

# ‘Alchemical’ Inks in the Syriac Tradition

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## Abstract

This paper explores recipes for ink making preserved in three Syriac alchemical manuscripts. First, I shall provide an analytical description of the scanty material transmitted in two codices kept at the British Library (Egerton 709 and Oriental 1593); then, particular attention will be devoted to a treatise that opens the collection of alchemical writings in the Cambridge MS Mm. 6.29 (15th century AD). This treatise includes several recipes on the making of inks that reveal evident similarities both with the instructions preserved in the Graeco-Egyptian tradition (especially in the so-called Leiden Papyrus) and with early medieval technical handbooks. A selection of Syriac recipes is edited here for the first time and translated and commented on in order to better understand the mechanisms that regulated the transmission of this technical material in Christian Near-Eastern communities.

## Keywords

gold inks – Syriac alchemy – *Mappae clavicula*

## 1 The Syriac Alchemical Collections and the Making of Inks

In terms of the Syriac language,\* alchemy is primarily known through the writings preserved in three manuscripts that date between the fifteenth and the sixteenth centuries: (1) British Library, MS Egerton 709 (16th century); (2) British Library, MS Oriental 1593 (15th–16th century); (3) Cambridge University

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looks like gold or a gold-silver alloy) and mix them with different kinds of gluey substances, such as honey, egg white, and gum arabic.<sup>5</sup> Moreover, the same Byzantine manuscript also preserves formulas for different glues, which could be used in the preparation of metallic inks. For instance, a recipe preserved at the beginning of the manuscript describes the making of a cheese glue (fol. 7r; *περὶ τοῦ ποιῆσαι τυρόκολλαν*), which involves roasting old cheese, boiling it in water, and then mixing it with quicklime, in order to make a paste that can “glue whatever you want” (*καὶ κόλλα εἴ τι δ’ ἂν θέλῃς*).<sup>6</sup>

## 2 The British Library Collection

The two Syriac manuscripts kept at the British Library preserve the same collection of ten alchemical books followed by various excerpts in *garšūnī*, which appear in the second part of the codices. This collection contains only scanty references to inks along with two short recipes in *garšūnī*, which describe the preparation of gold inks. Both recipes are included in the second part of the manuscripts, which features various technical passages on a variety of subjects, from the treatment of different metals and minerals to the classification of substances and instruments used by ancient alchemists. The first recipes in the *garšūnī* section describe various metallurgical techniques, among which is a recipe that explains how to liquefy a gold leaf in gum arabic (MSS Egerton 709, fol. 57r6–10; Oriental 1593, fol. 30r19–23):<sup>7</sup>

ܡܠܐ ܕܥܝܢܐ. ܡܠܐ ܕܥܝܢܐ ܕܥܝܢܐ. ܡܠܐ ܕܥܝܢܐ ܕܥܝܢܐ. ܡܠܐ ܕܥܝܢܐ ܕܥܝܢܐ.  
ܡܠܐ ܕܥܝܢܐ. ܡܠܐ ܕܥܝܢܐ ܕܥܝܢܐ. ܡܠܐ ܕܥܝܢܐ ܕܥܝܢܐ. ܡܠܐ ܕܥܝܢܐ ܕܥܝܢܐ.  
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5 Berthelot and Ruelle, *Alchimistes grecs* (cit. note 4), vol. 2, pp. 327 (rec. 19–20), 334–335 (rec. 49). On these recipes, see also Peter Schreiner and Doris Oltrogge, *Byzantinische Tinten-, Tuschen- und Farbzepte* (Wien: Verlag der Österreichischen Akademie der Wissenschaften, 2001), pp. 50–51, 58–59, 67.

6 Berthelot and Ruelle, *Alchimistes grecs* (cit. note 4), vol. 2, p. 380; Schreiner and Oltrogge, *Byzantinische Tinten* (cit. note 5), pp. 77–78. See also Maria Leontsini and Gerasimos Marianos, “From Culinary to Alchemical Recipes. Various Uses of Milk and Cheese in Byzantium,” in *Latte e Latticini. Aspetti della produzione e del consumo nelle società mediterranee dell'Antichità e del Medioevo*, edited by Ilias Anagnostakis and Antonella Pellettieri (Lagonero: Grafica Zaccara, 2016), pp. 205–222 (pp. 216–217).

