



BRILL

NUNCIUS 35 (2020) 1–19



Ὀδοντίζω

New Clues on Ancient Book Production from Alchemical Papyri

Miriam Blanco Cesteros

Università di Bologna, Bologna, Italy

miriam.blan@hotmail.com

Abstract

The multidisciplinary approach to different dyeing techniques of the papyri of Leiden (*P.Leid. x*) and Stockholm (*P.Holm.*) is entangled with Greco-Egyptian alchemy; yet, it is not an impediment for the recipes – or the processes described in them – to originate from an artisanal environment. In this regard, the lexical study of these recipes is the key to understanding the technical backgrounds of Greco-Egyptian alchemy. With this aim, this paper analyses the verb ὀδοντίζω (*odontizō*), which appears in a number of ink recipes of the Leiden and Stockholm papyri with a very technical meaning. The comparison to some Latin sources will help us to better understand its meaning and will lead us to explore the technical field from whence the recipes in which this verb appears came: ancient book production.

Keywords

alchemical papyri – inks – book production

Among the earliest sources for the study of the origins of alchemy, there are two recipe books, written by the same scribe,¹ known as *Papyrus x* of Leiden (hence-

1 The scribe of the two alchemical handbooks has been also identified as the main scribe (hand A) of a magical handbook (*PGM XIII*). In fact, the three papyri – *P.Leid.*, *P.Holm.*, and *PGM XIII* – belonged to the same archive, the so-called Theban Magical Library. Although, as bought in the Egyptian black market, the exact details of where this archive was found remain unknown, its Theban origin is indicated by some of the purchase receipts for these documents. On the modern and ancient history of the Theban Library, as well as the papyri that could belong to it, see Korshi Dosoo, *Rituals of Apparition in the Theban Magical Library* (PhD

forth *P.Leid.*) and *Papyrus Graecus Holmiensis* or Stockholm Papyrus (henceforth *P.Holm.*).² These papyri, together with the works of Pseudo-Democritus and Isis,³ preserve some of the earliest texts linked to the practice of alchemy in Greco-Roman Egypt. The papyri, written in Greek, date back to the 4th century AD.⁴ They point to a complex notion of this “art” (*technē*), which is wider than the view of alchemy as a discipline only focused on the making of noble metals⁵

-
- Diss., Macquarie University, 2014), pp. 25–41; Id., “A History of the Theban Magical Library,” *Bulletin of the American Society of Papyrologists*, 2016, 53:251–274; Michela Zago, *Tebe magica e alchemica. L’idea di biblioteca nell’Egitto romano: la Collezione Anastasi* (Padova: Libreria Universitaria, 2010), pp. 59–77.
- 2 The edition of reference for the study of these papyri is Robert Halleux (ed.), *Les Alchimistes Grecs*. Tome 1, *Papyrus de Leyde, Papyrus de Stockholm, Fragments de recettes* (Paris: Les Belles Lettres, 1981), with French translation. It rendered outdated that of Marcellin Berthelot, Charles-Emile Ruelle, *Collection des Anciens Alchimistes Grecs (CAAG)*, 3 vols., 1st ed. 1887–1888 (Osnabruck: O. Zeller, 1967). However, the Greek text provided in this paper comes from an ongoing study developed within the framework of the aforementioned *AlchemEast* project, the results of which will soon be published in a specialized monograph on these two manuscripts. Unless otherwise mentioned, the English translations are my own.
 - 3 The treatise of Pseudo-Democritus – a spurious work datable to the second half of the 1st century AD – was commented on by the alchemist Synesius, for a recent edition see *Scritti alchemici con il commentario di Sinesio*, edited by Matteo Martelli (Milano-Paris: S.E.H.A. ARCHE, 2011). The second one is a treatise which probably dates back to the 2nd century AD attributed to the goddess Isis. It is transmitted in *Parisinus gr. 2325* (fols. 256^r–258^v), see Michèle Mertens, *Un traité greco-égyptien d’alchimie: la lettre d’Isis à Horus* (Liège: Université de Liège, 1983–1984).
 - 4 Scholars have proposed different dates between the end of the 3rd and the beginning of the 4th century AD, see Halleux, *Les Alchimistes* (cit. note 2), pp. 22–24 for a summary. However, the palaeographical analysis sustains a likely dating in the 4th century. Yet, it should be noted that this dating applies exclusively to the redaction of the recipe books; it does not necessarily date the processes described in them or the composition of the recipes. As usually occurs in this kind of literature (handbooks and recipe books), the recipes stem from a long tradition transmitted through copying and recopying over a long period of time. Some of the recipes from the Leiden and Stockholm papyri, for example, are identically or almost identically transmitted in a Latin alchemical compendium from the 8th century AD known as *Mappae Clavicula*, see Gaia Caprotti, “*Mappae Clavicula*: prescrizioni della prima alchimia storica nei precedenti di lingua greca,” in *Mappae clavicula. Alle origini dell’alchimia in Occidente*, edited by Sandro Baroni, Giuseppe Pizzigoni, Paola Travaglio (Saonara: Il Prato, 2013), pp. 219–236. See also note 21, below.
 - 5 This vision of alchemy was very spread in the 10th century AD (e.g., Suda χ 280 Adler; al-Nadīm, *Kitāb al-Fihrist* 10, edited by Gustav Flügel, *Kitāb al-Fihrist* [Leipzig: Verlag von F.C.W. Vogel, 1871], Vol. 2, p. 305), but it can be also found in earlier works like the *Kitāb al-raḥma* by Ġābir ibn Ḥayyān (8th century AD; translated by Paola Travaglio in Michela Pereira (ed.), *Alchimia. I testi della tradizione occidentale* [Milano: Mondadori, 2006], p. 182). On the Greco-Egyptian notion of alchemy and its transformation in Late Antiquity and Byzantine

