

Thinking about Chemistry in Byzantium and the Islamic World

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The historical study of alchemical texts and the practices of those who wrote and studied them is thriving. Long gone are the days when historians could simply dismiss “alchemy” as a pseudoscience, the failed attempt to transmute base metals into silver and gold, practiced by a presumed class of foolish or fraudulent “alchemists,”¹ or Whiggishly mine alchemical texts for fragments of *modern* chemical knowledge and know-how, serendipitous flickers penetrating the darkness of an unfortunate superstition.² Mid-century spiritual-essentialist readings inspired by Carl Jung’s famous psychoanalysis of the metallurgical, allegorical dream-visions of Zosimos of

Work on this article was supported in part by an Alexander von Humboldt Fellowship at the Seminar für Semiotik und Arabistik of the Freie Universität Berlin (2020–21) and a National Endowment for the Humanities Fellowship (2022–23). Some material was presented and received valuable commentary and discussion at the Symposium in Honor of Professor George Saliba on the Occasion of his Retirement (Columbia University, February 2017); the Pre-Modern Mediterranean Seminar (EMSI and the Center for the Premodern World, University of Southern California, April 2020); and seminars in Middle East and Islamic Studies at the University of California, Riverside (October 2020), and at the Freie Universität Berlin and the Universität Tübingen (June 2021). I would also like to thank the anonymous reviewers, Manan Ahmed, and Ida Stewart for their comments, corrections, and suggestions.

¹ For an early dissenting voice, see Arthur John Hopkins, “A Modern Theory of Alchemy,” *Isis* 7, no. 1 (1925): 58–76.

² This was the approach, for example, of the foundational work of Marcellin Berthelot, *La chimie au Moyen Âge*, 3 vols. (Paris: Imprimerie nationale, 1893). Cf. Hopkins, “Modern Theory,” 70 suggestions.

Panopolis (ca. 300 CE)³ have also receded; few historians today believe that human perfection, not material change, was “alchemy’s” true quest. Instead, in the past several decades a new approach, developed largely by early modernists and dubbed the “new historiography of alchemy,”⁴ has become predominant and widely practiced,⁵ though older historiographies of alchemy, while seldom explicitly endorsed by specialists, continue to be influential.⁶

The “new historiography,” which typically approaches alchemical texts as evidence for the history of science that must be read in the contexts of practitioners’ lifeworlds, has produced impressive results. Over the last three decades, its practitioners have demonstrated that in the early modern period transmutational theory and practice was understood and pursued as part of the same discipline as non-transmutational chemistry,⁷ and they have shown how consequential, socially and intellectually, the nexus of chrysopoeia, counterfeiting, mining, artisanry, scholarship, and patronage was in early modern western Europe.⁸

Meanwhile, recent work on Aristotle’s theory of material transformation has advocated for the usefulness of applying the term “chemistry,” understood as the theory and practice of the transformation of matter, to

³ Carl Gustav Jung, “Einige Bemerkungen zu den Visionen des Zosimos,” *Eranos-Jahrbuch* 5 (1937): 15–54.

⁴ Lawrence M. Principe, “Reflections on Newton’s Alchemy in Light of the New Historiography of Alchemy,” in *Newton and Newtonianism: New Studies*, ed. James E. Force and Sarah Hutton (Dordrecht: Springer, 2004), 205–19; Brian Vickers, “The ‘New Historiography’ and the Limits of Alchemy,” *Annals of Science* 65, no. 1 (2008): 127–56 (a critique of this “new historiography”); William R. Newman, “Brian Vickers on Alchemy and the Occult: A Response,” *Perspectives on Science* 17, no. 4 (2009): 482–506.

⁵ For these historiographical shifts, with further references, see Wouter J. Hanegraaff, *Esotericism and the Academy: Rejected Knowledge in Western Culture* (Cambridge: Cambridge University Press, 2012), 195–97, 289–94.

⁶ E.g., in the works critiqued by William R. Newman, *Atoms and Alchemy: Chymistry and the Experimental Origins of the Scientific Revolution* (Chicago: University of Chicago Press, 2006), 6–12. Some older but still often consulted works too maintain the influence of older approaches, such as the indispensable reference work by Manfred Ullmann, *Die Natur- und Geheimwissenschaften im Islam* (Leiden: Brill, 1972), 1, 145–46 [hereafter NGWI].

⁷ E.g., William R. Newman, *Gehennical Fire: The Lives of George Starkey, an American Alchemist in the Scientific Revolution* (Cambridge, MA: Harvard University Press, 1994); Lawrence Principe, *The Aspiring Adept: Robert Boyle and His Alchemical Quest* (Princeton, NJ: Princeton University Press, 1998); Newman, *Atoms*; William R. Newman, *Newton the Alchemist* (Princeton, NJ: Princeton University Press, 2019).

⁸ E.g., Pamela H. Smith, *The Business of Alchemy: Science and Culture in the Holy Roman Empire* (Princeton, NJ: Princeton University Press, 1994); Tara Nummedal, *Alchemy and Authority in the Holy Roman Empire* (Chicago: University of Chicago Press, 2008); Jennifer M. Rampling, *The Experimental Fire: Inventing English Alchemy, 1300–1700* (Chicago: University of Chicago Press, 2020). I am grateful to an anonymous reviewer for emphasizing the methodological relevance of the last two books to the present study.

sources dating from before the rise of the modern chemical paradigm in the eighteenth century. It has been convincingly argued that Aristotle's theories of mixture and "diagnosis" constitute a legitimate theory of chemistry that should be recognized as such by historians of science.⁹

What about the period between Aristotle and early modernity, a period for which much of the evidence for intellectual developments in natural philosophy and the textual tradition typically called "alchemical" are in Greek and Arabic? Within both Islamic Studies and Byzantine Studies, the history of alchemy¹⁰ has tended to be a specialized subfield pursued in relative isolation from the broader history of science and philosophy, with important exceptions.¹¹ For the history of alchemy in Byzantium and the Islamic world, connections with other "occult sciences" and, in the case of Arabic alchemy, with Shiism and Sufism, have been important topics of investigation.¹² Recently, work on medieval Greek and Arabic alchemical texts has begun to explore the artisanal and cultural contexts in which some of them might best be situated.¹³ Research on the diverse theories of material transformation attested by Greek and Arabic alchemical texts has been gradual but revealing.¹⁴ This and related research has made clear that the textual tradition

⁹ Cristina Viano, "Mixis and *Diagnôsis*: Aristotle and the 'Chemistry' of the Sublunary World," *Ambix* 62, no. 3 (2015): 203–14. I thank the anonymous reviewers for emphasizing the importance of this article and another by Viano cited in n. 14 below.

¹⁰ For overviews, see Gerasimos Merianos, "Alchemy," chap. 14 in *The Cambridge Intellectual History of Byzantium*, ed. Anthony Kaldellis and Niketas Siniosoglou (Cambridge: Cambridge University Press, 2017), 234–51; Regula Forster, "Arabic Alchemy: Texts and Contexts (Sección Monográfica: Introducción)," *Al-Qanṭara* 37, no. 2 (2016): 269–78.

¹¹ E.g., Cristina Viano, ed., *L'alchimie et ses racines philosophiques: La tradition grecque et la tradition arabe* (Paris: Vrin, 2005).

¹² For Shiism, see the references cited by Forster, "Arabic Alchemy," 273nn23–24. For occult sciences, see Maria Mavroudi, "Occult Sciences and Society in Byzantium: Considerations for Future Research," in *The Occult Sciences in Byzantium*, ed. Paul Magdalino and Maria Mavroudi (Geneva: La pomme d'or, 2006), 39–95; Matthew Melvin-Koushki, ed., "Islamicate Occultism: New Perspectives," a special issue of *Arabica* 64, nos. 3–4 (2017).

¹³ E.g., Matteo Martelli, "Greek Alchemists at Work: 'Alchemical Laboratory' in the Greco-Roman Egypt," *Nuncius* 26, no. 2 (2011); Matteo Martelli, "Dissoluzioni, distillazioni e passaggi di stato nel Corpus degli alchimisti greci," in *Metamorfosi tra scienza e letteratura* (Florence: Leo S. Olschki, 2014), 81–99; Regula Forster, ed., "Alchemy in the Islamicate World," a special issue of *Asiatische Studien* 75, no. 2 (2021).

¹⁴ Important contributions include Cristina Viano, "Aristote et l'alchimie grecque: La transmutation et le modèle aristotélicien entre théorie et pratique," in "Théorie et pratique dans la constitution des savoirs alchimiques," *Revue d'histoire des sciences* 49, nos. 2–3 (1996): 189–213; Olivier Dufault, "Transmutation Theory in the Greek Alchemical Corpus," *Ambix* 62, no. 3 (2015): 215–44.

we usually call “alchemical” developed dynamically in close relation to other textual traditions, theories, and practices, from natural philosophy, theology, and medicine to the decorative arts and imperial administration.¹⁵

In the present article, I seek to build upon the pioneering work of the “new historiography of alchemy,” extend it in space-time into the Byzantine and Middle Eastern middle ages, and, more subtly, strengthen its methodology for all chronologies and geographies. My aim is to begin laying the groundwork for integrating the historiography of Byzantine and Arabic alchemy into a wider western Afro-Eurasian intellectual history, both in the sense of linking it to ancient history and the history of medieval and early modern western Europe, and in the sense of treating theories of matter in alchemical texts as potentially related to and inseparable from developments in contemporary texts of natural philosophy. To do so, I investigate several discussions of “chemistry,” understood as an analysts’ category (etic term) referring to theories and practices “concerned with the substances of which matter is composed, the investigation of their properties and reactions, and the use of such reactions to form new substances,”¹⁶ regardless of the scientific paradigm upon which such theories were built. In this sense, the “chemistry” of all the authors discussed below was ultimately grounded in Aristotle’s theory of chemistry, sketched but not fully fleshed out in his treatises, especially *On Coming-to-Be and Passing Away* 1.10 and *Meteorology* 4, and reflected and refracted by the intervening centuries of Aristotelian interpretation and commentary.¹⁷ This usage aims analytically to decouple a domain of knowledge (chemistry-as-topic) from textual traditions and so-

¹⁵ Maria Papathanassiou, “Metallurgy and Metalworking Techniques,” in *The Economic History of Byzantium from the Seventh through the Fifteenth Century*, ed. Angeliki E. Laiou, vol. 1 (Washington, DC: Dumbarton Oaks, 2002), 121–27; Eleonora Bacchi and Matteo Martelli, “Il principe Ḥālīd bin Yazīd e le origini dell’alchimia araba,” in *Conflitti e dissensi nell’Islam*, ed. Daniele Cevenini and Svevo D’Onofrio (Bologna: Il Ponte, 2008); George Saliba, “A New Alchemical Poem Attributed to Khālīd b. Yazīd (d. ca. 705),” *Ambix* 64, no. 3 (2017): 220–33.

¹⁶ *Oxford English Dictionary*, s.v. “chemistry, 1”; cited by Viano, “*Mixis*,” 204. I omit the beginning of this definition (“the branch of science . . .”) to avoid a definition of chemistry that might suggest an institutionalized discipline. See also Viano, 207n17. I am grateful to an anonymous reviewer for emphasizing the utility of the distinction between actors’ and analysts’ categories here. For the indispensability of etic terms, even for emic studies concerned with how historical actors understood what they were doing, see Nick Jardine, “Etics and Emics (Not to Mention Anemics and Emetics) in the History of the Sciences,” *History of Science* 42, no. 3 (2004): 261–78.

¹⁷ Viano, “*Mixis*”; Abraham Stone, “Avicenna’s Theory of Primary Mixture,” *Arabic Sciences and Philosophy* 18, no. 1 (2008): 99–119. I am grateful to Asad Q. Ahmed for pointing me to Stone’s work.

cial collectivities concerned with it entirely or in part—a methodology already latent but rarely explicit in the “new historiography.”¹⁸

In particular, I address texts that have typically been read as offering the views of “outsiders” on the validity of “alchemy” (often tacitly presumed to be a cohesive discipline cultivated by “the alchemists”). By contrast, I ask what these texts can tell us about their authors’ interrelated views on the manipulation and transformation of matter, how and why it can be effected, and whether and when it is legitimate—in other words, what they thought about chemistry. Such an analysis can, and I hope will, be systematically applied to Greek, Arabic, and other “alchemical” texts as well. Moving chronologically, I will examine two Abbasid-era Muslim philosophers (I–II), an eleventh-century Byzantine polymath (III), and a Muslim jurist active in thirteenth- and fourteenth-century Damascus (IV).

I. AL-FĀRĀBĪ

In a short treatise, *On the Necessity of the Art of Kīmiyā*,¹⁹ the tenth-century Muslim philosopher Abū Naṣr al-Fārābī (b. Turkestan, d. 950 Damascus) wrote to affirm “the Art” (*al-ṣināʿah*), an expression that often refers, as here, to the Sacred Art, a domain understood to include methods for ennobling base metals. He is particularly concerned to address those who condemn it. He begins by explaining that there are two categories of people who are mistaken about the Art: those who “reject it and declare it to be spurious,” and others who “affirm it but exceed the limit of what is possible” in what they claim for it. “Both sides,” he says, “are wrong.”²⁰

Al-Fārābī continues by explaining that “those who recorded [*dawwanū*] this Art” sought to make it incomprehensible to all but their fellow experts

¹⁸ See for example Rampling, *Experimental Fire*, who examines how scholarship and practice intersected and interacted in the domain of what late medieval and early modern Englishmen (sometimes) called “alchemy,” in the process speaking of her historical subjects’ “chemical theory” and eventually even their “chemistry” (19, 45, 50). See also Smith, *Business*, where Smith had already made similar use of the term “chemistry,” while nevertheless preferring “alchemy” when discussing transmutation in particular.

¹⁹ *Risālat al-ḥakīm al-fāḍil al-mutqin al-muḥaqqiq Abī Naṣr al-Fārābī Fī wujūb ṣināʿat al-kīmiyā*, ed. A. Sayılı, “Fārābī’nin Simyanın Lüzümü Hakkındaki Risālesi,” *Türk Tarih Kurumu: Belleten* 15, no. 57 (1951): 65–79. Previously trans. Eilhard Wiedemann, “Zur Alchemie bei den Arabern,” *Journal für Praktische Chemie*, n.s., 76, no. 1 (1907): 65–87, 105–23, at 117–24; cited by William R. Newman, *Promethean Ambitions: Alchemy and the Quest to Perfect Nature* (Chicago: University of Chicago Press, 2005), 37n4. Summarized by Ullmann, *NGWI*, 250.

²⁰ Sayılı, “Fārābī’nin,” 75.

by using poetic language (*fa-sta 'malū . . . aqāwīla shi 'riyyah*). Even after decipherment, most people still wouldn't understand the Art "because it is one of the parts of physics [*juz 'un min al- 'ilm al-ṭabī 'ī min ajzā 'ihi*] that is difficult to grasp [*allatī ya 'sur 'alayhā al-wuqūf*]." One must first learn the part of physics concerned with homeomerous, composite bodies (*al-ajsām al-murakkabah al-mutashābihah al-ajzā'*), namely the minerals (*ma 'ādin*); and for that, logic and more elementary parts of physics are prerequisites. These texts must be encoded, for if knowledge of the Art's procedures (*a 'māl al-ṣinā 'ah*) were to be widespread, there would be great harm to "nations and cities" (*al-umam wa-l-mudun*): cities as political formations could not exist (*lam yatimma l-battata ijtīmā 'un madanū*), and gold and silver would be useless as currency.²¹ Al-Fārābī leaves his reasoning here implicit, but we may infer that the overabundance of gold and silver would render them useless, while the resulting absence of a monetary currency would, in turn, make political association impossible. Continuing, he asserts that such texts are not intended to convey procedures but rather knowledge (*'ilm*) such as human beings naturally yearn to acquire. From these texts, "the one with superior intelligence will obtain perfect understanding and well-being."²² As long as the one who studies them is a philosopher, there is no danger, al-Fārābī contends, since this branch of natural philosophy offers much greater satisfaction (*ightibāt*) than the products of the Art.²³

Thus, for al-Fārābī, theoretical chemistry is the true purpose of the procedural manipulations described in texts on the Sacred Art—a standard way of justifying the cultivation of texts on the Sacred Art while seeking to avoid association with fraud.²⁴ This is not "spiritual alchemy," but rather

²¹ Sayılı, "Fārābī'nin," 76. For al-Fārābī's notion of an *umma* as a regional community intermediate between the city (*madīnah*) and the entire inhabited world (*ma 'mūrah*), and for his discussion of "the coming-together of the people of a city" (*ijtimā 'ahl madīnah*) as part of his typology of "societies" (*ijtimā 'āt*), see al-Fārābī, *Al-Farabi on the Perfect State: Mabādi 'ārā 'ahl al-madīna al-fāḍila*, ed. and trans. Richard Walzer (Oxford: Clarendon Press, 1985), 228_{11–13} (§ 5.15.2).

²² Sayılı, "Fārābī'nin," 77: *fa-dhū l-fiṭnati l-fā 'iqati sa-taḥṣulu labu l-ma 'rifatu l-tāmmatu wa-l-sa 'ādab*. Compare, e.g., Rampling, *Experimental Fire*, 31–36, 61.

²³ Sayılı, "Fārābī'nin," 77.

²⁴ See, e.g., Nummedal, *Alchemy and Authority*, 4–10, 17–27, 33–39; Rampling, *Experimental Fire*, 3–15, 31–36. I thank an anonymous reviewer for emphasizing these discussions of this trope. Ultimately this is a line of argument that goes back at least as far as Zosimos of Panopolis (fl. ca. 300 CE); see Gerasimos Merianos, "The Christianity of the Philosopher Christianos: Ethics and Mathematics in Alchemical Methodology," in "Artes químicas y religión en la antigüedad," ed. Naomi Borrelli and Matteo Martelli, *ARYS. Antigüedad: Religiones y Sociedades* 20 (2022): 271–322, here 286 at nn. 77–78, with references.

transmutation as observed phenomenon, whose explanation is its own reward—chemistry as “pure science.” Its aim is only the transformation of the human being insofar as ethical and psychological transformation of the inner self is an aim (or the aim) of philosophy.²⁵

Accordingly, al-Fārābī concludes his treatise by presenting a rational model for transmutation, a model which he traces to a text that he describes as a treatise by Aristotle “on minerals.”²⁶ In that book, al-Fārābī reports, Aristotle argued for the validity of “this Art” (*hādhi l-ṣinā‘ah*) on the basis of two premises.²⁷ First, fusible substances—“gold, silver, and all substances that fire does not burn but rather transforms”—are all of the same species (*naw‘*) but differ in essential and accidental accidents (*a‘rāḍ dhātiyyah* versus *a‘rāḍ ‘araḍiyyah*).²⁸ This is standard Aristotelian terminology to discuss kinds of things (“species”); things that exist and subsist in the world (“substances”), like a human being or a table; and the properties and other descriptions (“accidents”) that can be said of substances, like “bipedal” or “brown.” In the Aristotelian analysis of the *Categories*, an accident (like the property of being bipedal) can exist, but it never exists on its own, only insofar as it becomes manifest (“inheres”) in a substance (like a human being). Accidents, furthermore, can be either essential or accidental. Roughly speaking, an essential accident is a crucial feature of something, whereas an accidental accident is not.²⁹ The key point of this first premise, then, is that the various fusible metals (gold, silver, and so on) are in some sense individuals (a term not used but only implied by al-Fārābī)³⁰ of a single species that are distinguished from each other by both essential attributes that make

²⁵ Cf. the commonplace definition of philosophy (drawn from Plato, *Theaetetus* 176b1) as “assimilation to God as much as possible” (ὁμοίωσις θεῷ κατὰ τὸ δυνατόν); on which see Katerina Ierodiakonou and Dominic O’Meara, “Philosophies,” in *The Oxford Handbook of Byzantine Studies*, ed. Elizabeth Jeffreys, John F. Haldon, and Robin Cormack (Oxford: Oxford University Press, 2008), 711–20, at 712.

²⁶ Sayılı, “Fārābī’nin,” 78₃: *fa-qad bayyana Aristātālis fī kitābīhi fī l-ma‘ādin . . .*; noted by Ullmann, NGWI, 250.

²⁷ Sayılı, “Fārābī’nin,” 78₉₋₁₀: *thumma athbatabā [i.e., hādhibi l-ṣinā‘ah, 78₁] akhīran bi-qiyās allafahu min muqaddamatayn bayyanahumā fī auwal kitābīhi.*

²⁸ Sayılı, “Fārābī’nin,” 78_{10-79₂}: *aḥaduhumā anna l-dhabab wa-l-fiḍḍah wa-jamī‘ al-jawābir allatī lā taḥriqubā l-nār bal tuḥīlūhā . . .*

²⁹ For a succinct and clear discussion, even if it postdates al-Fārābī, see Ibn Sīnā, *Deliverance (Najāt)*, passage referenced below in n. 65.

³⁰ Later authors would use the term “individual” (*shakhṣ*, pl. *ashkhāṣ*) to articulate a related theory of metals; see, e.g., Abū l-Qāsim Muḥammad ibn Aḥmad al-‘Irāqī (a.k.a. al-Sīmāwī, fl. ca. thirteenth century?), *Kitāb ‘ilm al-muktasab fī zirā‘at al-dhabab*, 1.2, ed./trans. E. J. Holmyard, *Book of Knowledge Acquired Concerning the Cultivation of Gold* (Paris: Geuthner, 1923), 8 (Arabic) = 13 (English trans.).

each individual what it is (e.g., the attribute that makes gold gold rather than silver or lead) and accidental attributes. Though al-Fārābī does not elaborate, his understanding of “essential accidents” probably included perceptible properties such as density, malleability, color, and perhaps how a metal responded to assays.

The second premise that al-Fārābī ascribes to Aristotle requires less explanation. It is the claim that substances of the same species can be changed into each other, with difficulty if they differ by essential accidents, easily otherwise.³¹ Most of the fusible substances differ from each other by essential accidents, asserts al-Fārābī; transmutation is therefore possible but difficult.³²

II. IBN SĪNĀ

The philosopher Ibn Sīnā (a.k.a. Avicenna; b. 980 Afshana, near Bukhārā; d. 1037 Hamadān), born thirty years after al-Fārābī’s death and an avowed admirer of al-Fārābī’s exposition of Aristotelian philosophy,³³ addressed just the sort of rational argument that al-Fārābī had proposed. In particular, Ibn Sīnā argued in his philosophical summa, the *Healing* (*al-Shifā’*), that metals each belong to a different species and that human beings are not able to make these metals cross the species barrier.³⁴ This passage was included at the end of a Latin translation of Ibn Sīnā’s discussion of minerals that en-

³¹ Sayılı, “Fārābī’nin,” 79₂₋₄.

³² Sayılı, “Fārābī’nin,” 79₄₋₆.

³³ See most vividly Ibn Sīnā’s report that when he read Aristotle’s *Metaphysics*, he “did not understand what it contained and was confused about the author’s purpose” even after reading it forty times; only when he got ahold of a copy of al-Fārābī’s *On the Purposes of the Metaphysics* did he finally understand the book’s purpose. See Ibn Sīnā, *Autobiography*, §9, trans. Dimitri Gutas, *Avicenna and the Aristotelian Tradition: Introduction to Reading Avicenna’s Philosophical Works*, 2nd ed. (Leiden: Brill, 2014; orig. pub. 1998), 17–18 (= 1st ed., p. 28); and Gutas, *Avicenna*², ch. 6.1, esp. pp. 269–275 (= 1st ed., pp. 237–42).

³⁴ Ibn Sīnā, *Shifā’*, Physics 5.1.5, ¶7–9, ed. ‘Abd al-Ḥalīm Muntaṣir, Sa’īd Zāyid, and ‘Abd Allāh Ismā’īl, in Ibn Sīnā, *al-Shifā’*, ed. Ibrāhīm Madkūr, 28 vols. (Cairo, 1952–83), Physics 5:22₁₆–23₁₇. This passage had previously been published with an English translation as *Avicennae de congelatione et conglutinatione lapidum: Being Sections of the Kitāb al-Shifā’*. *The Latin and Arabic Texts*, ed. and trans. E. J. Holmyard and D. C. Mandeville (Paris: P. Geuthner, 1927), 69–86, at 85–86 (Arabic), 17–42, at 41–42 (English). For French translation, see Georges C. Anawati, “Avicenne et l’alchimie,” in *Convegno internazionale, 9–15 aprile 1969. Tema: Oriente e Occidente nel Medioevo: Filosofia e scienze* (Rome: Accademia Nazionale dei Lincei, 1971), 295–96; and Sébastien Moreau (as cited below in note 37).

joyed wide circulation in medieval and early modern western Europe as an appendix to a Latin translation of Aristotle's *Meteorology*, often presented as Aristotle's own conclusion to Book 4.³⁵ Accordingly, it has long attracted the interest of Europeanists. The passage has typically been adduced as evidence that Ibn Sīnā was "against alchemy"³⁶ and that he considered the artificial synthesis of silver and gold to be impossible in practice *and* untenable in theory.³⁷

Ibn Sīnā's position is, however, subtler and more cautious than this interpretation would suggest. The passage appears in the part of the *Healing* on physics (natural phenomena), under the subject heading (*fann*) of meteorology (on sublunar phenomena), at the end of a section on "the generation of minerals" (*takwīn al-ma'diniyyāt*).³⁸ That same section of the *Healing* begins by offering a taxonomy of minerals and a detailed account of the causes of their various properties.³⁹ Ibn Sīnā then observes that "mercury or something similar seems to be the elemental building-block [*'unṣur*] of all the fusibles" (the class of minerals embracing gold, silver, and so on

³⁵ See Holmyard and Mandeville, introduction to *Avicennae de congelatione*, 1–14, and their edition of the Latin, 45–55, at 54–55. Latin critically edited by Elisa Rubino, "Il *De mineralibus* di Avicenna tradotto da Alfredo di Shareshill," with an appendix by Samuela Pagani, *Bulletin de Philosophie Médiévale* 58 (2016): 23–87, at 35–44 (I owe this reference to an anonymous reviewer); in what follows I will also cite the edition of part of the Latin text by William R. Newman, ed. and trans., in *The Summa perfectionis of Pseudo-Geber: A Critical Edition, Translation and Study* (Leiden: Brill, 1991), 48–51.

³⁶ Ullmann, *NGWI*, 251 ("Gegen die Alchemie"); Newman, *Promethean Ambitions*, 37 ("Avicenna's attack on alchemy"). Cf. also Lawrence M. Principe, *The Secrets of Alchemy* (Chicago: University of Chicago Press, 2012), 48 ("attack on chrysopoecia").

³⁷ Anawati, "Avicenne et l'alchimie," 209–300: "pratiquement impossible et insoutenable du point de vue scientifico-philosophique." For a more cautious statement see Andrée Colinet, ed. and trans., *L'Anonyme de Zuretti, ou: L'art sacré et divin de la chrysopée par un anonyme* (Paris: Les Belles Lettres, 2000), XVII. See now also Sébastien Moureau, ed. and trans., *Le De anima alchimique du pseudo-Avicenne*, 2 vols. (Florence: SISMEL, Edizioni del Galluzzo, 2016), 1:11–18, with a side-by-side comparison of the Arabic (with readings from Holmyard and Mandeville, and the Cairo edition, but not from the latter's apparatus), a literal French translation, and the Latin translation (reproducing Newman's edition), as described at 14n22. Moureau acknowledges that this passage is "complex and ambiguous" on the question of Ibn Sīnā's "position vis-à-vis alchemy" (17). Nevertheless, by the end of his discussion, Moureau concludes that Ibn Sīnā, to judge from this passage, "was categorically opposed to the idea of the transmutation of species" (18), such that this position can be used as a clear criterion for assessing the authenticity of other texts ascribed to Ibn Sīnā.

³⁸ Ibn Sīnā, *Shifā'*, Physics 5.1.5 title, ed. Muntaṣir et al., 20.

³⁹ Ibn Sīnā, *Shifā'*, Physics 5.1.5, ¶1–6 (beginning), ed. Muntaṣir et al., 20–21₁₄; trans. Holmyard and Mandeville, 33–38.

that we have already encountered in al-Fārābī's treatise).⁴⁰ At this point in his text—just before the famous passage adduced to show Ibn Sīnā's opposition to “alchemy”—Ibn Sīnā describes how combinations of mercury of various purities with sulfur of various purities and fineness produce, respectively, silver, gold, copper, iron, tin (*al-raṣāṣ al-qala'ī*), and lead (*ānuk*).⁴¹ Importantly, Ibn Sīnā does not speak of *similar* products or *imitations* of these metals (with the exception of copper: “the result is like copper” [*kāna minhu mithlu l-nuḥās*]); he clearly means to say that this is how the metals are produced: “the result is silver” (*kāna minhu l-fiḍḍah*), sulfur with certain properties “compounds with [mercury] to form gold” (*‘aqadahu dhababan*), and so on. He *contrasts* the fineness of the sulfur necessary to form silver (and presumably gold as well) with the sulfur used by “artificers” or “tricksters” (*ahl al-ḥīlah*).⁴²

After describing each metal's formation, he goes on to make this contrast even more explicit: “those who use artifices” or “tricks” (*aṣḥāb al-ḥiyal*) can produce compounds of mercury and sulfur artificially⁴³ that appear to the senses to be the natural products but are in fact only similar.⁴⁴ Ibn Sīnā has thus already suggested that the metals could *theoretically* be synthesized by mixing the correct proportions of mercury and sulfur of the correct purity and fineness in the correct way, even if human art cannot, in fact, do so.⁴⁵

⁴⁰ Ibn Sīnā, *Shifā'*, Physics 5.1.5, ¶6, ed. Muntaṣir et al., 21₁₅; trans. (modified) Holmyard and Mandeville, 39: *fa-yushbbihu an yakūna l-zi'baqu aw mā yushbbihuhu huwa 'unṣuru jamū'ī l-dhā'ibāt*. For Ibn Sīnā's definition of *'unṣur* see his *Shifā'*, Physics 1.2.6, ed./trans. Jon McGinnis (Provo, UT: Brigham Young University Press, 2009), 1:15.

⁴¹ Ibn Sīnā, *Shifā'*, Physics 5.1.5, ¶6, ed. Muntaṣir et al., 21₁₉–22₁₁; trans. Holmyard and Mandeville, 39–40. For the (inconsistent) Arabic terminology for tin and lead see Fabian Käs, *Die Mineralien in der arabischen Pharmakognosie: Eine Konkordanz zur mineralischen Materia medica der klassischen arabischen Heilmittelkunde nebst überlieferungsgeschichtlichen Studien*, 2 vols. (Wiesbaden: Harrassowitz, 2010), 293–96, 585 (s.vv. *ānuk* and *raṣāṣ*).

⁴² Ibn Sīnā, *Shifā'*, Physics 5.1.5, ¶6, ed. Muntaṣir et al., 22₃; trans. Holmyard and Mandeville, 39: “adepts,” glossed as “alchemists” in a footnote (n. 7). This risks imputing the translators' inference to Ibn Sīnā, who has not said that all who seek to synthesize gold or silver are tricksters.

⁴³ Literally, “by art” or “by *the* Art” (*bi-l-ṣinā'ah*). Here I agree with the Latin translation (*artificialiter*, 53 line 4 from the bottom = Newman, *Pseudo-Geber*, 49₁; Rubino, line 144) in reading this as a general reference to human craft and not necessarily, as Holmyard and Mandeville read it (“by alchemy”), to the Sacred Art.

⁴⁴ Ibn Sīnā, *Shifā'*, Physics 5.1.5, ¶6 (end), ed. Muntaṣir et al., 22_{11–15}; trans. Holmyard and Mandeville, 40–41. For this passage as an “attack” against claims that art could match or surpass nature see Newman, *Promethean Ambitions*, 37.

⁴⁵ On the impact of Ibn Sīnā's version of the mercury-sulfur theory on the subsequent Latin tradition, see William R. Newman, “Mercury and Sulphur among the High Medi-

The better-known passage that immediately follows confronts the problem of synthesis and transmutation directly. It will be worthwhile to examine the entire passage:⁴⁶

[¶7] As for what the adherents of *kīmiyā*⁴⁷ claim, you must know⁴⁸ that they do not have the ability to transmute [*an yaqlibū*] species in reality. They do, however, have the ability to effect sensory resemblances, such that they dye the red with white dye that has a strong resemblance to silver, and they dye it with a yellow dye that has a strong resemblance to gold; and furthermore they dye the white with any dye they wish, to the point that it bears a strong resemblance to gold or copper; or to remove from types of lead [*raṣāṣāt*] most of their inferiority and flaws. Nevertheless, their substances [*jawāhir*] are preserved; it's just that added qualities [*kayfiyyāt mustafādah*] dominate them,⁴⁹ which leads one to be mistaken about them, just as people are liable to take [*yattakhidhū*] salt, *qalqand* [vitriol], *nūshādir* [sal ammoniac], etc. [for each other?].⁵⁰ [¶8] I wouldn't exclude the possibility of [this dyeing] being precise enough to escape the notice [even] of experts.

As for the specific difference [*al-faṣl al-munawwi*] to be removed or applied, I do not see how that could be possible. Indeed, in my mind it is far from being possible, since there is no way to dissolve [*ḥall*] the complex [*mizāj* ~ κρᾶσις]⁵¹ into the other

eval Alchemists: From Rāzī and Avicenna to Albertus Magnus and Pseudo-Roger Bacon,” *Ambix* 61, no. 4 (2014): 327–44, esp. 329–331.

⁴⁶ Ibn Sīnā, *Shifā'*, Physics 5.1.5, ¶7–9 (already cited above in n. 34), ed. Muntaṣir et al., 22₁₆–23₁₇. My translation is from the Cairo edition.

⁴⁷ *aṣḥāb al-kīmiyā'*, a vague expression that could mean a particular class of practitioners or theorists, by analogy with *aṣḥāb al-riwāq* (the Stoics), or simply anyone who shares a particular view.

⁴⁸ *yajibu an ta'lama*; cf. Latin *sciant*, “let them know” (54₁ = Newman, *Pseudo-Geber*, 49₇; Rubino, line 149).

⁴⁹ *yaghlibu 'alayhā* ~ κρατέω; this is presumably Aristotle's notion of domination in mixture, discussed by Viano, “*Mixis*,” 206.

⁵⁰ That is, that they confuse these different salts with each other. Alternatively, as Holmyard and Mandeville thought (41n5; followed, in his translation of the Latin, by Newman, *Promethean Ambitions*, 37), perhaps he meant to say that they take (synthetic versions of) these salts to be the natural products they imitate. For the terms see Käs, *Die Mineralien*, 2:604–12, 1100–1105.

⁵¹ For the later Aristotelian definition (grounded in Aristotle's less fixed usage) of *mizāj*/κρᾶσις (“complexion”) as the species of *ikhtilāt*/μίξις (“mixture”) that results in a homeomeric mixture, as opposed to “apposition,” the other species of mixture, which preserves

complex. Such perceptible states seem not to be the specific differences [*fuṣūl*] by which these bodies might become [different] species, but rather they are accidentals [*ʿawāriḍ*] and concomitants [*lawāzim*], while [the bodies'] specific differences are unknown. And if something is unknown, how is it possible to aim to produce or eliminate it? As for doffing or donning⁵² these dyes and accidents such as odor and weight, this is something that one should not insist on contradicting, for lack of knowledge about it; there is no demonstration of its impossibility, none at all, that can stand.

It seems that the relation [of proportion?]⁵³ between the elements in the composition [*tarkīb*] of each substance [*jawhar*] of those enumerated [above] is different from [the relation between the elements] in [each] other composition [*tarkīb*]. If that is so, then [one composition] cannot be reverted to [another],⁵⁴ except by dissolving the composition,⁵⁵ thus reverting it to the composition of what one wishes to transform it into. That is not something which is possible by fusion that preserves union;⁵⁶ indeed a foreign thing or a foreign faculty⁵⁷ is thereby mixed [*yakhtaliṭ*, referring to *μίξις*]⁵⁸ with it. [¶9] There is much more on this topic that we would say if we wished, but it would be of little use, and there is no more need for it in the present chapter.⁵⁹

(possibly invisibly small) parts of different types, see Stone, "Avicenna's Theory," 100–102. See also Viano, "Mixis," 206n9.

⁵² That is, removing or applying. For this English usage see *OED*, s.v. "don, *v.*" no. 2.

⁵³ I, like Holmyard and Mandeville (42) and the Latin translation (*proportio*, 55 = Newman, *Pseudo-Geber*, 51₂₈; Rubino, line 163), interpret *nisbah* as a relation of proportion.

⁵⁴ *lam yu'ad ilayhi*, i.e., cannot be changed into, or "reduced" to; see Moureau, *De anima*, 1:16n28.

⁵⁵ The Latin here is crucially different: *nisi forte in primam reducatur materiam*, 55 = Newman, *Pseudo-Geber*, 51₃₁; Rubino, lines 164–65. Ibn Sīnā himself made no mention of prime matter (Ar. *hayūlā*) and indeed was making another point entirely.

⁵⁶ Here I follow the Arabic text printed by Holmyard and Mandeville (86), with one correction: *wa-laysa dhālika mimnā yumkinu bi-idhābatin yabfaẓu* [read *taḥfaẓu*] *l-ittiṣāl*; from their translation (42), I carry over "fusion" and "union." Cf. Muntaṣir et al., 23₁₄: *wa-laysa dhālika mimnā yumkinu bi-adā'ihī ḥifẓu l-ittiṣāl* ("That is not something by whose execution union/continuity can be preserved"), listing three manuscripts in the apparatus with the correct reading (*bi-idhābatin taḥfaẓu*).

⁵⁷ For *quwwah* as the "faculty" in a substance that produces, but is distinct from, the substance's sensible qualities see Stone, "Avicenna's Theory," 111, 112.

⁵⁸ See n. 51 above.

⁵⁹ I do not detect the "sarcasm" in this final line that Holmyard and Mandeville thought they detected (42n7).

Ibn Sīnā's argument here has several parts. First, he asserts that while those who practice *kīmīyā* are unable to change one fusible metal into another, they are nevertheless capable of making one metal take on the perceptible attributes of another. Next, Ibn Sīnā elaborates on this point in terms of another key Aristotelian concept, the specific difference. Finally, he articulates his position in terms of mixture.

Reading this passage with care and in the context of his earlier discussion of the composition of metals from mercury and sulfur, we can clearly see that Ibn Sīnā's objection to the claims of "the adherents of *kīmīyā*" is *not* that transmutation from one species of metal to another, or the artificial production of a given species of metal, is theoretically impossible. Indeed, we would hardly expect him to rule out chrysopoeia *in theory*, given that he subscribes, as we have seen, to the mercury-sulfur theory that was often used to argue *for* the possibility of chrysopoeia.⁶⁰ Instead, his objection to their claims focuses on whether chrysopoeia and the like are possible *in practice*.

The crux of the matter is adding or removing specific differences. As Ibn Sīnā explains elsewhere, the specific difference is the answer to the question, which member of its genus is this species? If we ask which animal the human being is, the answer is "the rational one" (*al-nāṭiq*); being rational is therefore the specific difference of the human being.⁶¹ In other words, within the genus of animals, the human species is distinguished by its rationality—not, it should be noted, by other features always found in it (concomitants) such as the ability to laugh.⁶²

Ibn Sīnā argues that while one can add certain perceptible properties such as color, density, and so on to metals, he can see no way to add or remove a metal's specific difference. This position is consistent with Ibn Sīnā's theory of the elements and their qualities: perceptible qualities, even primary qualities, are accidents that are produced by (and thus typically associated with) the elements' substantial forms, which we can only observe indirectly through the qualities they produce. Thus, dry heat is not the essence or nature of fire itself but only the *product* of fire's nature.⁶³

Acknowledging and even insisting that properties accessible to the senses can be adjusted with great precision such that the result of chemical

⁶⁰ Ullmann, *NGWI*, 260–61; Newman, *Pseudo-Geber*, 2.

⁶¹ Ibn Sīnā, *Najāt*, Logic §14, ed. Muḥammad Taqī Dānešpažūh (Tehran, [1985]), 16_{3–7}, trans. (adapted) Asad Q. Ahmed, *Avicenna's Deliverance: Logic* (Oxford: Oxford University Press, 2011), 12.

⁶² Ibn Sīnā, *Najāt*, Logic §15, ed. Dānešpažūh, 16_{11–17}, trans. Ahmed, 12.

⁶³ See Stone, "Avicenna's Theory," 110–11.

manipulation of one species of metal can appear to be a different species of metal, he tentatively proposes that those perceptible properties are not the specific differences. Both the tentativeness of his proposal (“perceptible states *seem* not to be the specific differences”) and the precise content of the proposal itself are worth emphasizing. Crucially, his point is that these perceptible properties are concomitants and accidentals (*‘awāriḍ*, singular *‘āriḍ*)—the latter being accidental accidents, not to be confused with the broader category of accidents (*a ‘rād*).⁶⁴

Ibn Sīnā’s claim here is not that one could *never* change essential accidents that constitute specific differences but simply that the perceptible properties applied and removed in the case of chemical manipulation of the metals are not essential accidents but rather accidental accidents or concomitants (a specific type of accidental accident that is *always* found in the target substance but nevertheless falls short of rendering the thing that has those properties identical to the target substance).⁶⁵ The specific difference—what makes gold gold—remains, Ibn Sīnā suspects, unknown. That alone, not a theoretically insuperable species barrier, seems to motivate Ibn Sīnā’s thinking. If one *could* identify gold’s specific difference (something analogous to its atomic number in the modern chemical paradigm) and had a method for tinkering with it (such as firing neutrons at mercury to change

⁶⁴ Cf. Holmyard and Mandeville, 42: “accidents.” Ullmann, *NGWI*, 252: “Akzidenzien,” though earlier Ullmann correctly translates al-Fārābī’s explicit contrast between essential and accidental accidents (250). Anawati, “Avicenne et l’alchimie,” 296; Moureau, *De anima*, 1:16: “accidents.” Cf. Latin *accidentia*: Newman, *Pseudo-Geber*, 50₂₀; Rubino, line 158. Oddly, the correct Latin translation (*accidentalialia*), otherwise unattested, is printed by Holmyard and Mandeville, 54 line 4 from the bottom, even though the authority they cite for this reading, the Bologna edition of 1501, reads *accidentia* (fol. 22^v, <http://digital.slub-dresden.de/id468242333>) in agreement with the manuscripts. As Ibn Sīnā points out, it is easy to confuse accident (opposed to substance) with accidental (opposed to essential), but they are quite different: Ibn Sīnā, *Najāt*, Logic §8, ed. Dānešpažūh, 12₇₋₉, trans. Ahmed, 8.

⁶⁵ For essentials and accidentals, see Ibn Sīnā, *Najāt*, Logic §7–8, ed. Dānešpažūh, 11–12, trans. Ahmed, 6–8, where Ibn Sīnā explains that the essential (*dhātī*) is that which you need to understand in order to understand something else. For example, you need to understand “animal” to understand “human being” (since “human being” is defined as the rational animal), making “animal” an essential accident of the human species. An attribute that is not essential is accidental (*‘araḍī*, synonymous with *‘āriḍ*). By extension, an essential accident would be an accident which you need to understand in order to understand the substance in which it inheres. For example, having three angles is an essential accident of the (secondary) substance “triangle,” whereas the fact that the angles sum up to 180 degrees is an accidental accident because even though it is true of all triangles (making it a concomitant, *lāzim*, of triangles), it is not key to understanding what a triangle is. An accidental can be a concomitant (as in this case), or not (e.g., some but not all triangles are equilateral).

its atomic number),⁶⁶ nothing would stand in the way of transmutation. It is only ignorance of the specific differences that makes Ibn Sīnā, with hesitation, rule it out.

Ibn Sīnā ends with the further objection that one metal could not be produced out of another simply by fusion (melting a metal) but would require the dissolution of the original metal first before its ingredients, so divided, could be combined with the correct additional ingredients to result in the target metal. Aristotle had admitted the possibility that a mixture's (proximate) ingredients could be separated (without reduction to their elemental components), both in the abstract, and in rare concrete instances.⁶⁷ Ibn Sīnā seems to deny this possibility for the particular case of fusibles, on the grounds that fusion only permits one to add further ingredients, not separate existing ones; the implicit contrast is with other procedures like distillation that permit the separation of other substances but are inapplicable to fusibles. In any case, from this objection it is clear that what Ibn Sīnā finds especially implausible is converting one metal into another. Synthesizing gold or silver would require very pure and fine mercury and sulfur, according to his description. It is only the conversion of one metal (such as lead) into another (such as gold) that would require what he deems impossible in practice, namely the dissolution of the original metal.

Was Ibn Sīnā “attacking” or “opposing” alchemy in this passage? That depends on how we define “alchemy.” If alchemy is an esoteric or allegorical or exegetical approach to chemistry, he says nothing about it here. If alchemy is chemical theorizing in general, he engages in it himself—and if it is a specific sort of chemical theory, Ibn Sīnā could be accused of subscribing to such a theory too, given that he shares the mercury-sulfur theory of metals with an important subset of the texts we usually call “alchemical

⁶⁶ R. Sherr, K. T. Bainbridge, and H. H. Anderson, “Transmutation of Mercury by Fast Neutrons,” *Physical Review* 60, no. 7 (1941): 473–79. See also K. Aleklett et al., “Energy Dependence of ²⁰⁹Bi Fragmentation in Relativistic Nuclear Collisions,” *Physical Review C* 23, no. 3 (1981): 1044–46; discussed by Mark S. Morrison, *Modern Alchemy: Occultism and the Emergence of Atomic Theory* (Oxford: Oxford University Press, 2007), 135, 142–46, where the subsequently discredited chrysopoetic work of Adolf Miethe (“Der Zerfall des Quecksilberatoms,” *Die Naturwissenschaften* 12, no. 29 [1924]: 597–98) is also discussed. For Miethe's purported chrysopoeia see further Joris Mercelis, “Commercializing Academic Knowledge and Reputation in the Late Nineteenth and Early Twentieth Centuries: Photography and Beyond,” *History and Technology* 33, no. 1 (2017): 23–52, at 38–39.

⁶⁷ Aristotle, *De generatione et corruptione* 1.10, 327b27–29 (cited by Newman, *Atoms*, 52); *Meteorology* 4.7, 384a4 (cited by Viano, “*Mixis*,” 210). For the later position, in Arabic and Latin Aristotelianism, that explicitly ruled out any such separation short of total “corruption” (i.e., ceasing-to-be), see Newman, *Atoms*, 50–54.

texts.” If alchemy is laboratory work and experimentation in general, he clearly affirms it and seems to have practiced it himself (he describes what happened when he sought to melt certain stones that had fallen from the sky, and elsewhere adduces chemical transformation that takes place in a laboratory in defense of his views on homeomeric mixtures).⁶⁸ If alchemy is transmutation, then he thought it was theoretically possible but impossible in practice—and he was tentative in saying even this. Does that constitute an attack on transmutation? It seems rather like an expression of doubt about its feasibility based on his theory of chemistry and his understanding of the practical limits of the technology available in his day. And if alchemy is chrysopoeia (by transmutation or otherwise), then he seems to have thought it was theoretically possible with sufficiently pure and fine mercury and sulfur; whether he thought it was possible in practice too depends on how one interprets the *abl al-ḥīlah* whose mercury and sulfur are not sufficiently fine: did Ibn Sīnā mean that all metallurgists prepare—and are only able to prepare—insufficiently pure mercury and sulfur, or did he mean this to apply only to the charlatans among them?

Ultimately, Ibn Sīnā is discussing the theoretical interpretation of empirically observed transformations that are taken for granted, but which he argues should not be interpreted as the transformation of one species into another. Thus, both al-Fārābī and Ibn Sīnā acknowledge the reality of the same empirical phenomenon, that human craft can reproduce the properties of precious substances using other ingredients. They differ only in how they interpret that phenomenon. Whereas al-Fārābī believes all metals to be a single species, Ibn Sīnā does not. Indeed, al-Fārābī’s “pro-alchemy” account (framed as a paraphrase of Aristotle’s doctrine on fusible substances) is so abstract that it can be nearly reconciled with Ibn Sīnā’s “anti-alchemy” account by identifying al-Fārābī’s “essential accidents” that are difficult to change with the hidden properties that Ibn Sīnā believes give rise to the perceptible qualities associated with each substance.

In short, we should read these not only as arguments for or against “alchemy,”⁶⁹ but also, more broadly, as a discussion of chemical theory, in Aristotelian natural philosophical terms, that revolves around a paradigmatic example of matter’s transformation.

⁶⁸ Ibn Sīnā, *Shifā’* Physics, 5.1.1, ed. Muntaṣir et al., 5_{18–20}, trans. Holmyard and Mandeville, 23–24; Physics, *fann* 3 (*al-kawn wa-l-fasād*), *faṣl* 7, ¶4, ed. Maḥmūd Qāsim, in Madkūr, 133_{13–14}, cited by Stone, “Avicenna’s Theory,” 114n77, 116n80.

⁶⁹ As in the preliminary survey of Ullmann, *NGWI*, 249–55.

III. PSELLOS

Chrysopoeia makes a prominent appearance in at least two works by the eleventh-century Byzantine philosopher, historian, and courtier Michael Psellos.⁷⁰ His widely circulating treatise *On Making Gold* is framed as a letter addressed to the Byzantine patriarch Michael Keroularios (r. 1043–58), who had asked Psellos to teach him how to make gold.⁷¹ In it, Psellos—an avid consumer of Greek learning, from Plato to the Chaldean Oracles to the Church Fathers⁷²—argues that chemistry is not an occult practice but a straightforward craft explicable in rational, natural philosophical terms.⁷³ To demonstrate this, he sketches out how the standard four-element theory of matter might be used to explain the transmutation of one metal into another. Each element is associated with a pair of primary qualities (hot, cold, wet, dry); transforming metals or any other matter simply requires adjusting the proportions of the four elements, thus adjusting the proportions of the primary qualities). He adduces his own observation of petrified wood as an example of such transformation.⁷⁴ This is the standard, albeit problematic view of Peripatetics like Galen of Pergamon (second/?third century) and Alexander of Aphrodisias (second/third century).⁷⁵ Like al-Fārābī, then, Psellos uses standard Aristotelian concepts and doctrines to offer an account of how one metal could be changed into another. In the same treatise, Psellos also presents a series of chemical recipes that imitate silver and gold, or dilute these precious metals while preserving their outward properties.

Although Psellos's rhetoric plays with notions of initiation and the occult, deliberately complicating his claim that the transformation of metals has nothing to do with occult practices, the theory he presents, albeit

⁷⁰ These two texts have recently benefitted from analysis by Merianos, "Alchemy," 243–50.

⁷¹ Paul Moore, *Iter Psellianum: A Detailed Listing of Manuscript Sources for All Works Attributed to Michael Psellos* (Toronto: Pontifical Institute of Mediaeval Studies, 2005), 90–94, no. 314, listing 43 manuscripts. Ed. Bidez, in Joseph Bidez et al., eds., *Catalogue des manuscrits alchimiques grecs*, 8 vols. (Brussels, 1924–32), 6:26–41. See, with references, Merianos, "Alchemy," 243–44.

⁷² Stratis Papaioannou, *Michael Psellos: Rhetoric and Authorship in Byzantium* (Cambridge: Cambridge University Press, 2013), 10–11.

⁷³ Paul Magdalino and Maria Mavroudi, "Introduction," in *Occult Sciences*, 11–37, at 18. Cf. Gianna Katsiampoura, "Transmutation of Matter in Byzantium: The Case of Michael Psellos, the Alchemist," *Science & Education* 17, no. 6 (2008): 663–68, at 666. For the subtle shades of meaning of ἀπόρρητον and ἄρρητον ("secret" and "unutterable") in Psellos's writings see Magdalino and Mavroudi, "Introduction," 15–20.

⁷⁴ §2–4.

⁷⁵ Stone, "Avicenna's Theory," 102–9, esp. 107–8.

unelaborated, is straightforwardly rational (in presenting a reasoned explanation for observed metallurgical phenomena) and scientific (in using the prevailing Aristotelian paradigm of physics to make sense of apparently anomalous natural phenomena).⁷⁶ And even if Psellos's account is schematic, this is not, in my view, because he was struggling to come up with a natural philosophical explanation but simply because a detailed technical elaboration of the theory would have been inappropriate in the context.⁷⁷ After all, he had been asked to provide instructions for chrysopoieia, not a chemical theory; the theoretical discussion he offers is a prefatory framing of the goods he has been asked to deliver: recipes.

Psellos's letter to Patriarch Keroularios stands in apparent contrast to Psellos's public attitude toward the patriarch's interest in manipulating precious metals years later, when the patriarch was being deposed by the reigning emperor (Isaac I Komnenos, r. 1057–59). On that occasion, Psellos wrote an *Accusation against Keroularios*, intended to be used in hearings before a synod of bishops, but rendered moot by the patriarch's premature death.⁷⁸ Among Psellos's many charges against the patriarch is that he took undue interest in the texts of the Sacred Art and ran an illicit workshop. This striking text allows us to ask how an author thought about chemistry not only in a philosophical context, but also in a legal and social context, and so to ask what exactly he was condemning when he seems to us to be condemning "alchemy."

Psellos's long speech lays out a string of charges against the patriarch, including magic, paganism, and blasphemy. The aim is clearly not only to accuse the patriarch of contravening specific laws but also to defame him.

Late in the speech, there occurs a set of three accusations. First, Psellos contends, the patriarch was utterly uninterested in orthodox dogma.⁷⁹ Instead, the patriarch spent his time hiring cloth dyers, perfumers, makers of steam-powered mechanical devices, workers of gold and precious stones, and other artisans. Though Psellos does not say it, these artisans' products are among the trappings of an imperial court.

⁷⁶ For anomalies see Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 3rd ed. (Chicago: University of Chicago Press, 1996), ch. 6.

⁷⁷ Cf. Merianos, "Alchemy," 244.

⁷⁸ Psellos, *Orationes forenses et acta*, ed. George T. Dennis (Stuttgart: Teubner, 1994), 2–103. For a summary see Louis Bréhier, *Le schisme oriental du XI^e siècle* (Paris, 1899), 291–300; cited by Franz Tinnfeld, "Michael I. Kerullarios, Patriarch von Konstantinopel (1043–1058): Kritische Überlegungen zu einer Biographie," *JÖB* 39 (1989): 95–127, at 123n173.

⁷⁹ Psellos, *Accusation*, lines 2635–42, ed. Dennis, 96.

The same could be said of the experts in divination employed by the patriarch, according to Psellos. These “astrologers and seers” were ignorant of divination, but the patriarch employed them “because of their nation (*ethnos*),” since they were from Illyria and Persia, places with a reputation for divination. Psellos defames the patriarch here not for divination per se, but for being so incompetent in his choice of experts.

This same thread continues as he transitions to the specific accusation of attempting to transmute metals:⁸⁰ “Just as he knew other things that the law <forbids> one to know, he would also go about seeking the transformation of materials and would take it ill if he did not succeed in making copper into silver and silver into gold.”⁸¹ This led, Psellos writes, to the patriarch’s obsessive focus on “Zosimoses,” “Theophrastoses,” and “Democritean” works—a reference to the textual tradition of the Sacred Art—to the detriment of preferable subjects like logic and rhetoric. Psellos suggests that Keroularios engaged in laboratory experiments, alternating chemical procedures with attempts to develop new procedures.⁸² Ultimately, Psellos mobilizes these accusations to defame the patriarch as someone who foolishly wasted his time. He concludes: “And everything was stirred up but nothing was accomplished; rather iron was again iron, and the copper was gold only in color. For [the patriarch] did not know the reasons [for these transformations], nor did he consider them.”⁸³ Psellos transitions to his next, closely related subject with these words: “But what is there for me [to discuss] concerning these things? Long ago I knew them myself too, whether I alone or simply surpassing others, and I have renounced them as nonsense. Now, he should be blamed for this, but by no means let it be brought in as a charge against him. But the fact that he was working gold against the established laws, hidden and in shadows—how could this not be brought in as an accusation on the public record?”⁸⁴ As Merianos perceptively observes

⁸⁰ Psellos, *Accusation*, lines 2670–95, ed. Dennis, 97–98.

⁸¹ Psellos, *Accusation*, lines 2670–73: “Ὡσπερ δὲ τᾶλλα εἰδὼς ἂ νόμος εἰδέναι <κωλύεται> [conj. Dennis], καὶ τὰς μεταβολὰς τῶν ὑλῶν περιήει ζητῶν καὶ δεινὸν ἐποιεῖτο, εἰ μὴ τὸν μὲν χαλκὸν ἄργυρον, τὸν δὲ ἄργυρον χρυσὸν . . . ἀπεργάσατο.

⁸² Psellos, *Accusation*, lines 2683–86.

⁸³ Psellos, *Accusation*, lines 2686–89: καὶ πάντα μὲν συνεκινεῖτο, ἀποτελεῖτο δ’ οὐδέν, ἀλλ’ ἦν ὁ σίδηρος αὐθις σίδηρος καὶ ὁ χαλκὸς χρυσὸς ἄχρι τοῦ χρώματος· οὐ γὰρ ἤδει τοὺς λόγους . . . οὐδὲ ἔσταθμοῦτο.

⁸⁴ Psellos, *Accusation*, lines 2690–95: Ἄλλὰ τί μοι περὶ τούτων; ἂ πάλοι καὶ αὐτὸς εἰδὼς ἢ μόνος ἢ παρὰ τοὺς ἄλλους ὡς φλυαρίαν ἀπέπτυσα. πλὴν τοῦτο μέμψιν αὐτῷ ἴσως ἔχει, οὐδαμῶς δ’ ἐπαχθεῖν ὡς ἐγκλημα. ὅτι δὲ τὸν χρυσὸν παρὰ τοὺς καθεστηκότας νόμους εἰργάζετο κεκρυμμένως καὶ ὑπὸ σκότῳ, τοῦτο πῶς οὐκ ἂν ἀπογραφεῖν . . . ταῖς δημοσίαις κύρβεσι;

about this passage, “Psellos stresses that [Keroularios’s] preoccupation with alchemy was perhaps blameworthy but not suitable for a formal accusation. The real problem was that the patriarch processed gold in secret, which violated Byzantine legislation.”⁸⁵

Interest in texts on artificially producing gold, which Psellos admits to having once shared, seems in the speech to serve as the circumstantial evidence for the real crime, which Psellos now goes on to discuss in detail: clandestine gold-working,⁸⁶ by which the profit from producing finely worked gold, whether unmixed or mixed with other ingredients, accrues to a private individual rather than the imperial fisc, as Psellos explains. Such individuals “appropriate to themselves” what does not belong to them.⁸⁷ For this, Psellos continues, the law prescribes a harsh penalty: confiscation and exile or forced labor in the mines; clergy shall be stripped of their ecclesiastical office and subject to confiscation.⁸⁸

Psellos’s accusation here concerns the restricted products (κεκωλυμένα) that were controlled by the state, including goldsmiths’ products.⁸⁹ While earlier legislation had banned privately working gold and jewels for almost all purposes, an edict of Emperor Leo VI (r. 886–912) tellingly narrowed the ban to apply only when the resulting products are among those reserved for the use or benefit of the emperor.⁹⁰

⁸⁵ Merianos, “Alchemy,” 245.

⁸⁶ Psellos, *Accusation*, lines 2693–94: τὸν χρυσὸν . . . εἰργάζετο.

⁸⁷ Psellos, *Accusation*, lines 2714–15: ἐξιδιούνται . . . τὸ ἀλλόττριον.

⁸⁸ Discussed by Merianos, “Alchemy,” 250.

⁸⁹ Gilbert Dagron, “The Urban Economy, Seventh–Twelfth Centuries,” chap. 17 in Laiou, *EHB*, 2:431; Nicolas Oikonomides, “The Role of the Byzantine State in the Economy,” chap. 44 in Laiou, *EHB*, 3:993; Nicolas Oikonomides, *Les listes de préséance byzantines des IX^e et X^e siècles: Introduction, texte, traduction, commentaire* (Paris: Éditions du Centre national de la recherche scientifique, 1972), 317; cited by Angeliki E. Laiou and Cécile Morrisson, *The Byzantine Economy* (Cambridge University Press, 2007), 74 and n. 90.

⁹⁰ P. Noailles and A. Dain, eds. and trans., *Les Nouvelles de Léon VI le Sage* (Paris: Les Belles Lettres, 1944), 272–75 = no. 80, esp. 277_{10–12}: Ἡμεῖς οὖν γινώσκομεν οὐχ ἀπλῶς κωλύεσθαι τὸ ἐκ χρυσοῦ καὶ λίθων ἔργον ποιεῖν, ἀλλ’ ἐκεῖνα τὰ κατασκευάσματα ἃ μόνοις ἐφείται βασιλεῦσι, καὶ ὧν ἡ χρῆσις πρὸς τὸν ὄγκον τῆς βασιλείας καὶ τὴν ταύτης χρεῖαν ὄρεῖ (“Therefore we determine not to prohibit making works out of gold and [precious] stones in general, but only those artisanal products that are permitted for emperors alone, and whose use regards the dignity of the imperial office and its advantage”). Cf. *Codex Justinianus* 11.12(11).1, ed. Paul Krüger, *Corpus Iuris Civilis*, vol. 2, *Codex Justinianus* (Berlin: apud Weidmannos, 1877), 433, col. 1 (*Nulli prorsus liceat in frenis* etc.); cited by Noailles and Dain, *Les Nouvelles*, 274n2. Dennis’s apparatus cites *Basilika* 60.45.7.2 (ed. H. J. Scheltema and N. van der Wal, *Basilicorum libri LX*, ser. A, vol. 8 [Groningen: J. B. Wolters, 1988], 3043), which in fact concerns mint workers who steal gold and minting tools and then illicitly mint coins. Similarly, Merianos references

By contrast with this weighty accusation, Psellos's last gold-related charge is mere gossip: the patriarch was so miserly that when he hired workmen to gild a church's interior, he had them work in a nearby subterranean chamber so that he wouldn't have to pay them as much.⁹¹

Psellos hardly appears to reject theoretical chemistry at all, then, only its ignorant pursuit to the detriment of more important subjects. He also implies that the greed that impelled Keroularios to conduct chemical experiments is also what led him to violate the law against private gold-working. This position can be reconciled with Psellos's earlier treatise *On Making Gold*, where he emphasized that knowing and theorizing about metallurgical transformations was not a problem. Only *practical* chemistry is to be condemned outright, and only when it is illegally applied to controlled substances like gold.

IV. IBN TAYMIYYAH

I now turn to the blanket rejection and condemnation of *kīmiyā'* by the Ḥanbali jurist Ibn Taymiyyah (b. 1263 Ḥarrān, d. 1328 Damascus), who, despite his reputation as a “dogmatic literalist,” was a creative thinker in close conversation with philosophers and philosophically informed Muslim theologians.⁹² Among Ibn Taymiyyah's many legal opinions is a *fatwā* (legal responsum) against practicing *kīmiyā'*.⁹³ To my knowledge, this *fatwā* has

two studies on laws concerning counterfeit coinage; but his subsequent reference to regulations surrounding *argyropatai* is much more relevant: Merianos, “Alchemy,” 245n109, 250.

⁹¹ Psellos, *Accusation*, lines 2724–32. See Merianos, “Alchemy,” 250.

⁹² Carl Sharif El-Tobgui, *Ibn Taymiyya on Reason and Revelation: A Study of Dar' ta'āruḍ al-'aql wa-l-naql* (Leiden: Brill, 2019), quote at p. 12. See also Frank Griffel's review in *Orientalistische Literaturzeitung* 117, no. 2 (2022): 137–41.

⁹³ Ibn Taymiyyah, *Majmū' fatāwā*, ed. 'Abd al-Raḥmān ibn Muḥammad ibn Qāsim, 37 vols. (Rabat, Morocco: Maktabat al-Ma'ārif [1980s?]; reprint of Riyadh 1381–1386/1961f–1966f), 29:368–88 [hereafter this particular *fatwā* will be cited as Ibn Taymiyyah, *fatwā*]. I owe this reference to online discussions of whether Ibn Taymiyyah's condemnation of *kīmiyā'* means that modern chemistry (*kīmiyā'* in modern Arabic) is forbidden. For an example of such discussions see “Tawḍīḥ ḥawl mawqif Ibn Taymiyyah min 'al-kīmiyā',” IslamWeb.net, *fatwā* no. 67148 (15 Sha'bān 1426/18 September 2005), <https://www.islamweb.net/ar/fatwa/67148/> (also on the Internet Archive's Wayback Machine, <https://web.archive.org/web/20220820123606/https://www.islamweb.net/ar/fatwa/67148/>), in which one user asked whether it was really true that Ibn Taymiyyah had ruled against *kīmiyā'* or whether this was a fabrication by “enemies of the [Muslim] community” (*a'dā' al-ummah*); the answer given is that the *fatwā* in question was authentic

received no attention from historians of Arabic alchemy.⁹⁴ The *fatwā*'s heading reads: "And the Sheikh of Islam was asked about doing *kīmiyā*: is it rationally sound? or licit according to the law?" Ibn Taymiyyah's emphatic answer, elaborated in about twenty modern printed pages, is no and no.

Ibn Taymiyyah begins by asserting that *kīmiyā*' only *imitates* precious substances, such as gold, silver, pearl, ruby, musk, ambergris, and rose water—a list that suggests he understood the term *kīmiyā*' to embrace more than chrysopoeia and to include what we might call "practical synthetic chemistry," even if chrysopoeia is a primary concern. The real versions of such substances are created by God alone. Therefore, those who seek to synthesize them are engaging in imitation of God's creation (*tashbīh al-makhlūq*), which, he states, is unanimously forbidden by Muslim scholars.⁹⁵ Ibn Taymiyyah points out that this label, "imitation of God's creation," is applied to paintings of humans and other animate beings. Indeed, this label was typically applied in Islamic jurisprudence to Christian icon-painting.⁹⁶

Next, Ibn Taymiyyah explains why it is impossible for *kīmiyā*' to produce gold. Things in this world can be divided into two categories: created by God (*makhlūq*), like donkeys, and made by human beings (*maṣnū*'), like houses. There is no overlap between the two.⁹⁷ This is also the case with precious metals—as practitioners themselves attest, he emphasizes, when they speak of "yellowing" a metal (*taṣfīr* ~ ξάθωσις) and refer to themselves as "dyers" (*ṣabbāghūn*).⁹⁸ This distinction between created and man-made is a general rule, Ibn Taymiyyah continues, upon which Muslims and those who philosophize about nature and *kīmiyā*' agree.⁹⁹ Indeed, though Ibn Taymiyyah does not mention him by name, Ibn Sīnā himself had, centuries

but that *kīmiyā*' in Ibn Taymiyyah's day was "a kind of sorcery" (*naw' min anuwā' al-sihr*), completely different from the chemistry taught in schools nowadays.

⁹⁴ Louis Massignon's appendix on Arabic Hermetica in André-Jean Festugière, *La révélation d'Hermès Trismégiste*, 4 vols. (Paris: Gabalda, 1944–54), 1:386n3, briefly mentions Ibn Taymiyyah (but not this *fatwā*) in a typical pro-and-contra list. Ullmann (NGWI, 255) notes that al-Ṣafadī and al-Jildakī attest to Ibn Taymiyyah's opposition to *kīmiyā*' (but likewise does not mention the *fatwā*). For a scholarly community that *has* paid attention to this *fatwā* see the previous note.

⁹⁵ Ibn Taymiyyah, *fatwā*, ¶1, ed. Ibn Qāsim, 368₃₋₉.

⁹⁶ J. van Ess, *Encyclopaedia of Islam*, 2nd ed. (Leiden: Brill, 1960–2008), s.v. "Tashbīh wa-Tanzīh" (hereafter *EI*²).

⁹⁷ Ibn Taymiyyah, *fatwā*, ¶3, ed. Ibn Qāsim, 368₁₂–369₁₀.

⁹⁸ Ibn Taymiyyah, *fatwā*, ¶4, ed. Ibn Qāsim, 369₁₁₋₁₄.

⁹⁹ Ibn Taymiyyah, *fatwā*, ¶5, ed. Ibn Qāsim, at 369₁₆₋₁₈: *hiya thābitatun 'inda l-muslimīn, wa-'inda awā' ilī l-mutafalsifati lladhīma takallamū fī l-ṭabā'ī', wa-takallamū fī l-kīmiyā'ī wa-ghayribā.*

earlier, articulated this very principle for a similar purpose.¹⁰⁰ (Note that *kīmiyā*’ here is not part of philosophy in this formulation, but an *object* of philosophy.)

Through this opening discussion, Ibn Taymiyyah has introduced two distinct but related arguments against *kīmiyā*’. First, that what it claims to do (actually produce precious metals) is rationally inconceivable, and second, that by attempting the impossible, its practitioner is illicitly seeking to imitate God’s act of creation.

Ibn Taymiyyah elaborates on both of these strains throughout the *fatwā*. For example, at one point Ibn Taymiyyah explains why *kīmiyā*’ is rationally inconceivable by adducing the Aristotelian notions of genera and species, asserting that different metals are different species, and that it is impossible for human craft to make a metal cross the boundary between species because it is impossible for human beings to alter specific differences (*al-khawāṣṣ al-fāṣilah*, or *fuṣūl*) of beasts, plants, or minerals by artificial means.¹⁰¹ This line of argument is clearly related to Ibn Sīnā’s, but in Ibn Taymiyyah it has become more rigid: the possibility of changing specific differences, which Ibn Sīnā considered extremely difficult to the point of probably being impossible in practice, is rejected out of hand by Ibn Taymiyyah.

A theme that occupies much of Ibn Taymiyyah’s attention throughout the *fatwā* is fraud. For once he concludes that successful transmutation of metals is impossible, he asserts that anyone who makes imitation gold is trying to swindle others by passing off fake gold as real gold. This close conflation with fraud colors his thinking throughout. *Kīmiyā*’, he says, is worse than usury.¹⁰² Governors (*wulāt*) prosecute forgers, he tells us, forcing those who wish to practice *kīmiyā*’ to do so in secret.¹⁰³

¹⁰⁰ Ibn Sīnā, *Réfutation de l’astrologie*, ed. and trans. Yahya Michot (Beirut: Les Éditions Albouraq, 2006), 5₁₂–6₂ (edition), 58 (translation); Moureau, *De anima*, 11 and n. 8: *li-anna mā yakbluqubū llāhu ta’ālā bi-wisāṭati l-ṭabī’ati ya’jizu ‘anhu l-ṣinā’ah, wa-mā ta’maluhu [tu’allimuhu* Moureau, apparently a typo, but then followed in his translation: “enseigne”; cf. Michot’s correct “accomplir”] *l-ṣinā’atu lā yashtaghīlu* [majority reading: *yastaqillu* Michot based on a single manuscript] *bibi l-ṭabī’ah* (“what God Almighty creates by the mediation of nature, art cannot achieve, and what art achieves, with that nature does not occupy itself”). Passage referenced by Newman, *Promethean Ambitions*, 38 at n. 7.

¹⁰¹ Ibn Taymiyyah, *fatwā*, ¶27–28, ed. Ibn Qāsim, 381₄–382₂. For the edition’s *yafḍul*, *fāḍilah*, etc., read *yafṣil*, *fāṣilah*, etc. (ṣ and ḍ differ by only a single diacritical dot of the sort often omitted in manuscripts).

¹⁰² Ibn Taymiyyah, *fatwā*, ¶13–14, ed. Ibn Qāsim, 373₁₆–375₁.

¹⁰³ Ibn Taymiyyah, *fatwā*, ¶9, ed. Ibn Qāsim, 371₁₅–372₇.

Ibn Taymiyyah even describes at length his debates with an unnamed practitioner of his own day. This interlocutor seeks to convince Ibn Taymiyyah of the validity of his craft by claiming that a series of Quranic figures themselves practiced *kīmiyā*: the Prophet Muḥammad, Moses, and Korah (Qārūn).¹⁰⁴ Ibn Taymiyyah lays out proofs in each case that these are “lies.” Finally, Ibn Taymiyyah describes the man’s social isolation even in death, noting that fewer than ten Muslims attended his funeral. The deceased’s library, including books of “magic” (*sīmiyā*), was then auctioned off, and when Ibn Taymiyyah heard them call out the names of “books of the Art” (*kutub al-ṣan‘ah*), meaning, he explains, “books of *kīmiyā*,” he managed to convince the authorities to destroy them for the public good.¹⁰⁵

The perceived close link between practitioners of magic and of *kīmiyā*’ is driven home elsewhere in the *fatwā*, as when Ibn Taymiyyah seeks to condemn *kīmiyā*’ by association: “you find that *sīmiyā*, which is sorcery [*siḥr*], is often associated with *kīmiyā*’,” but not with pious scholars (*ahl al-ilm wa-l-īmān*). So *kīmiyā*’ must not be among the activities of pious scholars but rather, since sorcery is strictly forbidden, of sinful, seditious infidels (*ahl al-kufr wa-l-fusūq wa-l-iṣyān*).¹⁰⁶

In short, Ibn Taymiyyah’s basic argument for condemning *kīmiyā*’ uses a radical separation between divine and human demiurgy and a schematic theory of chemistry in which the specific differences of metals are immutable. His condemnation’s weight, however, depends on the circumstantial observation that practitioners of *kīmiyā*’ also took an interest in magic, and above all that they used *kīmiyā*’ to commit fraud.

V. CONCLUSION

These scholars thought about chemistry in similar ways. They all agreed that in practice, artisans can closely approximate the perceptible qualities of precious metals artificially. Their theoretical discussions—grounded in a shared Aristotelian conceptual vocabulary, in dialogue with texts and practices of the Sacred Art, and often conditioned by empirical observation—revolved around how best to interpret these metallurgical transformations.

¹⁰⁴ Ibn Taymiyyah, *fatwā*, ¶15–16, 19–20, ed. Ibn Qāsim, 375₂–376₉, 377₆–378₂. On Qārūn, see Ullmann, *NGWI*, 187–88.

¹⁰⁵ Ibn Taymiyyah, *fatwā*, ¶21, ed. Ibn Qāsim, 378_{3–13}.

¹⁰⁶ Ibn Taymiyyah, *fatwā*, ¶37, ed. Ibn Qāsim, at 385_{9–13}.

Most of them were also concerned with how such artisanal activities should be regulated in practice because of their potential impact on human communities and the state. Clearly *kīmiyā*’ was considered problematic, but as al-Fārābī and Ibn Taymiyyah show, the main concern was counterfeiting and other fraud. As Psellos’s *Accusation* reveals, gold-working could be legally problematic even when it involved no counterfeiting. Although associations with occult knowledge or elitist secrecy may have bothered some, the texts discussed here suggest that this association was not what made chrysopoeia so problematic; artificial gold itself was the problem. Indeed, al-Fārābī’s defense of the alchemical tradition’s secrecy presupposes that his reader will be reassured to learn that its purpose is traditional intellectual elitism. Even Ibn Taymiyyah knew better than to lean too heavily on associations with occult knowledge. When the books of the deceased practitioner of *kīmiyā*’ were being auctioned off, Ibn Taymiyyah did not advocate destroying the books on magic; it was only when the names of chemical books were called out that he raised his voice to argue that if they were sold, “people would buy them and follow their instructions. Such people are counterfeiters [*zaghliyyah*], whose hands are to be severed. If you sell these books, you will be enabling them.” No wonder that scholars like al-Fārābī and Psellos took care to profess interest in theoretical, not practical, chemistry—even, or especially, when transmitting chrysopoetic recipes.

But interest in theory was no mere pretense. The chemistry of chrysopoeia interested natural philosophers inside and outside the “alchemical tradition” because it dealt with phenomena that were anomalous and demanded a more satisfying theoretical account than Aristotle’s authoritative writings could provide. Paying close attention to the chemical theories of Byzantine and Middle Eastern authors, chrysopoetic and otherwise, and reading them side-by-side as representing parallel and possibly even interacting intellectual traditions,¹⁰⁷ will be key steps toward fully integrating them into the history of chemistry—a project with the potential to transform that history itself.

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¹⁰⁷ On reasons for doing so see Alexandre M. Roberts, “Byzantine Engagement with Islamic Alchemy,” *Isis* 113, no. 3 (2022): 559–80, esp. 578–80.