7 Syriac text edited in Berthelot and Duval, *Chimie* (cit. note 1), pp. 61–62; French translation on p. 142.

8 MS Oriental 1593.

9 MS Egerton 709 transmits the reading ܡܠܐ, corrected in ܡܠܐ (“it is watered with”).



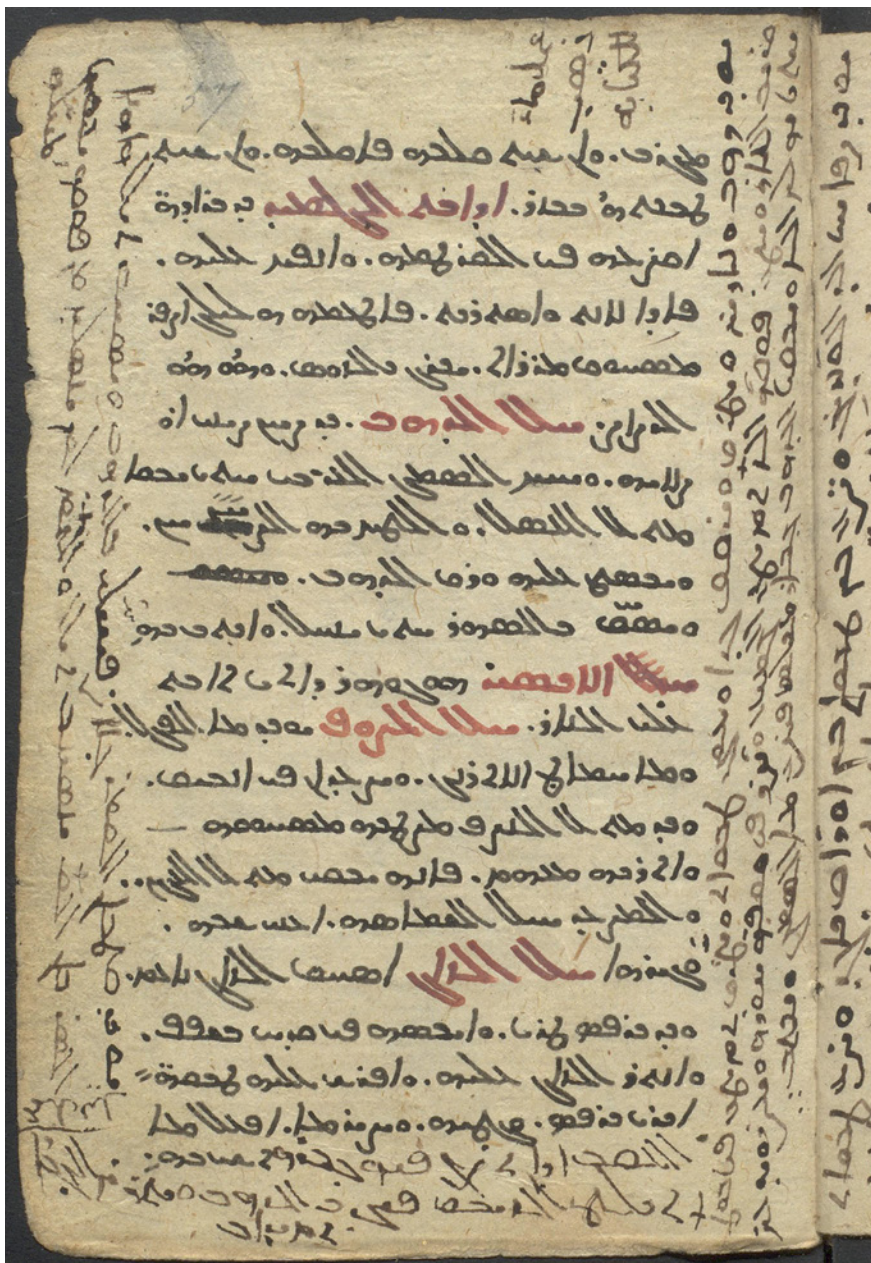


FIGURE 5.1 *Garṣūnī* recipes on ink making, MS British Library, Egerton 709, fol. 57r



process. As we shall see in other recipes for the making of gold inks, gold leaves are often processed with mercury.<sup>19</sup>

The two short texts discussed above represent the main sources on ink making in the collection disclosed by the British Library manuscripts, both included in a *garšūnī* section that collates many procedures for ‘liquifying’ either metals or minerals. Some metals (e.g. tin or lead) were simply melted, while other minerals like sandarac and vitriol underwent more complex treatments. The production of inks was somehow assimilated to these techniques: gold was not simply melted but crushed to a ‘powder’ or ‘dust’ and then mixed with a gluey liquid. On the other hand, if we return to the first part of the British Library collection, the ten Syriac alchemical books do not include any recipe dealing with the production of inks. Black inks, however, do appear in these books, as ingredients used in alchemical procedures. The first explicit reference to writing practices is encapsulated in the list of alchemical signs and abbreviations that begins the ten alchemical books. This list records either alchemical symbols — signs referring to metals, plants and minerals (e.g. electrum, vinegar, lime, copper, realgar, alum, lac-dye, etc.) — or transcriptions of Greek terms, which are written in red ink and followed by an explanatory note in black (see MS Egerton 709, fol. 2r–5v and Oriental 1593, fol. 1r–3v). Although similar, this list reveals relevant variants within the two British Library manuscripts. Only MS Oriental 1593 features the following entry (fol. 1114):

ܡܠܢܝܢ. ܡܠܢܝܢ ܡܠܢܝܢ.

*M'NYN* (*lege MLNYN*): ink of the writers.

The lemma *M'NYN* seems to be a misspelled transcription of the Greek term *μελάνιον*,<sup>20</sup> the diminutive of *μέλαν* (lit. ‘black,’ ‘ink’), which is transcribed as

19 The margin of MS Egerton 709, fol. 56v, preserves a few lines of another recipe that describes how to hammer gold leaves: Berhelot and Duval, *Chimie* (cit. note 1), p. 103. Next to these lines, a note in Arabic reads: *عمل ورق ذهب للنقش*, “The working of gold leaves for the painting.”

20 The term is attested in a recipe on the preparation of a ‘magical’ ink (τοῦ μελανίου ἡ σκευή) included in *PGM* I 253 (Karl Preisendanz, *Papyri Graecae magicae. Die griechische Zauberpapyri*, Stuttgart: Teubner, 1973, vol. 1, p. 14): see Miriam Blanco’s contribution in this volume (Chapter 2). A substance called *μελάνιον* is also mentioned in the *Libri medicinales* (*Medical books*) of the 6th-century Byzantine physician Aetius of Amida: in book XVI 146,12, *μελάνιον* appears among the ingredients of a scented drug to be used in fumigation (Skevos Zervos, *Gynaekologie des Aetios sive sermo sextus decimus et ultimus zum erstenmale aus Handschriften veröffentlicht*, Leipzig: Verlag von A. Fock, 1901, p. 170 = Roberto Romano, “Aezio Amidenò libro XVI,” in *Medici bizantini*, edited by Antonio

*MHL'WN* (ܡܠܗܘܢ) or *MHL'N* (ܡܠܗܢ) in other Syriac texts:<sup>21</sup> rather than *M'NYN*, here we should probably read *MLNYN* (ܡܠܢܝܢ), as already suggested by Duval and Brockelmann.<sup>22</sup> This correction is confirmed by an entry included in a Galenic section preserved in the Cambridge University Library alchemical manuscript.<sup>23</sup> The manuscript, in fact, includes a summarized Syriac translation of Galen's treatise *On Simple Drugs*, books 9–11. The translation takes the form of a lexicon attributed to the Greek alchemist Zosimus of Panopolis. The Greek names of various minerals and animal products originally described by Galen are simply transliterated in Syriac script and briefly explained. In particular, in book 9 of *On Simple Drugs*, Galen devoted two entries to the medical uses of *μελαντηρία*, 'shoemakers' black' (book 9, chap. 3.19 = 12.226, 4–6 Kühn) and *μέλαν*, 'ink' (book 9, chap. 3.20 = 12.226, 7–10 Kühn).<sup>24</sup> These two substances appear to have been combined in a single entry in the Syriac summary, which reads (MS Mm. 6.29, fol. 121r24–25):

ܡܠܢܝܢܐ ܕܡܠܗܢܐ ܡܠܗܢܐ [ ... ] ܡܠܗܢܐ ܡܠܗܢܐ.

*M'L'NTRY'* (= Gr. *μελαντηρία*), that is *MLNYN* (= Gr. *μέλανιον*), [...] <sup>25</sup> ink of the writers.

The term *MLNYN*, based on the Greek diminutive form *μέλανιον*, might have been used here to 'translate' the Greek *μέλαν*: indeed, as recently argued by

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- Garzya, Torino: UTET, 2006, p. 548). See also Erich Trapp, *Lexikon zur byzantinischen Gräzität besonders des 9.–12. Jahrhunderts* (Wien: VÖAW, 2001–2017), vol. 2, s.v. *μέλανιον*.
- 21 Robert Payne Smith, *Thesaurus Syriacus* (Oxford: Clarendon Press, 1897–1901; hereafter *ThSyr*), p. 2025. For instance, the 10th-century lexicographer Bar Bahlūl provides the following explanation: *ܡܠܗܢܐ ܡܠܗܢܐ ܡܠܗܢܐ ܡܠܗܢܐ*, "*MHL'N* (= Gr. *μέλαν*), ink (Syriac *dyuto*), ink of the writers (Arabic *midād al-kuttāb*)," see Duval, *Lexicon Syriacum* (cit. note 3), vol. 2, p. 1022, l. 6.
- 22 Berthelot and Duval, *Chimie* (cit. note 1), p. 11, n. 1, and Carl Brockelmann, *Lexicon Syriacum*, 2nd ed. (Halis Saxorum: Sumptibus M. Niemeyer, 1928), p. 302. See Michael Sokoloff, *A Syriac Lexicon. A Translation from the Latin, Correction, Expansion and Update of C. Brockelmann's Lexicon Syriacum* (Winona Lake, IN–Piscataway, NJ: Eisenbrauns–Gorgias Press, 2009), p. 774.
- 23 MS Mm. 6.29, fol. 120v–121v + 148 + 122r–129v. See Matteo Martelli, "Medicina e alchimia. 'Estratti galenici' nel *Corpus* degli scritti alchemici siriaci di Zosimo," *Galenos*, 2010, 4: 207–228; Martelli, *L'alchimie syriaque* (cit. note 1), pp. 208–211.
- 24 Uncritical edition by Karl G. Kühn, *Claudii Galeni opera omnia*, vol. 12 (Leipzig: Knobloch, 1826).
- 25 The manuscript is damaged here and a word has been erased by humidity; Berthelot and Duval, *Chimie* (cit. note 2), p. 298, paraphrased the whole entry as follows: "*μελαντηρία [sic!]* ou *μέλαν*, c'est l'encre des écrivains."



Aaron Butts, in many cases “the diminutive serves as an input form for a number of Greek loanwords in Syriac.”<sup>26</sup> Moreover, both in the opening list of the MS Oriental 1593 and in the Galenic section ascribed to Zosimus, the term *MLNYN* is explained with *dyuto* (ܕܝܘܬܐ), a standard Syriac term for ‘ink,’<sup>27</sup> which is used with reference to inks of various colours in many recipes recently edited and commented on by Jimmy Daccache and Alain Desreumaux.<sup>28</sup> Our alchemical passages further specify that the ink was used by ‘writers’ (ܡܠܬܐ), presumably either private or professional copyists working in Christian *scriptoria*.

The inclusion of terms referring to inks and writing practices in a list of alchemical signs and Greek loanwords might astonish the reader. This apparently unexpected mention, however, does not seem out of the ordinary, especially when the Syriac list is compared with the Byzantine tradition. Byzantine alchemical manuscripts, indeed, also feature lists of signs that reveal many similarities with the opening sections of the two British Library codices. In particular, the Byzantine manuscripts *Parisinus gr.* 2327 (1478 AD) and *Laurentianus Plut.* 86, 16 (1492 AD) feature long lists of alchemical signs that include a reference to the Greek term μέλαν and its abbreviation.<sup>29</sup> Moreover, a Byzantine lexicon of alchemical terms entitled *Lexicon on the Making of Gold*, organized alphabetically, features the following entry under the letter μ: “Indigo is prepared with woad and chrysolite” (μέλαν Ἰνδικόν ἀπὸ ἰσάτιος γίνεται καὶ χρυσολίθου).<sup>30</sup> The expression clearly refers to a blue-dark colour; indeed, indigo (μέλαν Ἰνδικόν) also appears among the ingredients used to produce an artificial hyacinth in a Byzantine recipe book on the making of gemstones.<sup>31</sup> On the other hand, the black ink of writers (μέλαν γραφικόν) is explicitly mentioned by the Graeco-Egyptian alchemist Pelagius to describe

26 Aaron Michael Butts, *Language Change in the Wake of Empire. Syriac in Its Greco-Roman Context* (Winona Lake, IN: Eisenbrauns, 2016) p. 101.

27 See, for instance, Bar Bahlūl explanation: ܡܠܬܐ ܕܝܘܬܐ, “Ink (Syr. *dyuto*), ink (Ar. *al-midād, al-hibr*),” see Duval, *Lexicon Syriacum* (cit. note 3), vol. 1, p. 562, l. 6.

28 Daccache and Desreumaux, *Recettes d'encre* (cit. note 11). See also Alain Desreumaux, “Des couleurs et des encres dans les manuscrits syriaques,” in *Manuscripta syriaca. Des sources de première main*, edited by Françoise Briquel Chatonnet and Muriel Debié (Paris: Geuthner, 2015), pp. 161–192 (p. 181).

29 For the list in the MS *Laurentianus Plut.* 86,16, see Zuretti, *Catalogue des manuscrits alchimiques grecs*, vol. 7. *Alchemistica signa* (Bruxelles: Union Académique Internationale, 1932), p. 16, l. 863; for the MS *Parisinus gr.* 2327, see Berthelot and Ruelle, *Alchimistes grecs* (cit. note 4), vol. 1, p. 114, l. 4.

30 Berthelot and Ruelle, *Alchimistes grecs* (cit. note 4), vol. 2, p. 11, l. 6. On this lexicon, see also Matteo Martelli and Stefano Valente, “Per una nuova edizione di un lessico alchemico bizantino,” *Eikasmos*, 2013, 24:275–296.

31 Berthelot and Ruelle, *Alchimistes grecs* (cit. note 4), vol. 2, p. 351, l. 29.

a black compound produced by treating chrysolite and *magnēsia*.<sup>32</sup> Likewise, in the collection of Syriac alchemical books preserved in the British Library manuscripts, ink (*dyuto*) is introduced among the ingredients used for specific preparations. For instance, purified ‘Indian ink’ (ܐܝܢܐ ܝܢܕܝܐ), namely ‘Indigo’), ‘flower of copper’ (ܐܝܢܐ ܕܥܡܪܐ), verdigris (ܐܝܢܐ ܕܥܡܪܐ) and juice of leeks (ܐܝܢܐ ܕܥܡܪܐ) represent the main ingredients of a red alchemical ‘water’ whose preparation is described in the ninth book of the collection.<sup>33</sup>

### 3 The Cambridge Alchemical Manuscript: An Overview of Ink Recipes

The scattered references to inks discussed so far are relics of a broader interest in ink making technologies (especially the making of gold and silver inks) that emerges more clearly in the collection of alchemical writings preserved by the Syriac MS Mm. 6.29. The first folia of the manuscript have been lost. In its current state, the collection opens with a series of recipes on metallurgical procedures that are difficult to read: fol. 1r, in fact, has been heavily damaged by humidity. The section is closed with the explicit: ܥܡܪܐ ܕܥܡܪܐ, “End of the first treatise on colours.”<sup>34</sup> Then, a second book begins (fol. 1v3), introduced by the title: ܥܡܪܐ ܕܥܡܪܐ [...] ܥܡܪܐ, “Second treatise, *hp*(...), letter *bēt* that deals with letters of any kind and paints (lit. ‘coating’) to write with gold.” The text — as we shall see, a collection of recipes — seamlessly continues until fol. 20v, where its end is marked by the *explicit*: ܥܡܪܐ ܕܥܡܪܐ, “End of the first treatise.” The inconsistency of this ending with the title is evident; indeed, we would have expected a reference to either book 2 or to the second letter of the Syriac alphabet (i.e. *bēt*). Hence, Berthelot and Duval supposed that this section actually merges two originally separate books: (1) a first treatise on gold inks and paints, which runs until fol. 9r, where it concludes with a recipe on how to write on iron with black letters (fol. 8v21–9r8: ܥܡܪܐ ܕܥܡܪܐ); (2) an untitled book on various metallurgical procedures and dyeing techniques, which ends with the above-mentioned *explicit*.<sup>35</sup> Indeed, after this first

32 *Ibid.*, p. 255, l. 20: γίνεται δὲ πᾶν μέλαν ὡς τὸ γραφικὸν μέλαν, “it becomes completely black as the ink for writing.” On Pelagius, see Jean Letrouit, “Chronologie des alchimistes grecs,” in *Alchimie: Art, histoire et mythes*, edited by Didier Kahn and Sylvain Matton (Paris–Milano: S.É.H.A.–Arché, 1995), pp. 11–93 (pp. 46–47).

33 Berthelot and Duval, *Chimie* (cit. note 1), p. 49 (see l. 8 in particular).

34 *Ibid.*, p. 203.

35 *Ibid.*, pp. 209–210.

treatise, the manuscript continues with other treatises progressively marked by Syriac letters in alphabetical order, from the second (*bēt*) to the eleventh letter (*kop*), which appear to be the Syriac translation of original Greek texts by the Graeco-Egyptian alchemist Zosimus of Panopolis (3rd–4th century AD).<sup>36</sup>

The possible relationship of the first two books with the other treatises by Zosimus awaits a proper examination and, hopefully, the question will be better assessed after the publication of a complete edition of Zosimus’ Syriac books.<sup>37</sup> Here, it will suffice to note that these books include various references to the use of compounds or simple substances as inks. Book 9 (on mercury), for instance, contains a recipe on how to produce a “golden mercury” (Mm 6.29, fol. 58v19–20) by grinding nails of gold (ܡܥܥܠܐ ܕܕܥܝܪܐ) in a mortar and mixing it with water or liquid gum (? ܡܥܥܠܐ).<sup>38</sup> Thanks to this procedure, the author specifies (fol. 58v19–20), ܡܥܥܠܐ ܕܕܥܝܪܐ ܕܥܝܪܐ ܕܥܝܪܐ [...] “You will have the mercury of gold that is useful also for the books (i.e. for writing on books).” In book 11 (on iron), a recipe on the treatment of iron is introduced by the title: ܡܥܥܠܐ ܕܕܥܝܪܐ ܕܥܝܪܐ ܕܥܝܪܐ, “Preparation of iron with which you will write on glass” (Mm. 6.29, fol. 77v24–28).<sup>39</sup> Finally, a section of book 7 explains a gilding technique that could be applied to both metallic leaves and parchment (Mm. 6.29, fol. 48v13–21). The recipe describes how to prepare a golden paint without actually adding the precious metal: a wide variety of ingredients — such as lime (ܡܥܥܠܐ = Gr. γύψος), fish glue (ܡܥܥܠܐ ܕܕܥܝܪܐ), *MLYSYN* (ܡܥܥܠܐ = Gr. Μιλήσιον),<sup>40</sup> ochre (ܡܥܥܠܐ = Gr. ὤχρα) and minion (ܡܥܥܠܐ) — are mixed together in different steps and applied to metallic leaves. The same product could also be used to write on parchment (ܡܥܥܠܐ ܕܕܥܝܪܐ).<sup>41</sup>

The wide range of substances handled by ancient alchemists included ‘chemicals’ that could serve multiple applications. Similar paints were used both to

36 See also Martelli, *Alchimie en syriaque* (cit. note 1), pp. 199–209.

37 The edition is in progress as part of the ERC project *AlchemEast*.

38 Berthelot and Duval, *Chimie* (cit. note 1), p. 245, translate: “avec de l’eau ou de la gomme liquide.” See also Duval, *Lexicographie* (cit. note 10), p. 366. The usual meaning of ܡܥܥܠܐ is, however, ‘filings’.

39 Berthelot and Duval, *Chimie* (cit. note 1), p. 257.

40 According to ancient Greek medical literature, the adj. Μιλήσιος ‘Milesian’ was used to qualify a specific kind of ἀλκυόνιον (perhaps a type of coral or sponge). In his book *On Materia Medica*, for instance, Dioscorides writes (v 118): “You must know that there are five kinds of *alkyonia*. One kind is thick, sponge-like in structure and heavy; [...] the third is vermicular and of purplish colour; some call it Milesian (τὸ δὲ τρίτον σκωληκοειδὲς ὑπάρχει τῷ τύπῳ, καὶ τῇ χροῖᾳ ἐμπόρφυρον, ὃ τινες Μιλήσιον καλοῦσι).” Translation by Lily Y. Beck, *Pedanius Dioscorides of Anazarbus, De Materia Medica*, 2nd edition (Hildesheim–Zürich–New York: Olms–Weidmann, 2011), p. 392.

41 Berthelot and Duval, *Chimie* (cit. note 1), p. 237.



to the Hellenistic period. In his *Compendium on Mechanics* (IV 77),<sup>46</sup> the 3rd-century BCE writer Philo of Byzantium mentions a special ink made of gall nuts dissolved in water, which enabled the writing of letters that became invisible as the mixture dried; however, the letter becomes legible again once it is washed with a sponge soaked in a solution of vitriol.<sup>47</sup>

#### 4 The Book on Inks in the Cambridge Manuscript

As already mentioned, the first section of the MS Mm. 6.29 preserves a treatise marked by the letter *bēt*, which collates more than 40 recipes on the making of inks.<sup>48</sup> The compiler's interest appears to be primarily focused on golden inks, which often include a quantity of gold. In some cases, however, cheaper ingredients — either metallic alloys or yellow plants and minerals — are used to prepare products that do not require the use of the precious metal. Methods for writing black letters on metallic surfaces are also described, along with those for the preparation of silver inks. Many of the recipes included in this book are based on earlier Greek texts that have been preserved in their original language in only a few cases. Indeed, the description of some procedures in the Syriac book matches the technical information conveyed by the Leiden Papyrus X (3rd–4th century AD), a Greek collection of (al)chemical recipes that also features various formulas on the preparation of gold and silver inks.<sup>49</sup> However, the most important alchemical source that overlaps significantly with the Syriac treatise is a Latin recipe book usually referred to as the *Mappae clavicula*. This has been identified as an early Medieval translation of a lost Late Antique alchemical treatise originally written in Greek.<sup>50</sup>

46 Edition in Hermann Diels and Erwin Adelbert Schramm, *Exzerpte aus Philons Mechanik B. VII und VIII (vulgo fünftes Buch). Abhandlungen der preußischen Akademie der Wissenschaften, Philosophisch-historische Klasse Nr. 12.* (Berlin: Reimer, 1920), p. 79.

47 Robert J. Forbes. *Studies in Ancient Technology*, 9 vols (Leiden: Brill, 1966–1993), vol. 3, pp. 236–239; Thomas Christiansen, “Manufacture of Black Ink in the Ancient Mediterranean,” *The Bulletin of the American Society of Papyrologists*, 2017, 54:167–195 (pp. 188–190).

48 Partial French translation in Berthelot and Duval, *Chimie* (cit. note 1), pp. 203–209.

49 See the recent edition and French translation by Halleux, *Papyrus* (cit. note 2), pp. 84–109 (see pp. 42–43 for an introduction to the recipes for ink making). A full English translation of the papyrus (although based on an earlier and less reliable edition) is available in Earle Radcliffe Caley, “The Leiden Papyrus X. An English Translation with Brief Notes,” *Journal of Chemical Education*, 1926, 10:1149–1166.

50 For a recent edition and Italian translation of the *Mappae clavicula*, see Sandro Baroni, Giuseppe Pizzigoni, and Paola Travaglio, *Mappae clavicula. Alle origini dell'alchimia in*



*Sir.* Take filings of gold and put in a mortar. Grind them with vinegar until they become liquid. Then drip vinegar and add fish glue; grind with water, mix together, moisten with water, and write.

Here, gold is added to the preparation after being limed and reduced to filings. Indeed, filings were probably easier to grind in a mortar than gold leaves, which are very malleable and difficult to process. As we shall see, when gold leaves appear in ink recipes, they are often mixed with mercury to facilitate the grinding process.<sup>53</sup> In our recipe, vinegar seems to be used for the same purpose: the aim was to produce a gold powder in suspension in a liquid substance. Fish glue is mixed to make the ink stickier. A similar technique is already attested in the Leiden Papyrus, according to which a gold ink was produced by grinding a gold alloy with vinegar (rec. 44):<sup>54</sup>

Χρυσογραφία. Χρυσᾶ γράμματα γράφειν· κολλῇ χρυσοχοικῇ γράφε δ̄ θέλεις  
σὺν ὀξει.

Chrysography. To write in letters of gold. Write what you desire with goldsmith's solder and vinegar.<sup>55</sup>

Rather than pure gold, a gold alloy is used here. Indeed, the Leiden Papyrus also includes two different formulas for gold solders, in which gold (in different proportions) is alloyed with copper and silver.<sup>56</sup> According to Alexander's experiments, who used a gold-copper alloy (2 parts of gold, 1 part of copper) with a little of silver,<sup>57</sup> "the ink — made by filing the metal, rising the powder in vinegar and mixing with gum — is reddish brown when applied to the parchment, though discrete particles of metal give a decided lustre to the surface."<sup>58</sup> The Greek text, however, fails to specify the addition of a glue, like gum or fish glue.

In some cases, litharge — an orange-yellow lead oxide — was also mixed with gold, as described in the next recipe of the Cambridge manuscript:

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- 53 Shirley M. Alexander, "Medieval Recipes Describing the Use of Metals in Manuscripts," *Marsyas*, 1964–1965, 12:34–53 (p. 38).
  - 54 Halleux, *Papyrus* (cit. note 2), p. 96.
  - 55 Translation by Caley, *The Leiden Papyrus X* (cit. note 49), p. 1157.
  - 56 See rec. 30 and 32 of the Leiden Papyrus: Halleux, *Papyrus* (cit. note 2), pp. 92–93.
  - 57 This is the formula given by rec. 32 of the Leiden Papyrus.
  - 58 See Alexander, *Medieval Recipes* (cit. note 53), p. 40.







as well as in recipes 47 and 50 of the *Mappae clavicula*. Texts and translations of these three recipes are provided below:

Leiden Papyrus, **rec. 72**<sup>66</sup>

Ἄλλη. Χρυσογραφία χωρίς χρυσοῦ· ἐλυδρίου μέ(ρος) α', ῥητίνης καθαράς μέ(ρος) α', ἄρσενικοῦ χρυσίζοντος μέ(ρος) α' ὃ ἐστὶν σχιστόν, κόμμεως καθαροῦ, χολῆς χελώνης μέ(ρος) α', ὠῶν τοῦ ὑγροῦ μέ(ρη) ε', ἦται δὲ τῶν ξηρῶν πάντων ἡ ὅλη Σ κ', εἶτα ἐπέμβαλε τούτοις κρόκου κιλικίου Σ δ'. Ποίει δὲ οὐ μόνον ἐπὶ χάρτου ἢ διφθέρας, ἀλλὰ καὶ ἐπὶ μαρμάρου ἐστιλβωμένου καὶ ἐάν τι ἄλλο καλὸν θέλης ὑποζωγραφῆσαι καὶ ποιῆσαι χρυσοειδές.

Another (recipe). To write in letters of gold without gold. Celandine, 1 part; pure resin, 1 part; golden coloured orpiment, the one that is scissile, 1 part; pure gum; bile of tortoise, 1 part; the liquid part of eggs, 5 parts; take 20 staters by weight of all these materials dried; then throw in 4 staters of saffron of Cilicia. Can be used not only on papyrus or parchment, but also upon highly polished marble, or also when you wish to make a beautiful design upon some other object and give it the appearance of gold.<sup>67</sup>

*Mappae clavicula*, **rec. 47**<sup>68</sup>

*Auri alia scriptio sine auro. Elydrii partem 1, resinae fixae partem 1, ovorum v humores, gummi puri partem 1, auripigmenti scissilis partem 1, fellis testudinis partem 1. Sit autem eorum id est tunsorum omnium pondus ad dragmas xx. Deinde adicias croci ciliciensis dragmas 11. Fac autem hoc non solum in cartis et in membranis, verum etiam in marmore et in vitro.*

Another writing in gold without gold. Celandine, 1 part; broken resin, 1 part; the white of 5 eggs; pure gum, 1 part; scissile orpiment, 1 (part); gall of a tortoise, 1 (part). The weight of them all, after they have been pounded, should be about 20 drachmae. Then add 2 drachmae of Cilician saffron. This works not only on papyrus and parchment, but also on marble and on glass.<sup>69</sup>

66 Halleux, *Papyrus* (cit. note 2), p. 101. See also the recipe 56 of the Leiden papyrus, which records a list of similar ingredients: Halleux, *Papyrus* (cit. note 2), p. 98.

67 Translation (slightly modified) by Caley, *The Leiden Papyrus* (cit. note 50), p. 1159.

68 Baroni et al., *Mappae clavicula* (cit. note 50), p. 108.

69 Translation based on Cyril Stanley Smith and John G. Hawthorne, "Mappae Clavicula. A Little Key to the World of Medieval Techniques," *Transactions of the American Philological Society*, 1974, 64,4:1–128 (p. 34).

*Mappae clavicula*, rec. 50<sup>70</sup>

*Aurei coloris scriptura in cartis, in marmore et vitro ut videatur de auro. Elydrii partem 1, auripigmenti partem 1, fellis testudinis partem 1, aluminis scissilis partem 1 et de corio mali punici quod intus est aurei coloris 1, gummi 1, ova v. Sit autem eorum pondus dragmas IX et croci dragmas II.*

Gold-coloured writing on papyrus, marble, and glass, so that it seems to be made of gold. Celadine, 1 part, orpiment, 1 part, gall of a tortoise, 1 part, scissile alum, 1 (part) and 1 part of the skin of a pomegranate that is gold-coloured inside, gum, 1 part, 5 eggs. The weight of all these should be 9 drachmae, and 2 drachmae of saffron.<sup>71</sup>

All these recipes, except for R8 of the Cambridge manuscript, emphasize the multiple applications of the produced ink, which could be used to write on different supports, from papyrus and parchment to metal, marble, wood, stone, and glass. In order to better compare the substances involved in the described procedures, I have listed the ingredients in Table 5.1.

The Syriac recipe included in Democritus’ book overlaps in many respects with Leiden Papyrus, rec. 72, and *Mappae clavicula* (hereafter *MC*) rec. 47. Both the ingredients and their proportions are almost the same, and some variations can probably be explained with textual arguments. As for the amount of eggs, the Leiden Papyrus and *MC* 47 specifies taking 5 parts, while Democritus’ Syriac text mentions the same quantity for the bile of a calf, but omits any mention of eggs: we cannot exclude that the term ‘eggs’ was originally in the Syriac recipe (or in its source), but was later omitted by a scribe who copied the text.<sup>72</sup> Likewise, the variation between “bile of a tortoise” (both in the Leiden Papyrus and in *MC* 47) and “bile of a calf” (Democritus’ recipe) can be explained by considering the transmission of the Syriac text: in Syriac, in fact, the terms for the two animals are very similar — ܡܠܚܐ (*galo*), ‘tortoise’ and ܡܠܚܐ (*eglo*), ‘calf’ — and they can be easily interchanged. Philologists and critical editors, however, should be very cautious in handling similar texts, since lexical variations can also point to subtle changes in the selection of the ingredients. Indeed, the Leiden Papyrus (rec. 61) specifies that very bitter bile of a calf (ܡܡܫܚܝܐ ܚܠܝܗ ܕܡܠܚܐ) could be used instead of tortoise bile (ܚܠܝܗ ܕܡܠܚܐ) in the making of a golden ink.<sup>73</sup>

70 Baroni et al., *Mappae clavicula* (cit. note 50), p. 110.

71 Translation based on Smith and Hawthorne, *Mappae Clavicula* (cit. note 69), p. 35.

72 See also R7, where 5 eggs are recorded.

73 Halleux, *Papyrus* (cit. note 2), p. 99; see also Alexander, *Medieval Recipes* (cit. note 53), p. 42.

TABLE 5.1    Ingredients of the golden ink according to ancient texts

	R7	R8	Democritus	Leiden 72	MC 47	MC 50
<i>Plants</i>						
plant dye w'RŠ'	✓ (1 part)	✓ (1 part)				
plant dye 'celandine'			✓ (1 part)	✓ (1 part)	✓ (1 part)	✓ (1 part)
pomegranate (inner part)	✓ (1 part)					✓ (1 part)
saffron	✓ (1 part)		✓ (4 drach.)	✓ (4 stat.)	✓ (2 drach.)	✓ (2 drach.)
resin				✓ (1 part)	✓ (1 part)	
gum		✓ (1 part)		✓	✓ (1 part)	✓ (1 part)
<i>Minerals</i>						
orpiment	✓ (1 part)	✓ (1 part)	✓ (1 part)	✓ (1 part)	✓ (1 part)	✓ (1 part)
verdigris		✓ (1 part)				
alum	✓ (1 part)					✓ (1 part)
earth of Samos	✓ (1 part)					
metallic leaf		✓				
<i>Animal products</i>						
bile of a calf		✓ (1 part)	✓ (5 parts)			
bile of a tortoise	✓ (1 part)			✓ (1 part)	✓ (1 part)	✓ (1 part)
eggs	✓ (5 eggs)			✓ (5 parts)	✓ (5 eggs)	✓ (5 eggs)

A clear similarity in the ingredients and their quantities is also detectable between the Syriac recipe **R7** and *MC 50*: as for the dye plant used in the process, the Syriac text prescribes using *wʾršʿ* rather than celandine,<sup>74</sup> and it also includes the earth of Samos, which is not mentioned in the *Mappae clavicula*.

If we go back to the recipe book on ink making preserved by the Cambridge manuscript, we must note that recipes 8–9, which do not require the use of precious metals, are followed by a cluster of recipes that describe various treatments of gold for preparing inks and paints:

(Rg) Fol. 2v17–3r11 (golden ink with the precious metal)  
Inc.: ههـنـى حـمـر و نـحـس و سـفـر دھـب . "Sir. Pour lead and copper etc."

(Rio) Fol. 3r11–3v2 (golden ink with the precious metal)

*Sir:* To write with gold. Good orpiment (= Gr. ἄρσενικόν), 2 parts; wʾršʾ (a dye plant), 1 part; litharge that we have gilded, 1 part; grind and mix with water. Then take 24 leaves (of gold?) and add a quarter of the mixture. Grind together in a clean mortar by adding a bit of salt. When it is well ground, add water until only pure gold remains. Then add what is left of the mixture and a bit of broken gum, by pouring a bit of water of saffron over it. Then you grind until it thickens like an ink (*dyuto*) and put it in a copper vessel. When you write with it, soak a reed (in) liquid alum, and write. When it gets dry, polish with pork rind.

This detailed recipe singles out the different passages of the procedure, at the same time specifying the right proportions of the various substances added to the preparation of the golden ink. Quite striking is the mention of 24 leaves of gold (l. 2), which seems to imply the use of a significant amount of the precious

74 The same substitution can be observed in **R10** (see below).

75 I added the prep. **ع**; the MS simply reads **ف**. See also below, R13.

metal. The same datum, however, appear to be confirmed by the Latin version of this recipe (clearly based on a common Greek source), which is included in the *Mappae clavicula* (rec. 38):<sup>76</sup>

*Auripigmenti scissilis partes II, elydrii partem I, spumae argenti cuius color sit aureus partem I. Haec, cum triveris, diffunde in vase. Postea accipe laminas aureas XXIIII ad quartam, quantum voles ex his tere in mortario mundo medicinali. Adice sal modicum et, cum tibi apparverit ut arena diligenter trita, adice aquam puram et tere et ablue, ita ut frequenter aquam effundas et aliam infundas donec tibi aurum purum appareat. Tunc adice de suprascripto medicamine quod sufficiat et modicum gummi triti, ita ut non sit glutinosum. Instilla destillationem croci et omnia simul tere, ut sit quasi atramenti pinguedo, et recipe aut in concam aut in vitreum vas. Cumque scribere vis, primum ungue cannam liquido alumine et tunc in aurum intingue et scribe et, cum siccaverit, dente frica diligenter.*

Scissile orpiment, 2 parts, celandine, 1 part, litharge, whose colour must be golden, 1 part. After grinding them, pour them into a pot. Then take as fourth (part) 24 gold leaves, and grind as much as you want of these in a clean pharmacist's mortar. Add a bit of salt and, when it looks like well-ground sand, add fresh water, grind and wash it off, so that you continually pour out the water and add new water until you see that the gold is pure. Then add a sufficient amount of the above-mentioned drugs and a little ground gum, so that it does not get sticky. Drip onto it an extract of saffron and grind everything together, so that it has the consistency of ink. Place it in a shell or a glass pot, and when you want to write, first smear the reed pen with moist alum, then dip it in the gold and write. When it gets dry, rub it thoroughly with a tooth.<sup>77</sup>

Only a few differences between the Latin and the Syriac text are detectable. As already noted in the comparison between R7 and MC 50, the dye plant called w'rš' is used in the Syriac text (R10) instead of celandine (*elydrium* = Gr. ἐλύδριον), which is prescribed in the Latin recipe (MC 38). Moreover, according to the latter, the ink was to be placed in a shell or a glass pot rather than in a copper vessel as in the Syriac recipe. Here, pig skin is used to polish the written letters, while the Latin text mentions using a tooth.

<sup>76</sup> Baroni et al., *Mappae clavicula* (cit. note 50), p. 100.

<sup>77</sup> Translation based on Smith and Hawthorne, *Mappae Clavicula* (cit. note 69), p. 34.









## 5 Concluding Remarks

A galaxy of recipes on ink making emerges from the comparison of the instructions preserved by multiple traditions, which, despite their own peculiarities and different ramifications, appear to be firmly rooted in a shared and rich Late Antique material. In particular, the close similarities between Syriac and Latin recipes cannot be properly assessed without supposing common Greek sources that were independently translated into either language by scholars working in distinct cultural settings and operating in different periods. Traces of this Greek Late Antique heritage can be detected in Graeco-Egyptian papyri, such as the Leiden Papyrus, which represents a crucial source for reconstructing ancient procedures used to prepare gold or silver inks and paints. Other relics of this ancient technology are detectable in the collection of Greek alchemical treatises transmitted by Byzantine manuscripts, which share various features with the Syriac sources under examination.

On the other hand, the Syriac manuscript Mm. 6.29 includes a variety of procedures for the making of metallic inks, which substantially enriches the scanty information that can be extracted from the material preserved in Graeco-Egyptian papyri as well as in Byzantine alchemical sources. Gold and silver inks were important tools belonging to a broader umbrella of techniques that aimed at changing the colours of different materials, from metals and stones to papyrus and parchment. As already seen, commenting on the recipes included in the Leiden Papyrus, Robert Halleux rightly emphasized that: “La composition des encres est rigoureusement parallèle à celle des dorures et des vernis.”<sup>87</sup> After all, Late Antique alchemical theories and practices developed around the effort to select and conceptualize a broad spectrum of techniques dealing with chromatic transformations. The Syriac tradition testifies to the centrality of colours and dyes in the ancient alchemical discourse, which included the making of inks among the areas of expertise to be explored, organized, and handed down over centuries.

<sup>87</sup> Halleux, *Papyrus* (cit. note 2), p. 42.