and prior to its Byzantine redefinition as “the art (τέχνη, *technē*) of transmutation (μεταβολή, *metabolē*).”⁶ In fact, the Greco-Egyptian remains of alchemical treatises show that, in that period, alchemy was a multidisciplinary art that included, along with metallurgical processes, the making of artificial pearls and gemstones (by dyeing crystals), the manufacture of inks, pigments and dyes, among others.⁷ The common thread that links these techniques is the change of colour, which, according to ancient thought, implied more or less profound changes in the nature of the treated substances. This is the reason why, for instance, the work of Pseudo-Democritus was described by the alchemist Synesius (4th century AD) as βαφικαὶ βιβλοὶ (*baphikai bibloi*, “the books on dyeing”).⁸ The belonging of *P.Leid.* and *P.Holm.* to this same current of alchemical art is proven by their selection of recipes, which, like Pseudo-Democritus’ work, deal with (a) gilding processes used for giving base metals the appearance of noble metals or making alloys that looked like noble metals; (b) the dye of rock crystal and the artificial production of different gems (including pearls); and (c) the production of purple dyes for fabrics, mainly wool. The Leiden papyrus gathers also recipes for the making of some golden and silver inks, with or without the use of noble metals.⁹

However, the alchemical nature of these recipe books has been – and still is – a matter of debate.¹⁰ As Rober Halleux pointed out, from a technical perspective, “il est extrêmement difficile de distinguer une recette technique d’une recette alchimique.”¹¹ Alchemical practitioners employed the same in-

period, see Matteo Martelli, *L'alchimista antico. Dall'Egitto greco-romano a Bisanzio* (Milano: Editrice Bibliografica, 2019), pp. 22–30 and 45–118.

- 6 This is the way, e.g., in which Michael Psellos (1018–c. 1078) refers to alchemy in his treatise *Letter on the Making of Gold* (§ 5, 3–4), edited by Joseph Bidez, in *Michel Psellus, Epître sur la Chrysopée; Opusculs et extraits sur l'alchimie, la météorologie et la démonologie* (Brussels: Lamertin, 1928). See also Martelli, *L'alchimista* (cit. note 5).
- 7 See Matteo Martelli, “The Alchemical Art of Dyeing: The Fourfold Division of Alchemy and the Enochian Tradition,” in *Laboratories of Art. Alchemy and Art Technology from Antiquity to the 18th Century*, edited by Sven Dupré (London-New York: Springer, 2014), pp. 1–22, and Martelli, *L'alchimista* (cit. note 5), pp. 25–30.
- 8 Synesius the Alchemist 1.14, edited by Martelli, *Pseudo-Democritus* (cit. note 3).
- 9 These recipes were actually considered a subtype of those dealing with metals.
- 10 A survey on the discussion about the artisanal or alchemical nature of these papyri in Halleux, *Les Alchimistes* (cit. note 2), p. 27. To the scholars cited by Halleux, we must add Adriano Caffaro and Giuseppe Falanga, who present the Leiden papyrus as “un documento di tecnica artistica e artigianale,” thus joining those who consider these papyri artisanal, see Adriano Caffaro, Giuseppe Falanga, *Il papiro di Leida* (Salerno: Arci Postiglione, 2004).
- 11 Halleux, *Les Alchimistes* (cit. note 2), p. 29.

struments and ingredients as the artisans specialized in these crafts,¹² perhaps even sharing the same working space.¹³ Yet, the alchemical nature of these two recipe books can be sustained on the basis of the following argument: the aforementioned “transversal” interest of *P.Leid.* and *P.Holm.* in dyeing τέχναι (*technai*, “arts, crafts”) surpassed the figure of the artisan – who, in the ancient world, was understood as an expert in a given craft¹⁴ – and is typical of the Greco-Egyptian alchemy. This explains why the recipes demonstrate a distance between their compilers (and their audience) and the craftspeople mentioned therein, with whom they did not identify.¹⁵ That said, this is not an impediment for the recipes – or the processes described in them – to originate from an artisanal environment. Therefore, the nature of these two recipe collections and the origin of the methods described in the recipes are two different, but not necessarily opposing, issues.

In this regard, the lexical study of the recipes collected in these two papyri continues to provide key information about the craft milieu in which these methods originated and with which the Greco-Egyptian alchemists dealt with for their inquiries. With this aim, the focus of this paper is on the use of a particular verb, ὀδοντίζω (*odontizō*) – whose meaning will be discussed in the first section of this study – as it appears in a number of ink recipes of the Leiden and Stockholm papyri. In the second section, the comparison to some Latin

-
- 12 Alchemical texts refer frequently to the use of tools or ingredients of other τεχνίται (*technitai*, “artisans”), such as βαφείς (*bapheis*, “dyers”), or χρυσόχοοι (*chysochooi*, “goldsmiths”). Alchemists often claimed that the results of their recipes were so good that they were able to deceive “even the *technitai*” (i.e. the goldsmiths in the case of recipes for gilding objects like *P.Leid.* § 89.7, *P.Holm.* § 3.4; or jewellers in the case of recipes for gems like *P.Holm.* § 48.4, etc.). For a detailed analysis of the connections between Greco-Egyptian alchemy and Greco-Egyptian craftworks’ cosmos, see Matteo Martelli, “Greek Alchemists at Work: Alchemical Laboratory in the Greco-Roman Egypt,” *Nuncius*, 2011, 26/2:271–311.
- 13 Martelli, *Alchemical Laboratory* (cit. note 12), p. 289. The extant testimonies of Greco-Egyptian alchemy – the alchemical papyri, the Pseudo-Democritus or even the *Corpus alchemicum graecum* handed down by the Byzantine tradition – never used a term more concrete than ἐργαστήριον (*ergastērion*, “workshop”) to refer to the place where the alchemist worked; see Martelli, *Alchemical Laboratory* (cit. note 12), p. 280.
- 14 *Ibid.*, p. 289.
- 15 “D’ autre part, l’ auteur prescrit d’ utiliser un creusend d’ orfèvre, de la paille d’ orfèvre, des charbons et de l’ eau ferrée des forgeros, du vinaigre et de l’ alun de teinturier et d’ aller chercher la mousse de guède chez les teinturiers. Cela signifie qu’ il n’ est ni orfèvre, ni forgeron, ni teinturier,” Halleux (ed.), *Les Alchimistes* (cit. note 2), p. 28. This contention is reinforced by the general mention of the *technitai* as a professional category different from the compilers, see recipes quoted in note 12, above.

sources will help us to better understand its meaning and will lead us, in the third and last part of the paper, to explore the technical field from whence the recipes in which this verb appears probably came: ancient book production.

1 ὀδοντιζῶ (*odontizō*) in the Alchemical Papyri

The verb *odontizō* – which stems from the Greek word ὀδούς (*odous*, “tooth”) – is not an *unicum* of the alchemical papyri, but it deserves a special attention because in them this verb bears a meaning that, to the best of my knowledge, is never attested beyond these texts. *Odontizō* appears in Greek medical and technical works, in which it bears the meaning of “to have teeth” (e.g. with reference to animals or, most technically, to babies and children teething).¹⁶ However, this meaning does not make sense in the alchemical papyri, in which *odontizō* is used at the end of two recipes for making inks and in a recipe for the production of fake pearls:

P.Leid. §56,¹⁷ l. 4–5: “[...] after writing, let (the ink) dry and *odontize* – ὀδοντιζε”¹⁸

P.Leid. §68,¹⁹ l. 9: “[...] after writing, *odontize* – ὀδοντιζε.”

P.Holm. §18,²⁰ l. 14 ff.: “when they [the pearls] are still humid, drill it and let them dry and *odontize* – ὀδοντιζε – thoroughly and they will be better than natural ones if they are manufactured appropriately.”

Since aimed at producing golden and silver-coloured inks, all the ink recipes of *P.Leid.* – including *P.Leid.* §56 and 68 – belong to a decorative writing technique called *chrysography*. A Latin alchemical treatise called *Mappae Clavicula* (henceforth *MC*), compiled circa the 8th century from a lost Greek recipe

16 See *Liddell-Scott-Jones Greek-English Lexicon*, s.v. “ὀδοντιζῶ.”

17 Halleux, *Les Alchimistes* (cit. note 2), p. 98. In Berthelot-Ruelle, *CAAG* (cit. note 2) this recipe is the no. 56. Also in Earle R. Caley, William B. Jensen, *The Leiden and Stockholm Papyri. Greco-Egyptian Chemical Documents from the Early 4th Century AD* (Cincinnati: University of Cincinnati Press, 2008).

18 A precise translation for this verb will be provided below.

19 Halleux, *Les Alchimistes* (cit. note 2), p. 100. In Berthelot-Ruelle, *CAAG* (cit. note 2) and Caley-Jensen, *Leiden and Stockholm Papyri* (cit. note 17), this recipe is the no. 70.

20 Halleux, *Les Alchimistes* (cit. note 2), p. 116. The same numeration in Berthelot-Ruelle, *CAAG* (cit. note 2) and Caley-Jensen, *Leiden and Stockholm Papyri* (cit. note 17).

book,²¹ transmits a set of recipes for *chrysographic* inks very similar to that of *P.Leid.* In fact, some of them are almost *verbatim* translations. At the end of several of the *MC*'s recipes, an instruction clearly connected with the verb *odontizō* is repeated: in order the ink can shine, the text written with it must be polished with a tooth (*dente defrica/perdefrica, dente poli, etc.*).²² According to some recipes, this *dens* was a "porcine tooth" – probably a pig tusk (or perhaps from a wild boar). However, other materials as well, such as seashells, onyx and wool, were used for the same purpose:

MC § 37: "ut autem aurum cum scripseris possit lucere, coclea marina vel dente aprino seu lapide onychino literas perfrica." [in order for this gold to shine after you have written, polish the letters with a seashell, a porcine tooth, or an onyx stone].

MC § 42: "contenere ut praedictum est et scribe. cum siccaverit, deline linatorio de lana vel vitro." [grind as stated above and write. When it is dry, rub with a polisher of wool or glass].

If applied to *P.Leid.* § 56 and 68, the meaning "to polish with a tooth" makes sense for the verb *odontizō*. In fact, the Latin expressions *dente defrica/perdefrica, dente poli* can be considered different ways to translate the Greek imperative *odontize*. This meaning fits well also in *P.Holm.* § 18; the problem of this recipe is, however, that this action is not feasible on the little and round surface of a pearl. Consequently, the presence of *odontizō* in this recipe is due, probably, to some textual contamination or scribal confusion. Either way, the Latin version of this recipe transmitted by the *Mappae* (*MC* § 170) confirms the meaning of *odontizō*:

-
- 21 The *Mappae Clavicula*'s dependence on a Greek model is proven by the numerous Graecisms employed in its oldest versions. That Greek model had some recipes in common with *P.Leid.* and *P.Holm.* However, it was not a compendium derived from *P.Leid.* and *P.Holm.*, but rather a contemporaneous treatise belonging to the same alchemical tradition, see Caprotti, *Mappae Clavicula* (cit. note 4), p. 219. I take both the numeration and the Latin text of the recipes from Sandro Baroni, Giuseppe Pizzigoni, Paola Travaglio (eds.), *Mappae clavicula. Alle origini dell'alchimia in Occidente* (Saonara: il Prato, 2013). The English translations, however, are my own.
- 22 E.g. "scribe et, cum siccaverit, dente defrica diligenter" [write and, when it is dry, polish diligently with a tooth] (*MC* § 38); "scribe illud ut atramento et dente poli" [write it as you do with black ink and polish with a tooth] (*MC* § 39). Similar expressions also in *MC* § 41 and *MC* § 132. This last one is very interesting because, as prepared with *verdigris* (copper rust), the metallic ink is green.

P.Holm. § 18: ἔα παγγῆναι καὶ πλεῖον ὀδόντιζε,
MC § 170: *et postquam coagulate fuerint dente defrica,*
 Translation of *MC*: “and after being solid, polish it with a tooth.”

A close examination of the vocabulary of these papyri shows that, in fact, the redactors of these recipes employed a very complex assortment of technical verbs to transcribe the processes they described. The choice of one or other verb seems to have been clearly determined by things such as the instrument used²³ or the intensity of the action.²⁴ This lexical specification as well as the creation of new terms or meanings (as in the case of *odontizō*) to express very specific ideas are typical of the technical vocabulary.

Since in the *Mappae Clavicula* as well as in the alchemical papyri the use of a tooth as a tool to polish is restricted to the recipes for *chrysography*,²⁵ one may wonder whether the particular meaning of *odontizō* here evinced could have arisen in a context linked with writing and book production.

2 *Odontizō* and the Manufacture of Ancient Papyri

The use of a tooth as a tool to polish the papyrus surface inevitably leads us to Pliny the Elder, *HN* 13.74–82, a *locus classicus* when discussing the production of a papyrus sheet.²⁶ In this passage, following an excursus about the quality

23 In addition to *odontizō*, which implied the use of a tooth as tool, alchemical recipes uses also, for instance, the verb *κισερίζω* (*kiserizō*), stemmed from *κισήρις* (*kiseris*), “pumice stone” (*P.Leid.* § 88). Accordingly, this verb means “to polish/sand down with a pumice stone.”

24 Just limiting to the lexical field of “to polish,” the specificity of the terms employed is evinced, for instance, from the comparison between *σμήχω* (*smekhō*) and its derivative *ἀποσμήχω* (*aposmekhō*) and the verbs *ἀπομάσσω* and *ἐκμάσσω* (*apomassō*, *ekmassō*). The analysis of the processes they describe reveals that the formers were used when the action developed erodes the metal surface by physical or chemical abrasion (*P.Holm.* § 74, *P.Leid.* § 63; for pickling, see *P.Leid.* § 39, 45, 47, 55, and 64). *Apomassō* and *ekmassō*, on the contrary, denote a more delicate treatment: for instance, *apomassō* is used in *P.Holm.* § 74 to indicate that the *verdigris* (copper rust) on a piece of copper should be gently removed with a quill.

25 *P.Holm.* § 18 and its Latin version (*MC* § 170), are the only two exceptions.

26 Instead its value as one of the few ancient testimonies about papyrus production, this passage by Pliny has been the subject of much scholarly discussion. In Pliny’s description there are some inconsistencies evinced from the comparison with papyrological testi-

of the different varieties of manufactured papyrus, Pliny explains that, once dry, any irregularities on the papyrus sheet were corrected by polishing its surface with a tooth (*dens*) or a seashell (in fact, the same tools mentioned in *MC* § 37):

Scabritia levigatur dente conchave, sed caducae litterae fiunt. minus sorbet politura charta, magis splendet [rough spots are rubbed smooth with a tooth or a shell, but then the writing is prone to vanish; the more the polished papyrus shines, the less it absorbs].²⁷

According to Pliny's testimony, tooth and sea-shells served for polishing the writing surface when the papyrus sheet had imperfections. In fact, as Pliny points out, the process was problematic, since the result was a sheet not particularly suitable for writing. Many modern scholars who have tried to replicate the ancient manufacture of papyrus support Pliny's statement.²⁸

monies, ancient sources, and modern replications of the process. The general consensus is that Pliny did not have first-hand experience of the processes he described. As Naphtali Lewis, *Papyrus in Classical Antiquity* (Oxford-New York: OUP, 1974), pp. 41 and 115, argued, the manufacture of papyrus only took place in Egypt because the papyrus had to be fresh to be processed. Pliny, however, never visited this country. Therefore, although in general terms, his account corresponds to what we know about papyri, and the description of the basic method is correct, it is assumed that the inconsistencies are due to the fact that Pliny's description mixes the author's personal experience with whatever source of this process he might have used, see Alfred Lucas, *Ancient Egyptian Materials and Industries*, 1st ed. 1962 (London: Kessinger Publishing, 2003), pp. 138–140; Lewis, *Papyrus* (cit. above), pp. 34–69; Ingelisse Nielsen, *Papyrus. Structure, