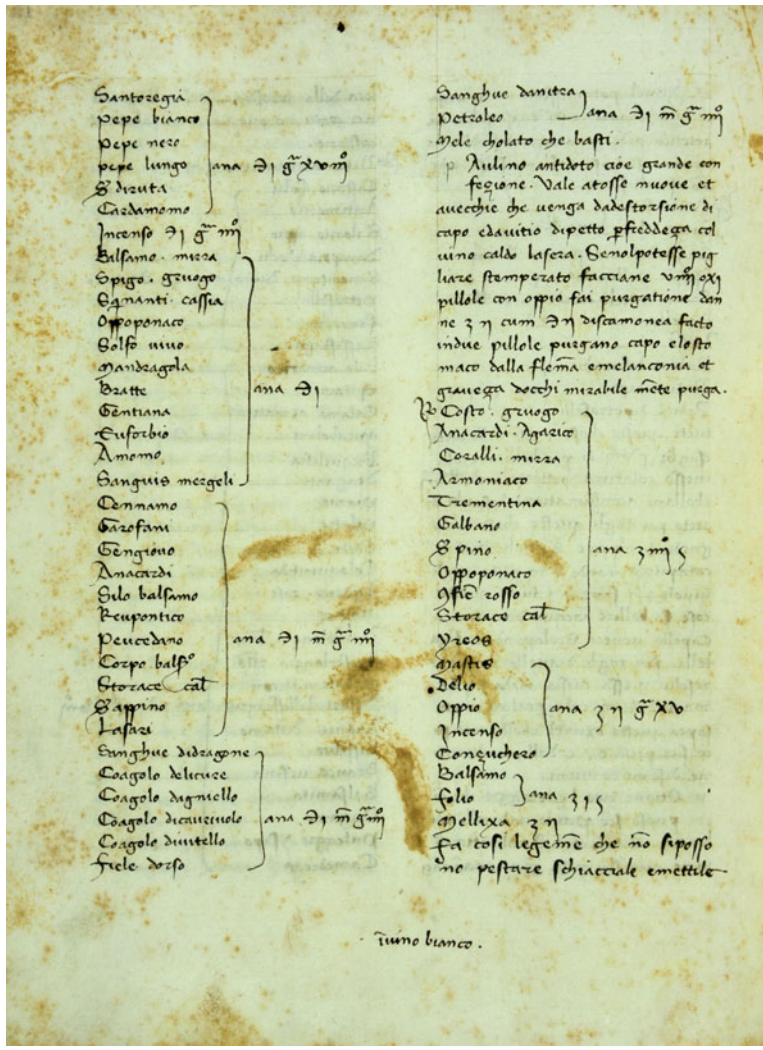

Figure 5. "Sangue didragone" and animal blood, in Biblioteca Riccardiana, Florence, MS Riccardianus 2168, fol. 126ᵛ. S. XV. Courtesy of the Biblioteca Riccardiana, Ministero della Cultura.

In Renaissance Florence, the manuscript evidence shows a rich experimental artisanal culture written in Latin and the vernacular (or hybrid forms thereof), across the spectrum of elaborate hospital vade mecums to slapdash personal notebooks. Dragon's blood was combined in all sorts of pharmaceutical preparations, such as waters, oils, electuaries, ointments, salves, plasters,

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troches, and pills.[74] It figured prominently in remedies to aid wound healing and coagulation, to restrain menstrual bleeding and hemorrhages, and to cure hemorrhoids.[75] But it was also a regular ingredient in preparations to treat fractures, kidney ailments, and hernias,[76] and to care for eyes

[74] Dragon's blood was utilized in all kinds of preparations: (1) "unghuento" (unguent): BNF, MS Magliabechiano (hereafter Mag.) XV 92, fols. 41^{r}, 56^{r}, 93^{v}, 151^{v}, 162^{v}, 190^{r}; BR MS Ricc. 2709, fols. 137^{v}–38^{r}; BR MS Ricc. 2378, fols. 29^{v}, 46 ^{v}, and 60^{v}–61^{r}; BR MS Ricc. 3057, fols. 58^{r} and 173^{r}; (2) "cerotto" (cerate): BNF Mag. XV 92, fols. 45^{v}, 166^{r}, and 190^{r}; BR MS Ricc. 2376, fols. 22^{v}, 33^{v}, and 46^{r}; BR MS Ricc. 3057, fol. 48^{r}; BR MS Ricc. 3074, fol. 17^{r}; BR MS Ricc. 3073, fol. 113^{r}; (3) "impiastro" (plaster): BNF Mag. XV 92, fols. 46^{v}, 61^{v}, 62^{r}, 63^{r}, 89^{r}, 126^{r}, 130^{v}, 166^{r}; BR MS Ricc. 2162, fols. 44^{r}, 47$^{r–v}$; BR MS Ricc. 2378, fol. 18^{v}; BR MS Ricc. 3057, fol. 56^{v}; BR MS Ricc. 3073, fol. 169 $^{r–v}$; (4) "pillole" (pills): BNF MS Mag. XV 92, fols. 52^{r}, 129^{v}; (5) "polvere" (powder): BNF MS Mag. XV 92, fol. 94^{r}; BR MS Ricc. 2168, fols. 34^{v}, 107^{r}, 124^{v}; BR MS Ricc. 2162, fol. 78^{r}; BR MS Ricc. 3058, fol. 69^{v}; BR MS Ricc. 2378, fol. 28^{r}; BR MS Ricc. 3073, fol. 16^{r}; (6) "lattovare" (electuary): BNF MS Mag. XV 92, fols. 88^{v}–89^{r}; BR MS Ricc. 2709, fol. 103^{r}; BR MS Ricc. 3057, fols. 54^{v} and 174^{r}; (7) "olio" (oil): BR MS Ricc. 2376, fol. 4^{v}; BR MS Ricc. 3073, fol. 130^{r}; (8) "acqua" (water): BR MS Ricc. 2376, fol. 13^{v}; BR MS Ricc. 3058, fol. 6 $^{r–v}$.

[75] For wound healing, see BNF Mag. XV 92, fol. 39^{r}: "polvere da ristringniere il sanghue," fol. 191^{v}: "polvere da ristringere sanghuine [blood-shrinking powder]"; BR MS Ricc. 2376, fol. 48^{v}: "per tenere le labbra d'una ferita unite insieme quando i punti si strappassino [to hold the edges of a wound together when the stitches tear]," fol. 108^{r}: "in fluxum emorroidarum [for hemorrhoidal flow]"; BR MS Ricc. 3057, fol. 126^{r}: "polvere da restringere sangue di rottura di vena in qualunque parti del corpo fussi [blood-shrinking powder for ruptured veins in any part of the body]," fol. 152$^{r–v}$: "polvere a restringere el sangue della vena fagliata [powder to constrict the blood from the severed vein]" BR MS Ricc. 1177, fol. 138^{r}: "ad constringendum sanguinem menstrualem pulvis mirabilis [miracle powder to stem menstrual flow]".

[76] For fractures and bones, see BNF MS Mag. XV 92, fol. 45^{v}: "sanghue di draghone" for "cerotto da ossa secondo m° ficino [cerate for bones by master Ficino]," fols. 61^{v}–62^{r}: "impiastro da capi rotti [plaster for broken heads]," fol. 128^{r}: "unguento da ossa rotte [ointment for broken bones]," fol. 151^{v}: "unghuento da ossa di m°ficino [ointment for bones by master Ficino]," fol. 162^{v}: "unghuento da ghambe et daogni malattia [unguent for legs and all diseases]," fol. 166^{r}: "impiastro da ossa secondo avicienna [ointment for bones by Avicenna]," fol. 190^{r}: "unghuento da ossa secondo m° ficino [ointment for bones by master Ficino]," "cirotto da ossa secondo m. ficino [cerate for bones by master Ficino]"; BR MS Ricc. 2376, fol. 32^{v}: "sangue di drago" in "rimedio per la rottura [remedy for fractures]"; BR MS Ricc. 3073, fol. 113^{r}: "sangue di drago in lagrima" in "cerotto per la rottura raro al mondo [rare fracture cerate]," fol. 169$^{r–v}$ "sangue di drago, sangue humano" in "impiastro fatto a uso di cerotto e mettuo sopra la rottura con un bracchiero buono ben fatto [plaster to be used as a cerate on the fracture with a well-made binding]." For hernias, see BNF MS Mag. XV 92, fol. 63^{r}: "sanghue di drago" for "impiastro da crepati [plaster for cracks]"; BR MS Ricc. 2376, fol. 22^{v}: "sangue di drago" in "cerotto per crepati di St. R. [cerate for cracks]," fol. 129^{v}: "pillole da crepati [pills for cracks]," fol. 130^{v}: "impiastro da crepati [plaster for cracks]"; BR MS Ricc. 2378, fol. 18^{v}: "sanguinis draconis" in "emplastrum (ad crepatos) Galienum [Galenic plaster for cracks]"; BR MS Ricc. 3057, fol. 48^{r}: "sangue di drago" in "cerotto da crepati [cerate for cracks]."

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and teeth.[77] Moreover, the sources reveal that it was often used as a dye or pigment along with other red substances in topical preparations.[78] Recipe books display a sprawling variety of uses of dragon's blood, usually by tweaking, recombining, or repurposing the same basic simples with others to produce new medicines.[79] Thus, unlike the conservative civic pharmacopeias featuring a limited number of standard preparations, the vernacular tradition speaks of the high level of experimentation with dragon's blood. Whether all these remedies were tried, administered to patients, or commercialized is hard to say.

Books of secrets, another popular genre of medical and technical literature growing out of the medieval *receptaria*, artisanal, and esoteric traditions, became a runaway editorial success in the mid-sixteenth century; these works also mention dragon's blood sparsely in various recipes.[80] For example, the immensely popular *De' secreti del reverendo donno Alessio Piemontese* (The secrets of the reverend master Alexis of Piedmont, 1555) features a handful of recipes that employ dragon's blood in the preparation of powders, cosmetics, potions for dental hygiene, and tinctures.[81] A volume attributed

[77] For the care of the eyes, see BNF MS Mag. XV 92, fol. 49^{r}: "difensivo per lo occhio [protective eye remedy]"; BR MS Ricc. 3057, fol. 56^{v}: "impiastro rosso da ochi [red eye salve]," fol. 58^{r}: "unguento da ochi [ointment for the eyes]"; BNF MS Pal. 857, fols. 7^{v}–8^{r}. For the care of mouth and teeth, see BR MS Ricc. 2160, fol. 15^{v}: "sangue di drago" is listed in two recipes concerning the care of teeth ("dentes fortificati"); BR MS Ricc. 2376, fol. 13^{v}: in "acqua per levare il dolore de denti et incarnare e non lassare putrefare [water to relieve tooth pain, reduce sores and prevent decay]"; BR MS Ricc. 3058, fol. 6$^{r–v}$: in "acqua a fare belli i denti [water to embellish the teeth]"; BR MS Ricc. 3073, fol. 16^{r}: in "polvere per fare bianchi i denti [teeth-whitening powder]."

[78] As a red colorant in powders: BNF MS Mag. XV 92, fols. 94^{r} and 124^{v} mention "polvere da rimettere carne [flesh-replenishing powder]"; Biblioteca Nazionale Centrale di Roma, MS Vittorio Emanuele 369, fol. 34^{r} mentions "polvere constritive [constrictive powder]" and "polvere incarnative [flesh-replenishing powder]"; BR MS Ricc. 2376, fol. 89^{v} mentions "pulvus incarnativus [flesh-replenishing powder]"; BR MS Ricc. 2378, fols. 29^{v}, 46^{v}, 60^{v}–61^{r} mention "unguento incarnativo [flesh-replenishing ointment]"; BR MS Ricc. 3057, fol. 56^{v} mentions "impiastro rosso da ochi [red eye plaster]."

[79] On the apothecaries' practice of tweaking, see Pugliano, 237–50.

[80] On secrets and books of secrets, see the introduction to *Secrets and Knowledge in Medicine and Science*, 7–20.

[81] See Piemontese, 173: "sangue di drago" is used in "stilletti perfetti da nettare i denti [perfect tooth-cleaning splints]," 254: "polvere per nettare i denti [tooth-cleaning powder]" uses "lacrima di sangue di drago," 259: "polvere bianchissima [ultra-white powder]" uses "un poco de sangue di drago in lagrima [a dash of dragon's blood in tears]," 262: "decottione da lavarsi la bocca [mouthwash decoction]" uses "lacrima di sangue di drago [dragon's blood tear]," 268: "azzurro oltramarino perfetissimo [perfect ultramarine blue]" includes "una noce di sangue di drago macinato sottilissimo [a knob of finely ground dragon's blood]."

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to Gabrielle Falloppio (but probably authored by Leonardo Fioravanti), the *Secreti diversi et miracolosi ne' quali si mostra la via facile di risanare le infirmità del corpo humano* (Various miraculous secrets that reveal the easy way to heal the infirmities of the human body, 1563),[82] also includes dragon's blood in secret formulas for processes ranging from healing nosebleeds to jewel-making and producing colored ink.[83] Likewise, the book *I secreti della signora Isabella Cortese* (The secrets of signora Isabella Cortese, 1565), attributed to an unidentified female writer,[84] uses preparations containing dragon's blood for whitening teeth and for making unguents and dyes.[85] The substance is also mentioned in the popular domestic handbook of secrets the *Opera nova intitolata Dificio di ricette* (The palace of recipes), first published in Venice (1529) and subsequently republished and translated into various languages.[86] It is used here in the preparation of a collyrium to cure sore eyes. What these texts more clearly evince, apart from the assorted uses of dragon's blood for cosmetics, dyeing, tincturing, jewelry making, and personal hygiene in a bourgeois household setting, is the circulation of dragon's blood as a retail commodity in the late sixteenth century. Terms like "fino" (fine), "in lagrima" (in tears), and "maccinato" (ground) suggest that dragon's blood was commercialized in at least two distinct forms: as a juice or liquid, and as an earth, lozenge, or powder, both of which could be adulterated in various ways. Thus, the books of secrets provide glimpses into the circulation of simples as consumer goods in the early modern period and practical instructions for their manipulation in the household.

The question still remains as to what exactly doctors, healers, or laypeople understood when recording or reading *sangue di drago* in a medical recipe or a book of secrets, and what substance was actually used. The confusion with the poisonous cinnabar admonished by Leoniceno may well have been the case with less well-trained medical practitioners. Indeed, various medical recipes list *cinabro* or *cinabrio* in the preparation of "acqua forte" for dental and oral care,

[82] On the attribution of Falloppio's book to Fioravanti, see Eamon, 1994, 166–68.

[83] Falloppio, 1563, prescribes "sangue di drago" in various preparations. See 29: "unguento per ogni piaga et per far aprir la piaga che fosse troppo presto serrata [ointment for every sore and to open the sore that was closed too soon]," 57–58: "rimedio per stagnare il sangue del naso [remedy for nosebleeds]," 268–69: "diversi modi di far molte pretiose gioie [various ways of making several precious stones]," 301–02: "a far lettere d'oro in carta, e in altre cose [making golden letters in paper and other materials]."

[84] On Cortese, see the introduction to *Secrets and Knowledge in Medicine and Science*, 16–17; and Eamon, 2011, 28–34.

[85] Cortese, 12, 90, 124, and 125.

[86] See Eamon, 1994, 361–65; Eamon, 2011, 35–38.

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and the manufacture of red wax ("ciera rossa").[87] In the book of secrets literature, cinnabar is also extensively cited both as a dye and a medicine, as shown, for example, in the manifold uses prescribed by the Bolognese physician Leonardo Fioravanti (1517–83) in his *Del compendio de i secreti rationali* (The compendium of rational secrets, 1564), where it is not only recommended for the preparation of red ink but also prescribed for the healing of ailments of the stomach and ears, for the treatment of ulcers, and even for the "French disease."[88] This practice may well have resulted in intoxication, especially if cinnabar was consumed for extended periods of time or in the wrong dosage. If confused with other simples, such as dragon's blood, and used in larger quantities and taken orally, cinnabar could prove lethal.[89] In this respect, it is noteworthy that the 1499 *Ricettario fiorentino* (The Florentine recipe book) does not include cinnabar anywhere in the inventory of simples or the accredited pharmaceutical preparations.[90] This is a further confirmation not only of Leoniceno's judgment regarding the toxicity of cinnabar but also, more generally, of the civic guilds' efforts to regulate the exercise of the medico-pharmaceutical profession in the face of a rambling and highly experimental vernacular tradition embraced by unlicensed practitioners.

In most of the Italian medical recipe books, dragon's blood is routinely listed together with "bolio armeno" (Armenian bole) and "terra sigillata" (sealed earth), usually in close proximity.[91] An examination of some of the records of the Speziale al Giglio in Florence, which transmit detailed accounts of retail sales by customers from 1464 to 1568 in over forty volumes, reveals a similar pattern, as most purchase orders filled by clients include Armenian bole and sealed earth together

[87] See BNF MS Mag. XV 92, fols. 34^{v} and 40^{v}: "cinabro fine [fine cinnabar]" used "affare acqua forte per la bocca secondo la ricietta di m. fruosino [making strong water for the mouth following master Fruosino's recipe]," fols. 96^{r} and 120^{v}: "cinabro" used for "ciera rossa [red wax]," fol. 182^{r}: "acqua forte fine [fine strong water]," fol. 190^{r}: for "acqua forte [strong water]," BR MS Ricc. 2168, fol. 17^{v}: "cinabrio mannato"; BR MS Ricc. 2162, fol. 30^{r}: "cinabro" for "ciera rossa"; BR MS Ricc. 2376, fol. 32^{r}: "cinabro"; BR MS Ricc. 2709, fol. 86^{r}: "cinabro" mixed with "cera chiara [clear wax]," and "trementina [turpentine]."

[88] See Fioravanti, fols. 17^{r}–18^{r}, 28$^{r–v}$, 44^{r}–45^{v}, 50^{v}–51^{r}, and 53$^{r–v}$. When discussing the medical properties of metals (book 2, chapter 73), Fioravanti mentions that cinnabar heals the French disease ("Il cinabrio sana il mal francese"): 77.

[89] On the toxicity of cinnabar and its use in traditional medicine, see Liu et al.

[90] Cinnabar is, however, listed as a colorant in the 1574 edition of the *Ricettario fiorentino*, 97. "Cinabro" (cinnabar) is mentioned here, along with other substances, in a chapter on coloring medicines ("Del colorire").

[91] See: BNF MS Mag. XV 92, fols. 39^{r}, 46^{v}, 49^{r}, 63^{r}, 85^{v}, 106^{r}, 108^{r}, 109^{r}, 121^{r}, 123^{r}, 128^{r}, 130^{v}, 151^{v}, and 162^{v}; BR MS Ricc. 1177, fols. 137^{v} and 138^{r}; BR MS Ricc. 2168, fols. 21^{v}, 22^{v}, 23^{r}, 24^{r}, and 27^{r}; BR MS Ricc. 2376, fols. 46^{r}, 48^{v}, 105^{v}, and 108^{r}; BR MS Ricc 2709, fol. 103^{r}. On the therapeutic uses of these medicinal earths, see Macgregor.

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with dragon's blood.[92] Many of these clients made regular acquisitions of these three simples, such as the friars of the Badia of Florence, probably to stock the abbey dispensary and prepare their own medicines.[93] The correlation of the recipe books and apothecaries' registers suggests that toward the turn of the fifteenth century—in Florence, at least—dragon's blood was primarily commercialized as some form of medicinal red earth worked into cakes or lozenges. This matches the admonition of the university-trained physicians, such as Mattioli, Cordus, and Falloppio, who mention the various ways in which true dragon's blood was adulterated and sold in this compact form by apothecaries, and used by healers and veterinarians alike. It is likely that *sanguis draconis in lachryma*, which occurs frequently in the sixteenth-century books of secrets, was subsequently processed from these lumps or cakes. At any rate, counterfeit production of dragon's blood was the order of the day. An eloquent example of the adulteration procedure is recorded by Giovanni Villani in a sixteenth-century manuscript handbook of secrets: "Way of making dragon's blood. Pick pieces of broken pots, and used texts, pound them and dust them thinly and with them incorporate the redwood. Other way for the same. Pick rosin pitch, melt it and incorporate the redwood, and grain, and an egg white, and you can also add a speck of pounded pots, as above. This is called dragon's blood in tears."[94]

[92] Archivio dell'Ospedale degli Innocenti (hereafter AOI), Estranei (hereafter E) 12931, fol. 316^{r}: "unzione magistrale da reni in che ento sanghue di testugine sanghue di dragho bolo armeno terra sugielata e altre chose [magisterial kidney ointment containing tortoise blood, dragon blood, Armenian bole, sealed earth, and other things]"; AOI E 12932, fol. 52^{r} (May 1496): "bolo armeno, sangue di drago, eterra sugialata [Armenian bole, dragon's blood, and sealed earth]," fol. 55^{r}: "sangue di drago," fol. 70^{v} (July 1496): "sangue di drago, bolio armeno, terra sigillata," fol. 78^{r} : "bolo armeno, sangue di drago terra sigillatta" / "Fratte et monaci dela badia di firenze [Friars and monks of the Abbey of Florence]"; AOI E 12933, fol. 3^{v} (March 1497): "bolio sangue di drago" / "bolio armenio sangue di drago," fol. 134^{v} (April 1499): "sangue di drago, bolio armenio, limatura diaborso, coralli [dragon's blood, Armenian bole, ivory filings, corals]."

[93] On the Giglio business, see Shaw and Welch, 31–80; on the monks of the Badia di Firenze as regular customers, see Shaw and Welch, 95–98.

[94] "Modo di fare il sangue di drago. R[ecipe] pezi di pentole rotte, testi usati, pestali e spolverizali sottilme[n]te et con essi incorpora verzino. Altro modo p[er] il medesimo. R [ecipe] della pece colofonia, fondila et incorpora co[n] essa verzino, et grana, e una chiara d'huovo, e puoi anche agiugner[e] una perticella di pentole peste come di sopra." Biblioteca Estense Universitaria, Modena, MS Campori App. 504 (gamma R.5.17), "Segreti di Giovanni Villani." See a complete online transcription of this manuscript in Baraldi, 80. For other similar methods of producing counterfeit dragon's blood, see BNF MS Pal. 916, fol. 73^{r}: "per fare otimo sangue di dragone [to make optimal dragon's blood]"; and BNF MS Mag. XV 118, fol. 6$^{r–v}$: "a chontrafare sanghue di dragho [to counterfeit dragon's blood]."

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

IN SEARCH OF DRAGON'S BLOOD: TRAVEL NARRATIVES AND NEW MYTHOLOGIES

The frequent references to adulteration indicate that whatever was commercialized as genuine dragon's blood in the early modern period was indeed a costly merchandise. Beginning with Pliny's account of the legendary origin, dragon's blood must have often been associated with an Oriental, exotic, and expensive substance imported into Europe from the Levant, and later on from the Atlantic trade.[95] This must have been the case with the merchants who traded the product from the East, as well as navigators and explorers, who provided the first references both to the red sap and to the tree from which it was extracted. While early descriptions of the dragon's blood tree (now the *Dracaena* species) and the red gum can be found in late medieval travel narratives, the information derived from this broadly defined genre of literature barely encroached on the traditional European pharmacopeias well into the seventeenth century and was only belatedly, if not inconsistently, incorporated into the intellectual debates regarding the identification of the substance. Moreover, far from helping elucidate the enigma, the proliferation of accounts from the West Indies in the sixteenth century, along with the new discoveries and naturalistic explorations, obscured the matter even further. Notwithstanding the miscellaneous reports, the common understanding in travel literature was that dragon's blood was indeed the product of an exotic tree.

Travel writing could accommodate different textual formats, such as letters, first-person narratives, or official chronicles, authored by a diverse array of personalities ranging from merchants, missionaries, and explorers to naturalists and physicians. Autopsy and empirical details, often couched in a language of wonder and novelty, were nonetheless standard features of most early modern travel accounts.[96] The earliest reference to Canarian dragon's blood as a costly commodity can be found in Jean de Bethencourt's *Le Canarien* (The Canarian, 1402–22), an account of the conquest of the islands written by the Franciscan chroniclers Jean Le Verrier and Pierre Boutier. Here we are informed that the valuable gum, worth two hundred gold doubloons ("deulx cens doubles d'or"), was bartered with the locals for inexpensive European goods such as tools, knives, and hooks. The *dragonnyer* (dragon tree) is also mentioned here as

[95] See, for example, Gucciardini, 119. He lists dragon's blood as one of the exotic products acquired by apothecaries in Antwerp from Venice: "canella, noci moscade, gégiouo, & drogherie assai, come riobarbero, cassia, agarico, *sangue di drago*, mummia, sena [cinnamon, nutmeg, ginger, and various drugs, such as rhubarb, cassia, agaric, dragon's blood, mummy, senna]." On the trade of colorants and *materia medica*, see Delancey.

[96] For an overview of travel writing as a genre, see Campbell; for the early modern period, see Maclean. On the rhetoric of wonder, see, among others, Sell; Greenblatt, 73–80.

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the source of dragon's blood.[97] The first mention of the mode of extracting the gum from the tree is found in the travel account made by Alvise Cadamosto (ca. 1432–88), a Venetian explorer hired by the Portuguese prince Henry the Navigator, who undertook two journeys to West Africa, in 1455 and 1456. In his narrative, first published in 1507,[98] *sangue di drago* is mentioned on two occasions. In the opening section, it is cited as one of the commodities, among other valuable items ("buone cose utili"), from the island of Madeira, which were presented to Cadamosto by the Portuguese to lure him into the lucrative business of exploiting the natural resources of the island and finding other exotic goods ("cose amirande").[99] The wording of Cadamosto's text suggests that *sangue di drago* was a familiar commodity, whose commercial value must have been well known, especially to a Venetian merchant.

What was unprecedented, however, is the description he gives of the extraction process from a tree endemic to the island of Porto Santo. While recounting his first navigation, Cadamosto writes that the gummy resin is extracted from incisions made into the bark of a tree, cooked, filtered, and made into blood.[100] It would take over three decades for the next record of the *Dracaena draco* species by a European traveler to appear. This time it was the German humanist Hieronymus Münzer (1437/47–1508) who made a description of the three dragon's blood trees that he found in the monastery of Saint Augustine in Lisbon, which he recorded during his travels through the Iberian Peninsula in 1494–95.[101] Münzer provides a detailed description of the physical form and external structure of the magnificent *draco* ("arbor magna"), including the trunk, branches, bark, and fruits, along with the extraction of the red sap ("succus rubeus"), called *sanguis draconis*.[102] Unfortunately, Münzer's Latin text must have enjoyed a very limited circulation, since it was preserved in a single manuscript, which was only published in the early twentieth century.[103] In a letter written in 1517, the Italian explorer Andrea Corsali (b. 1487), who traveled to Asia aboard a Portuguese vessel, offers the first reference to the Oriental dragon's tree (now the *Dracaena cinnabaris*), which he encountered on the island of Socotra. Naturally, explorers were perfectly

[97] See *Le Canarien*, 2:135, 149, 237, 239, 243.

[98] In Montalboddo.

[99] Montalboddo, 3^{r}.

[100] Montalboddo, 3^{r} and $4^{r–v}$.

[101] The Latin text of the Iberian section of the *Itinerarium* was published in 1920 by Ludwig Pfandl in *Revue Hispanique* as "Itinerarium Hispanicum Hieronymi Monetarii." See Pfandl.

[102] Pfandl, 83–84.

[103] The report exists today only as a copy and is preserved in a codex of Hartmann Schedel (Bayerische Staatsbibliothek, Munich, MS Clm 431, fols. 96^{r}–274^{v}).

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

unaware of the existence of more than one species of dragon's tree from which the red gum could be extracted. After briefly describing the wondrously high mountains ("di maravigliosa grandezza") and the many watercourses on the island ("infiniti rivi d'acqua dolce"), Corsali writes that he could find much dragon's blood, the gum of a tree ("gomma d'un' arbore"), and describes its pyramidal shape and protruding umbrella-like branches atop.[104] Similarly, the Christian pastor and officer of Portuguese India, Duarte Barbosa (1480–1521), while describing the island of Socotra and its native population, writes, "In this island there is much dragon's blood and aloes of Socotra."[105] Toward the mid-sixteenth century, the French Franciscan friar André Thevet (1516–90) notes again the presence of the dragon tree on the island of Madeira, the method of extracting dragon's blood, and its cherry-shaped, yellowish fruit. Unlike his predecessors, he makes an explicit correlation between dragon's blood and the cinnabar mentioned by Dioscorides and Pliny, observing the astringent and cooling properties of these substances.[106]

A remarkable example of the confluence between medical humanism, trade, and the epistolary genre is offered by the German physician Johann Lange (1485–1565), in a letter entitled "De Sanguis Draconis et Cinnabaris Speciebus."[107] While sojourning in Venice, Lange recounts, he met a friend of his, Geraldus, who had just returned from Alexandria carrying a mysterious parcel ("farcinula"). At dinner, Geraldus opened the parcel and produced a gum of purple color ("gummata purpurei coloris") the size of a hazelnut ("nucis auellanae magnitudine"). He proudly declared that it was *sanguis draconis* originating from the Eritrean Sea, Arabia, and the Atlantic Sea, on the island of Porto Santo. Geraldus referred to this substance as "Indian cinnabar," a medicine used to produce antidotes and healthy eye salves ("colliria") and to stop hemorrhages, and distinguished it from the mineral cinnabar, the poisonous ore with which it was often confused, to the detriment of human health.[108] Reviewing the usual classical authorities, Lange explains that this Indian cinnabar, extracted from trees in India and the islands of the Atlantic, was unknown to Dioscorides, Pliny, and Theophrastus, but is mentioned in the *Periplus of the Erythrean Sea*.[109] By citing the precise passage in the Greek

[104] See Ramusio, 1:181$^{r–v}$.

[105] "In questa isola vi è molto sangue di drago & molto aloe zocoterino": Ramusio, 1:292^{r}.

[106] See Thevet, 14^{v}.

[107] See *Epistolae medicinales*, 531–32 (Epistola LXV). On Lange, see Siraisi, 38–60; Nutton, 2022, 33–35.

[108] *Epistolae medicinales*, 531–32.

[109] Casson, 68 (*Periplus maris Erythraei* 30).

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

text, Lange succeeds in showing the importance of this neglected classical source, which had only been published a few decades earlier.[110] In fact, the *Periplus of the Erythrean Sea*, written sometime around 40 to 70 CE, helps map the connection between the "Indian cinnabar" and the trees on the island of Socotra, which produce a tear-like gum (ὡς δάκρυ). Finally, Lange contrasts the adulterated product on sale in drugstores ("in officinis"), which was full of dirt ("sordibus plena") and odorless ("inodora"), with genuine dragon's blood, which had a slimy texture but pleasant smell, and was used by dyers to fumigate attire and dye wool, and also by the Arabs and Greeks as medicine.[111] Regardless of the veracity of Lange's account, the epistle offers a rather unparalleled articulation of medical connoisseurship, scholarly humanist expertise, and empirical evidence derived from the Venetian trade to the East and West. Moreover, Lange's report is quite unprecedented in bringing together the Indian and Atlantic oceans as sources of dragon's blood.

While travel reports routinely identified dragon's blood as the sap of an exotic tree, it was difficult to determine where exactly that tree grew and which one in particular was the source of the red gum. The description of the new flora from the Spanish and Portuguese colonial territories posed new questions. Toward the late sixteenth century, the dragon's blood enigma was magnified by the accounts of the newly discovered dragon tree growing in the Americas, a novelty that both grew out of the preexisting uncertainties and helped perpetuate them. It was the renowned physician of Seville, Nicolás Monardes (1493–1588), who spread the news of the discovery in the second part of his work on the exotica from the Americas, first published in 1571.[112] Monardes reports on an American tree called "El dragón," described by the bishop of Cartagena (Colombia). The seeds of this plant, Monardes says, were closely inspected by himself and the bishop in question. The fruit of "El dragón," Monardes writes, enclosed a seed in the form of a tiny dragon with an elongated neck, open mouth, thorn-like upright bristles, and a long tail, an image of which is reproduced in his book (fig. 6). After citing the cleric's words about the wondrous seed ("cosa maravillosa de ver"), Monardes denounces the ignorance ("ignorancia") and myriad tales ("mil desatinos") told by ancients and moderns regarding dragon's blood. It was, Monardes claims, a matter of time until the truth came to light, for time was the discoverer

[110] The *Periplus* was first published in 1533 and mistakenly attributed to Arrian, author of the later *Periplus of the Black Sea*. There were several subsequent editions, all of which reproduced numerous errors contained in the only manuscript available, the codex *Palatinus Graecus* 398, fols. 40^{v}–54^{v}, in Heidelberg. See Casson, 5–6.

[111] *Epistolae medicinales*, 531–32.

[112] Monardes, fols. 78^{v}–80^{v}.

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of all things ("descubridor de todas las cosas"). Nature forged the emblem of a dragon in the seeds, whence the name of the tree and, by extension, the red sap derives. Monardes thus shows that the evidence brought forth by the cleric confirms the source of true dragon's blood and settles the age-old debate: "And from now on we are certain of what dragon's blood is and why it is thus called because the fruit gives its name to the gum and tear that comes from it."[113]

The fact that botanists have been unable to corroborate the existence of an autochthonous American species with a dragon stamped on the seeds, the vagueness in attributing the finding to an unnamed bishop of Cartagena, and the deliberate manipulation of the dragon's blood legend to create an epiphany raise serious doubts about the veracity of Monardes's account. Was Monardes deceived by the bishop? Had the latter been deceived in the first place? Why was the renowned physician reproducing this untenable account? Given Monardes's strong business interests with America, especially from 1551 to 1565, and his later financial difficulties, it would not be too farfetched to hypothesize a commercial motivation behind the introduction of the American species as the true legendary red gum.[114] The account, in fact, can be read as a full-fledged marketing strategy. By advertising the true "dragon" from the Americas, was the Spanish physician expecting to hog the trade of dragon's blood by introducing a new red sap–producing species from Colombia (the *Pterocarpus officinalis Jacq.*, *Pterocarpus draco L.*),[115] one that would vie with the Portuguese *Dracaena draco* in the Azores, Madeira, and Porto Santo, or the *Dracaena* species in the East? If so, who would finance or profit from these gains?

Whatever Monardes's motivation, his account of the American dragon tree was widely circulated well into the seventeenth century. His work was soon translated into Latin in an abridged form (1575), and translated into Italian (1576) and English (1577). Monardes's last-ditch legend swelled thereafter the ranks of the age-old fabrications related to the tree and its sap. The success of Monardes's account can be measured by the extent to which it was integrated into the botanical literature of the late sixteenth century. One year after Monardes's 1571 publication of the second part of his work, for example, the Spanish physician Juan Fragoso reworks the detail regarding the image of

[113] "Y de aquí adelante estaremos certificados qué sea sangre de drago y por qué se dice sangre de drago, pues su fructo da el nombre al árbol y a la goma y lágrima que de él sale": Monardes, fols. 79^{v}–80^{r}.

[114] On Monardes's commercial ambitions and the exploitation of American species, see, among others, Nutton, 2022, 19–21; and Pardo Tomás, 198–201.

[115] On these species, see Weaver.

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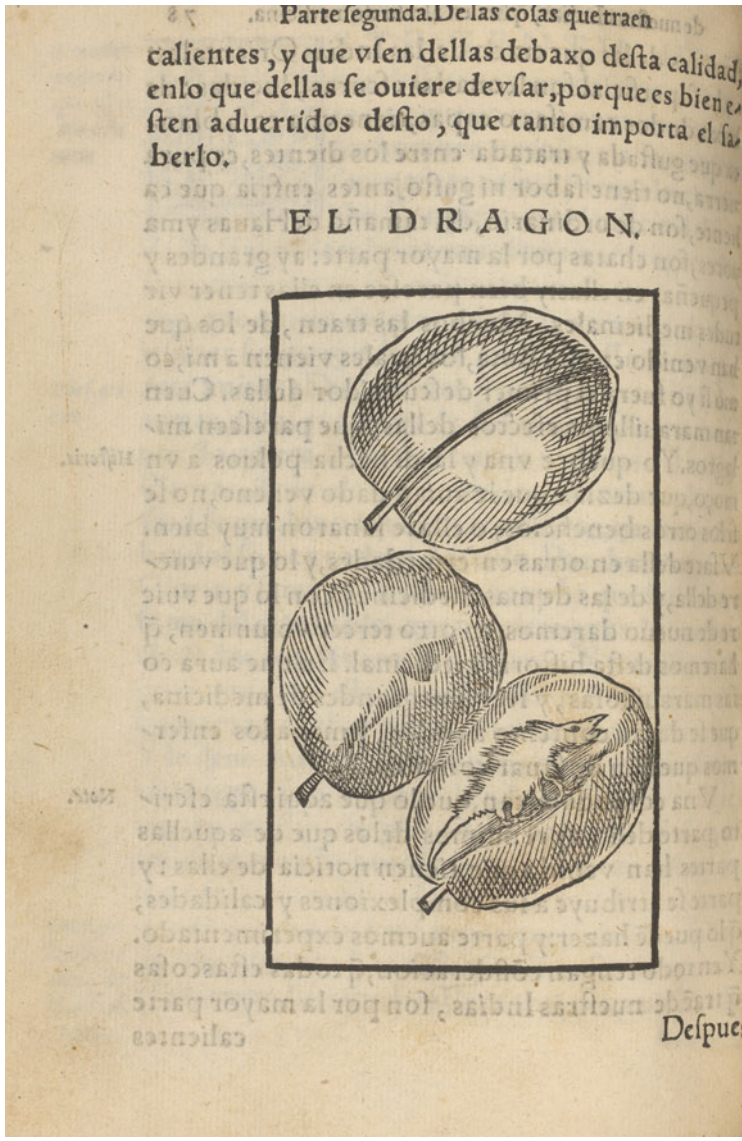

Figure 6. "El dragón," in Monardes, *Primera y secunda y tercera partes de la historia medicinal de las cosas que se traen de nuestras Indias occidentales que sirven en medicina*, 1574, fol. 79[r]. Courtesy of the Wellcome Collection.

the dragon imprinted on the seeds to describe the dragon tree species from the Canary Islands, which certainly does not match the newly discovered American species but, rather, the well-known *Dracaena draco* identified by Jean de

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Bethencourt in the early fifteenth century.[116] Reproducing Monardes's words verbatim to describe a different species, Fragoso not only replicates the myth but also complicates the dragon's blood narrative further. The legend soon traveled abroad.[117] Published in 1597, John Gerard's lofty and richly illustrated *The Herball, or Generall Historie of Plants* (chapter 135, "Of the dragon tree") transmits the same legend in connection with the fruit of the tree: "Wherein is to be seene, as Monardus and diuers other report, the forme of a dragon, having a long necke, or gaping mouth, the ridge or backe armed with sharpe prickes, like the Porpentine; it hath also a long taile, and fower feet, very easie to be discerned." Gerard's notice on the origin of the tree, now further complicated, is the perfect colophon for over a century of ever-growing uncertainties: "And as it seemeth it was first brought out of Affrike, although some are of contrarie opinion, and say, that it was first brought from Carthagena, in Nova orbe, by the bishop of the same province."[118]

CONCLUSION

Writing in the early sixteenth century, the Swiss physician Paracelsus (1493–1541) evoked the daunting task of naming, identifying, and manipulating drugs and materials in early modern Europe. He said, "And even the jars and pots in the apothecaries, you see how they are all indicated and marked with different names on the labels, for if this were not so, who could recognize the various waters, the various liquors, the syrups, oils, powders, seeds, ointments, and all the simple medicines?"[119] The difficulty arose from a combination of terminological, technical, and epistemic factors that rendered the identification of substances particularly problematic. Not only did pre-Linnaean taxonomies based on the authorities of Greco-Roman, Arab, and medieval sources provide inconsistent nomenclatures, soon to be heightened by the transoceanic discoveries, but artisanal methods of manipulating substances also failed to yield reliable criteria for identifying products that were commercialized in a given form and often subject to adulteration. More broadly, the various early modern communities of learning and practice

[116] Fragoso, fols. 89^{v}–90^{r}.

[117] On Monardes's "El dragon" and its circulation, see Molinos Tejada and García Teijeiro; on the iconographic tradition of Monardes's dragon and the language of alchemy, see Bauer, 2014; Bauer, 2019, 346–54.

[118] Gerard, 1339.

[119] "Also sehen ir auch an den glesern und büchsen in apotheken wie dieselben alle mit besondern underschitlichen namen auf zedeln bezeichnet und signirt werden. wa das nit geschehe, welcher wolt erkennen die mancherlei wasser, die mancherlei liquores, die syrup, olea, pulveres, samen, salben, und in summa alle simplicia": Paracelsus, 375.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

codified natural objects in different ways and established assorted—sometimes conflicting—criteria for the description, classification, definition, or use of medicinal substances and materials.

The fluctuations in meaning, reference, and connotations of the name *sanguis draconis* have shown that different genres of learned, artisanal, and empirical literature codified natural objects differently; presupposed different *realia*; created conflicting regimes of truth and falsity, authenticity and inauthenticity; and established various criteria for the description, classification, and use of medicinal simples and materials more generally. In this regard, while the university-trained physicians and pharmacists advocated a correspondence notion of truth, whereby names were expected to conform to the objective reality they intend to reproduce, the vernacular tradition of medicine, health, and artisanal practices appeared to operate by long-standing consensus within a community of practice and by pragmatic criteria that prioritized use-values and effects as the yardsticks of truth. As discussed above, the intellectual debates among physicians and botanists were largely geared toward the identification of a precise referent under the name *sanguis draconis*, one that primarily rested on the cross-examination of authoritative texts but increasingly incorporated empirical evidence. Advocating the language of truth, this genre of discourse was actively engaged with discussions about authentic and adulterated materials. The artisanal episteme, on the other hand, organized knowledge based on functional criteria, drawing not only on the Aristotelian-Hippocratic-Galenic paradigm but also on oral vernacular traditions grounded in a metaphoric conception of language and the world that was capable of evoking symbolic and esoteric meanings. The naturalistic data provided by the chronicles of the Indies, narratives of travel to the East, and official or private missives in the era of transoceanic discoveries was driven, in turn, by a profit-oriented rhetoric of the wondrous, the exotic, and the new, which multiplied the sources of conflicting information by adding new, uncharted specimens to the European markets.

Naturally, the boundaries between these broadly defined epistemic paradigms were porous. Cross-pollination and overlaps between these communities of learning and practice frequently occurred as Renaissance humanists, artisans, and merchants performed various social roles, interacted with each other, and generated new knowledge and genres of scientific discourse. Medical humanists not only lectured in universities but also practiced medicine; healers, artisans, and alchemists convened at the apothecary's for their raw materials and supplies; and naturalists increasingly joined the crews in transoceanic ventures. It is precisely at these junctures that new insights were made in the correct identification of dragon's blood and other red substances. When Leoniceno associated Pliny's and Dioscorides's *kinnabari* with the *sangue di drago* on the

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marketplace; when Fuchs supplemented his bookish knowledge with Cadamosto's account; when Falloppio was sensitive to the esoteric resonances of dragon's blood in religious art; and when a close reading of a recently discovered text, the *Periplus of the Erythrean Sea*, revealed the missing link in the botanical literature, connections were established across systems of knowledge and new discoveries were made.

However, the dragon's blood enigma endured. The intersection of various knowledge traditions, languages, and translation processes, coupled with mystifying reports on new botanical discoveries, meant that the information was not uniformly circulated, but accrued in multilayered, contested, and fragmentary ways during the fifteenth and sixteenth centuries. The period from 1492, a symbolic date that brings together Columbus's landing on San Salvador and the debates on Pliny's *Natural History* in Italy, to 1597, the year that marks the publication of the *Ricettario fiorentino di nuovo illustrato* (The new illustrated Florentine recipe book) and John Gerard's *The Herball, or Generall Historie of Plants*, reveals a complex pattern of non-cumulative, coexisting, and often contradictory fragments of information on dragon's blood in early modern Europe. It comes as no surprise, then, that the 1574 edition of the *Ricettario fiorentino*, the official civic pharmacopeia, still described *sangue di drago* in these highly tentative terms: "The dragon's blood held by some, as Dioscorides said, to be cinnabar, is according to what the Florentine Andrea Corsali reports, a gum of a hefty tree, of delicate bark, which narrows down from bottom to top as a round pyramid, at the tip of which are a few branches with carved leaves, like those of the oak. The gum is red, like natural blood, transparent and breakable, and is commonly called dragon's blood in tears, unlike another mixture, which is sold for dragon's blood, and is adulterated, and should not be used in its place. Some think that dragon's blood is the juice of the clarified and dried *siderite achillea*, of which we have no certainty. The latter can be used in the absence of dragon's blood, but since the aforementioned gum abounds, it should not be left behind."[120]

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[120] "Il sangue di drago, tenuti da alcuni, come diceva Dioscoride, che fussi il cinabro, è secondo che riferisce Andrea Corsali Fiorentino, una gomma di un grosso arbore, di scorza dilicata; il quale va continuamente diminuendo da basso ad alto come rotonda piramide; nella punta del quale sono pochi rami con foglie intagliate, come quelle della rovere. La gomma è di color rossa come di Sangue naturale, e trasparente, e frangibile; e chiamasi volgarmente Sangue di drago in lagrima, à differenza di una altra mestura, la quale si vende per sangue di Drago, & è adulterata, e non da usarsi per esso. Alcuni pensano, che il sangue di drago sia il sugo della siderite achillea chiarito, e secco; del che non ne habbiamo certezza: ben si potrebbe usare per sangue di Drago, mancando del sopradetto, per hauere qualità assai simili;

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

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ma mentre che noi hauiamo copia della sopradetta gomma, non si deve per altra cosa lasciarla in dietro": *Ricettario fiorentino*, 62.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

BIBLIOGRAPHY

Archival and Manuscript Sources

Archivio dell'Ospedale degli Innocenti (AOI) Florence, Estranei (E), 12931. "Memoriale grande terzo" (1493–95). Retail sales of the speziale al Giglio (Tommaso di Giovanni di Piero's tenure), 479 fols.

AOI, E, 12932. "Memoriale giallo segnato A" (1495–1502). Retail sales of the speziale al Giglio (Tommaso di Giovanni di Piero's tenure), 255 fols.

AOI, E, 12933. "Memoriale rosso segnato A" (1497–1503; 1508–21). Retail sales of the speziale al Giglio (Tommaso di Giovanni di Piero's tenure), 216 fols.

Biblioteca Estense Universitaria, Modena, MS Lat. 175 (alfa.0.6.8). Marango, Pietro. "Liber novae traditionis per tabulas," fols. 99^{r}–105^{v}. 1290–94.

Biblioteca Estense Universitaria, Modena, MS Campori App. 504 (gamma R.5.17), "Segreti di Giovanni Villani," S. XVI.

Bayerische Staatsbibliothek, Munich, MS Clm 431. "Conradi Celtis Protucii libellus de situ, moribus et institutis Norimbergae," fols. 96^{r}–274^{v}. S. XV–XVI.

Biblioteca Nazionale Centrale di Firenze (BNF), MS Magliabechiano (Mag.) XV 9. Ricette diverse (ca. 1460).

BNF, MS Mag. XV 92. Ricettario di Santa Maria Nuova (1515).

BNF, MS Mag. XV 118. Raccolta di ricette mediche (1470).

BNF, MS Palatino (Pal.) 857. Ricette e segreti di medicina, di alchimia e di arti industriale (in volgare dialettale e in latino). S. XV.

BNF, MS Pal. 916. "Segreti diversi del 1460." 158 fols. S. XV.

BNF, MS Pal. E.6.1.27. *Nuovo Ricettario Fiorentino* ("Nuovo Receptario composto dal famosissimo chollegio degli eximii doctori della arte et medicina della inclita ciptà di Firenze," 1499).

Biblioteca Nazionale Centrale di Roma, MS Vittorio Emanuele 369. "Miscellanea in latino e in volgare di testi medici e farmaceutici," fols. 1^{r}–154^{v}. S. XV.

Biblioteca Riccardiana di Firenze (BR), MS Riccardianus (Ricc.) 878. Marango, Pietro. "Liber novae traditionis per tabulas," fols. 16^{r}–21^{v}. S. XV.

BR, MS Ricc. 956. *Elenchus medicamentorum* (latino), fols. 1^{r}–80^{r}. S. XVIII. Culled from various authors.

BR, MS Ricc. 1177. Pietro da Varignana. "Ricettario" (latino), fols. 130^{r}–141^{v}. S. XV.

BR, MS Ricc. 2160. "Ricettario" (italiano), fols. 1^{r}–114^{v}. S. XVI.

BR, MS Ricc. 2162. "Ricettario" (italiano), fols. 1^{r}–100^{v}. S. XV.

BR, MS Ricc. 2168. "Ricette varie" (italiano), fols. 15^{v}–36^{r}; Niccolò (maestro) "Antidotario" (italiano), fols. 107^{r}–136^{v}. S. XV.

BR, MS Ricc. 2376. "Ricettario" (italiano e latino), fols. 1^{r}–120^{r}. S. XVI.

BR, MS Ricc. 2378. "Ricettario" (italiano e latino), fols. 1^{r}–86^{v}. S. XV.

BR, MS Ricc. 2709. "Ricettario" (italiano), fols. 81^{r}–141^{v}. S. XV–XVI.

BR, MS Ricc. 3057. "Ricettario" (italiano), fols. 34^{r}–181^{v}. S. XVI.

BR, MS Ricc. 3058. "Trattato di cosmetica" (italiano), fols. 1^{r}–84^{v}. S. XVI.

BR, MS Ricc. 3073. "Ricettario" (italiano), fols. 1^{r}–183^{r}. S. XVI–S. XVII.

BR, MS Ricc. 3074. "Ricettario" (italiano), fols. 1^{r}–90^{r}. S. XVI.

Bibliothèque Nationale de France, MS Parisinus Latinus 6741. "Tabula ordine alphabetico digesta de vocabulis synonymis et aequivocis colorum, eorumque accidentium" (1431), fols. 1^{r}–15^{r}.

Bibliothèque interuniversitaire, section médicine, Montpellier, MS H 277. "Liber diversarum arcium," fols. 81^{v}–101^{v}. S. XV.

British Library, London, MS Sloane 1754. "Liber de coloribus illuminatoriis seu pictoriis," fols. 142^{r}–149^{v}. S. XIV (first quarter).

Jagiellonian Library, Kraków, MS 825. Marango, Pietro. "Liber novae traditionis per tabulas" (1412), fols. 251^{v}–254^{r}.

Printed Sources

Abraham, Lyndy. *A Dictionary of Alchemical Imagery*. Cambridge: Cambridge University Press, 1998.

Agricola, Georgius. *Bermannus, sive de Re Metallica*. Basel, 1530.

Alphita: *Edición crítica y comentario*. Ed. Alejandro García González. Florence: SISMEL, Edizioni del Galluzzo, 2008.

Amar, Zohar, and Efraim Lev. *Arabian Drugs in Early Medieval Mediterranean Medicine*. Edinburgh: Edinburgh University Press, 2017.

Avicenna. *Liber canonis, de medicinis cordialibus, et cantica*. Venice: Giunti, 1555.

Baraldi, Pietro, ed. "Trascrizione dei *Segreti di Giovanni Villani* (cap.504 = gamma.r.5.17)." Accessed 31 July 2023. http://bibliotecaestense.beniculturali.it/info/img/cat/i-mo-beu-stru-archeo-gamma.r.5.17.html.

Barbaro, Ermolao. *Castigationes Plinianae, Castigationes in Pomponium Melam*. Venice, 1494.

Baroni, Sandro, Giuseppe Pizzigoni, and Paola Travaglio. *Mappae clavicula: Alle origini della alchimia in Occidente; Testo, traduzione, note*. Saonara: Il prato, 2013.

Baroni, Sandro, and Maria Pia Piccardi. "Tracce di Alchimia in latino, prima dell'Alchimia latina." *Medioevo Europeo* 5.1 (2021): 5–50.

Bauer, Ralph. "The Blood of the Dragon: Alchemy and Natural History in Nicolás Monardes's *Historia medicinal*." In *Medical Cultures of the Early Modern Spanish Empire*, ed. John Slater, María Luz López-Terrada, and José Pardo Tomás, 67–88. London: Routledge, 2014.

Bauer, Ralph. *The Alchemy of Conquest: Science, Religion, and the Secrets of the New World*. Charlottesville: University of Virginia Press, 2019.

Baumer, Ursula, and Patrick Dietemann. "Identification and Differentiation of Dragon's Blood in Works of Art Using Gas Chromatography/Mass Spectrometry." *Analytical and Bioanalytical Chemistry* 397.3 (2010): 1363–76.

Bennett, Bradey. "Doctrine of Signatures: An Explanation of Medicinal Plant Discovery or Dissemination of Knowledge?" *Economic Botany* 61.3 (2007): 246–55.

Bianchi, Massimo L. *Signatura rerum: Segni, magia e conoscenza da Paracelso a Leibniz*. Rome: Edizioni dell' Ateneo, 1987.

Brasavola, Antonio Musa. *Examen Omnium Simplicium Medicamentorum, quorum in Officinis Usus Est*. Rome, 1536.

Bucklow, Spike. *The Alchemy of Paint: Art, Science and Secrets from the Middle Ages*. London: Marion Boyars, 2009.

Bucklow, Spike. *Red: The Art and Science of a Colour*. London: Reaktion Books, 2016.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

Cabo González, Ana María, and Joaquín Bustamente Costa. "En torno al drago, Dracaena draco L. Notas de fitonimia árabe." *Al-Andalus Magreb: Estudios árabes e islámicos* 8–9.2 (2000–01): 325–52.

Campbell, Mary B. "Travel Writing and Its Theory." In *The Cambridge Companion to Travel Writing*, ed. Peter Hulme and Tim Youngs, 261–79. Cambridge: Cambridge University Press, 2002.

Cardano, Gerolamo. *De Subtilitate Libri XXI*. Lyon, 1580.

Casper, Siegfried Jost. "Die Geschichte des Kanarischen Drachenbaumes in Wissenschaft und Kunst: Vom Arbor Gadensis des Posidonius zur *Dracaena draco* (L.) L." *Haussknechtia Beiheft* 10 (2000): 1–128.

Casson, Lionel, ed. *The Periplus Maris Erythraei: Text with Introduction, Translation, and Commentary*. Princeton, NJ: Princeton University Press, 1989.

Cennini, Cennino. *Il libro dell' arte, o Trattato della pittura di Cennino Cennini; di nuovo pubblicato, con molte correzioni e coll'aggiunta di più capitoli, tratti dai codici fiorentini*. Ed. Gaetano and Carlo Milanesi. Florence, 1859.

Cesio, Bernardo. *Mineralogia sive Naturalis Philosophiae: Thesauri lib. IV*. Lyon, 1636.

Champier, Symphorien. *Castigationes seu Emendationes Pharmacopolarum ac Arabum Medicorum*. Lyon, 1532.

Champier, Symphorien. *Le Myrouel des Appothiquaires et Pharmacopoles (Le miroir des apothicaires)*. Ed. Paul Dorveaux. Paris, 1894.

Cifuentes, Lluís. "El receptari mèdic baixmedieval i renaixentista: un gènere vernacle." In *Els manuscrits, el saber i les lletres a la corona d'Aragó, 1250–1500*, ed. Lola Badia, Lluís Cifuentes, Sadurní Martí, and Josep Pujol, 103–60. Barcelona: Publicacions de l'Abadia de Montserrat, 2016.

Clarke, Mark. *Mediaeval Painters' Materials and Techniques: The Montpellier 'Liber diversarum arcium.'* London: Archetype Publications, 2011.

Clusius, Carolus. *Rariorum Aliquot Stirpium per Hispanias Observatarum Historia*. Antwerp, 1576.

Collenuccio, Pandolfo. *Pliniana Defensio Adversus Nicolai Leoniceni Accusationem*. Ferrara, 1493.

Constantinus Africanus. "De gradibus." In *Opera omnia Ysaac in hoc volumine contenta cum quibusdam aliis opusculis*, vol. 2. Lyon, 1515.

Cordus, Valerius. *Annotationes in Dioscoridis de Medica Materia Libros V*. Strasbourg, 1561.

Cortese, Isabella. *I secreti della signora Isabella Cortese*. Venice, 1565.

Crisciani, Chiara. "Ricette e medicina: Tre zibaldoni nel Quattrocento." *Doctor Virtualis* 13 (2015): 11–37.

Daston, Lorraine. "Type Specimens and Scientific Memory." *Critical Inquiry* 31.1 (2004): 153–82.

De Lancey, Julia A. "Dragonsblood and Ultramarine: The Apothecary and Artists' Pigments in Florence." In *The Art Market in Italy: 15th–17th Centuries*, ed. Marcello Fantoni, Loiusa C. Matthew, and Sara Matthews-Grieco, 141–50. Modena: Panini, 2003.

Dilg, Peter. "Die botanische Kommentarliteratur Italiens um 1500 und ihr Einfluß auf Deutschland." In *Der Kommentar in der Renaissance*, ed. August Buck, 225–52. Boppard: Boldt, 1975.

Dioscorides. *Pedanii Dioscuridis Anazarbei: De materia medica libri quinque*. Ed. Max Wellmann. 3 vols. Berlin: Weidmann, 1906–14.

Eamon, William. *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture*. Princeton, NJ: Princeton University Press, 1994.

Eamon, William. "How to Read a Book of Secrets." In *Secrets and Knowledge in Medicine and Science, 1500–1800* (2011), 23–46.

Epistolae medicinales diversorum authorum Ioannis Manardi . . . Nicolai Massae . . . Aloisii Mundellae . . . Io. Baptistae Theodosii . . . Ioan. Langii Lembergii. Lyon, 1556.

Falloppio, Gabriele. *Secreti diversi et miracolosi ne' quali si mostra la via facile di risanare le infirmità del corpo humano*. Venice, 1563.

Falloppio, Gabriele. *Opera Omnia*. Frankfurt, 1584.

Findlen, Paula. "The Formation of a Scientific Community: Natural History in Sixteenth-Century Italy." In *Natural Particulars: Nature and the Disciplines in Renaissance Europe*, ed. Anthony Grafton and Nancy Siraisi, 369–400. Cambridge, MA: MIT Press, 1999.

Fioravanti, Leonardo. *Del compendio dei secreti rationali, libri cinque*. Venice, 1571.

Fragoso, Juan. *Discurso de las cosas aromaticas, arboles y frutales y de otras muchas medicinas simples que se traen de la India Oriental, y sirven al uso de la medicina*. Madrid, 1572.

Frison, Guido, and Giulia Brun. "*Compositiones Lucenses* and *Mappæ Clavicula*: Two Traditions or One? New Evidence from Empirical Analysis and Assessment of the Literature." *Heritage Science* 6.24 (2018): 1–17.

Fuchs, Leonhart. *Paradoxorum Medicinae Libri Tres*. Basel, 1535.

Gentilcore, David. "Was There a 'Popular Medicine' in Early Modern Europe?" *Folklore* 115.2 (2004): 151–66.

Gerard, John. *The Herball, or Generall Historie of Plants*. London, 1597.

Gernett, Folke. "La controversia médica sobre simples y compuestos en el Diálogo llamado Pharmacodilosis de Nicolás Monardes." *Criticón* 137 (2019): 155–73.

Gettens, Rutherford, Robert L. Feller, and W. T. Chase. "Vermilion and Cinnabar." *Studies in Conservation* 17 (1972): 45–69.

Godman, Peter. *From Poliziano to Machiavelli: Florentine Humanism in the High Renaissance*. Princeton, NJ: Princeton University Press, 1998.

Green, Monica. "Bodies, Gender, Health, Disease: Recent Work on Medieval Women's Medicine." *Studies in Medieval and Renaissance History* 4 (2007): 12–17.

Greenblatt, Stephen. *Marvelous Possessions: The Wonder of the New World*. Oxford: Clarendon Press, 1991.

Gucciardini, Ludovico. *Descrittione di M. Lodovico Gucciardini . . . di tvtti i Paesi Bassi*. Antwerp, 1567.

Gupta, Deepika, B. Bleakley, and Rajinder K. Gupta. "Dragon's Blood: Botany, Chemistry and Therapeutic Uses." *Journal of Ethnopharmacology* 115.3 (2008): 361–80.

Guy de Chauliac. *Inventarium, sive Chirurgia Magna*. 2 vols. Ed. Michael R. McVaugh. Leiden: Brill, 1997.

Hasse, Dag Nikolaus. *Success and Suppression: Arabic Sciences and Philosophy in the Renaissance*. Cambridge, MA: Harvard University Press, 2016.

Historia plantarum: Roma, Biblioteca Casanatense, MS 459 "Tacuinum Sanitatis" (ambito lombardo, seconda metà del XIV secolo). Ed. Silvia Panini and Vera Segre Rutz. Modena: Franco Panini Editore, 2001.

Hortus Sanitatis. Ed. Jacob Meydenbach. Mainz, 1491.

Ibn al-Jazzār. *Kitâb al-I'timâd fi'l-adwiya al-mufrada / The Reliable Book on Simple Drugs*. Ed. Fuat Sezgin. Vol 20. Institute for the History of Arabic-Islamic Science at the Johann Wolfgang Goethe University: Frankfurt am Main, 1985.

Ibn al-Jazzār. *On Sexual Diseases and Their Treatment*: *A Critical Edition of Zād al-Musāfir wa qūt al-ḥāḍir, Provisions for the Traveller and Nourishment for the Sedentary, Book 6*. Ed. Gerrit Bos. London: Taylor and Francis, 1997.

Isidore. *Etimologías: Libro XIX; De naves, edificios y vestidos*. Ed. Miguel Rodríguez Pantoja. Paris: Les Belles Lettres, 1995.

Isidore. *The Etymologies of Isidore of Seville*. Trans. Stephen A. Barney, W. J. Lewis, J. A. Beach, and Oliver Berghof. Cambridge: Cambridge University Press, 2006.

Jordan Gschwend, Annemarie, and Katherine J. P. Lowe, eds. *A Cidade Global: Lisboa no Renascimento / The Global City: Lisbon in the Renaissance*. Lisbon: Museu Nacional de Arte Antiga, 2017.

Klein, Ursula, and Emma C. Spary, eds. *Materials and Expertise in Early Modern Europe: Between Market and Laboratory*. Chicago: University of Chicago Press, 2010.

Le Canarien: Crónicas Francesas de la Conquista de Canarias. 3 vols. Ed. Elías Serra and Alejandro Cioranescu. La Laguna de Tenerife: Instituto de Estudios Canarios, 1959–64.

Leoniceno, Niccolò. *Nicolai Leoniceni Vicentini, Philosophi & Medici clarissimi, opuscula*. Basel, 1532.

Leoniceno, Niccolò. *De Plinii in medicina erroribus*. Ed. Loris Premuda. Milan: Edizioni del Giardino di Esculapio, 1958.

Liu, J., J. Z. Shi, L. M. Yu, R. A. Goyer, and M. P. Waalkes. "Mercury in Traditional Medicines: Is Cinnabar Toxicologically Similar to Common Mercurials?" *Experimental Biology and Medicine* 233.7 (2008): 810–17.

Long, Pamela. *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance*. Baltimore, MD: Johns Hopkins University Press, 2001.

Lonitzer, Adam. *Naturalis Historiae Opus Novum*. Frankfurt, 1551.

Macgregor, Arthur. "Medicinal Terra Sigillata: A Historical, Geographical and Typological Review." *Geological Society, London, Special Publications* 375 (2013): 113–36.

Maclean, Gerald. "Early Modern Travel Writing (1): Print and Early Modern European Travel Writing." In *The Cambridge History of Travel Writing*, ed. Das Nandini and Tim Youngs, 62–76. Cambridge: Cambridge University Press, 2019.

Manardo, Giovanni. *Medicinales Epistolae*. Strasbourg, 1529.

Manlio del Bosco, Giovanni Giacomo. *Luminare Maius Super Mesue Antidotarium et Practicam*. Pavia, 1494.

Mason, Peter. *El drago en el Jardín del Edén: Las Islas Canarias en la circulación transatlántica de imágenes en el mundo ibérico, siglos XVI–XVII*. Madrid: Iberoamericana Editorial Vervuert, 2018.

Mattioli, Pietro Andrea. *Di Pedacio Dioscoride . . . Libri cinque della historia et materia medicinale, tradotti in lingua volgare italiana da M. Pietro Andrea Matthiolo*. Venice, 1544.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press

Merrifield, Mary Philadelphia. *Original Treatises Dating from the XII to XVIII Centuries on the Arts of Painting*. 2 vols. London: Murray, 1849.

Molinos Tejada, Teresa, and Manuel García Teijeiro. "La sangre de dragón y el drago." *Fortunatae* 25 (2014): 363–72.

Monardes, Nicolás. *Primera y segunda y tercera partes de la historia medicinal de las cosas que se traen de nuestras Indias occidentales que sirven en medicina*. Seville, 1574.

Montalboddo, Fracanzano da, ed. *Paesi novamente retrovati et novo mondo da Alberico Vesputio Florentino intitulato "A la fin."* Vicenza, 1507.

Mugnai Carrara, Daniela. "Profilo di Nicolò Leoniceno." *Interpres: Rivista di Studi Quattrocenteschi* 2 (1979): 169–212.

Nutton, Vivian. "The Rise of Medical Humanism: Ferrara, 1464–1555." *Renaissance Studies* 11 (1997): 2–19.

Nutton, Vivian. *Renaissance Medicine: A Short History of European Medicine in the Sixteenth Century*. London: Routledge, 2022.

Ogilvie, Brian. *The Science of Describing: Natural History in Renaissance Europe*. Chicago: Chicago University Press, 2006.

Paracelsus [Theophrastus von Hohenheim]. *Sämtliche Werke / Abt. 1: Medizinische, naturwissenschaftliche und philosophische Schriften; Vol. 11, Schriftwerk aus den Jahren 1537–1541*, ed. Karl Sudhoff. Munich: Oldenbourg, 1928.

Pardo Tomás, José. "East Indies, West Indies: García de Orta and the Spanish Treatises on Exotic Materia Medica." In *Medicine, Trade and Empire: Garcia de Orta's "Colloquies on the Simples and Drugs of India" (1563) in Context*, ed. Palmira Fontes da Costa, 195–212. London: Routledge, 2015.

Park, Katharine. *Doctors and Medicine in Early Renaissance Florence*. Princeton, NJ: Princeton University Press, 1985.

Pearson, Jane, and Hew D. V. Prendergast. "Daemonorops, Dracaena and Other Dragon's Blood." *Economic Botany* 55.4 (2001): 474–77.

Petit, Caroline. "Medical Humanism in the Making: Symphorien Champier (1471–1539) and Galen." *Arts et Savoirs* 15 (2021). https://doi.org/10.4000/aes.3753.

Pfandl, Ludwig. "Itinerarium Hispanicum Hieronymi Monetarii (1494–1495)." *Revue Hispanique* 48 (1920): 1–179.

Piemontese, Alessio. *De' secreti del reverendo donno Alessio Piemontese: prima parte, diuisa in sei libri: opera utilissima*. Lyon, 1558.

Platearius, Matthaeus [pseud.]. *Circa instans: De simplici medicina nouis exornatus additionibus*. Lyon, 1512.

Pliny. *Pline l'Ancien: Historie Naturelle, Livre XXXIII*. Ed. Hubert Zehnacker. Paris: Les Belles Lettres, 1983.

Pseudo-Serapion. *Liber aggregatus in medicinis simplicibus*. Venice, 1479.

Pugliano, Valentina. "Pharmacy, Testing, and the Language of Truth in Renaissance Italy." *Bulletin of the History of Medicine* 91.2 (2017): 233–73.

Rabanus Maurus. *De universo libri viginti duo: Opera omnia; Tomus Quintus*. Vol. 111 of *Patrologia Latina*, ed. Jacques Paul Migne. Paris, 1864.

Ramusio, Giovanni Battista. *Delle navigationi et viaggi*. 3 vols. Venice, 1556–63.

Ricettario fiorentino. Florence: Giunti, 1574.

Rosól, Rafal. "The Greek Name of Cinnabar." *Eos (Poland)* 105.2 (2018): 311–22.

Secrets and Knowledge in Medicine and Science, 1500–1800. Ed. Elaine Leong and Alisha Rankin. Farnham: Ashgate, 2011.

Sell, Jonathan. *Rhetoric and Wonder in English Travel Writing, 1560–1613*. Farnham: Ashgate, 2006.

Shaw, James, and Evelyn Welch. *Making and Marketing Medicine in Renaissance Florence*. Amsterdam: Rodopi, 2011.

Silvatico, Matteo. *Pandectae medicinae*. Lyon, 1541.

Simon of Genoa. *Clavis sanationis*. Venice, 1514.

Siraisi, Nanci. *Communities of Learned Experience: Epistolary Medicine in the Renaissance*. Baltimore, MD: Johns Hopkins University Press, 2013.

Smith, Pamela. *The Body of the Artisan: Art and Experience in the Scientific Revolution*. Chicago: University of Chicago Press, 2004.

Smith, Pamela. "Science on the Move: Recent Trends in the History of Early Modern Science." *Renaissance Quarterly* 62.2 (2008): 345–75.

Smith, Pamela. "Vermilion, Mercury, Blood, and Lizards: Matter and Meaning in Metalworking." In *Materials and Expertise in Early Modern Europe: Between Market and Laboratory*, ed. Ursula Klein and Emma Spary, 29–49. Chicago: University of Chicago Press, 2010.

Smith, Pamela. "What is a Secret? Secrets and Craft Knowledge in Early Modern Europe." In *Secrets and Knowledge in Medicine and Science, 1500–1800* (2011), 47–68.

Solinus. *Collectanea rerum memorabilium, iterum recensuit*. Ed. Theodorus Mommsen. Berlin, 1895.

Stannard, Jerry. "Medieval Herbalism and Post-Medieval Folk Medicine." *Pharmacy in History* 55.2/3 (2013): 47–54.

Stratford, Jordan. *A Dictionary of Western Alchemy*, Wheaton, IL: Quest Books, 2011.

Straub, Rolf E. "Der Traktat 'de Clarea' in der Burgerbibliothek Bern." In *Jahresbericht 1964*, 89–114. Zürich: Schweizerisches Institut für Kunstwissenschaft, 1965.

Thevet, André. *Les singularitez de la France antarctique, autrement nommée Amérique, & de plusieurs terres et isles découvertes de nostre temps*. Paris, 1558.

Towaide, Alain. "Foreign vs. Local New Horizons, and Ancient Dilemmas and Strategies?" *Early Science and Medicine* 14.6 (2009): 765–88.

Tractatus de herbis (Ms London, British Library, Egerton 747). Ed. Iolanda Ventura. Florence: SISMEL, 2009.

Trinquier, Jean. "*Cinnabaris* and Dragon's Blood: Ancient 'Cinnabar' between Mineral, Plant, and Animal." *Revue archéologique* 56.2 (2013): 305–46.

Ventura, Iolanda. "La medicina e la farmacopea della Scuola Medica Salernitana e le traduzioni italiane: ipotesi di lavoro." In *Volgarizzare, tradurre, interpretare nei secc. XIII–XVI, Atti del Convegno internazionale di studio, Studio, Archivio e Lessico dei volgarizzamenti italiani (Salerno 24–25 novembre 2010)*, ed. Sergio Lubello, 29–53. Strasbourg: Eliphi, 2011.

Wallert, Arie, and Maarten R. van Bommel. "Sanguis draconis, Dragon's Blood: The Use and Analysis of a Manuscript Illuminators Colorant." *Dyes in History and Archaeology* 21 (2008): 75–88.

Weaver, Peter. "Pterocarpus officinalis Jacq., Palo de Pollo, bloodwood." In *Bioecología de árboles nativos y exóticos de Puerto Rico y las Indias Occidentales*, ed. John Francis and

Carol Lowe, 443–49. Río Piedras, PR: Departamento de Agricultura de los Estados Unidos, Servicio Forestal, 2000.

Webster, Charles. *Paracelsus: Medicine, Magic and Mission at the End of Time*. New Haven, CT: Yale University Press, 2008.

Zwink, Julia. *Altfranzösisch in hebräischer Graphie: Teiledition und Analyse des Medizintraktats Fevres*. Berlin: De Gruyter, 2017.

https://doi.org/10.1017/rqx.2023.543 Published online by Cambridge University Press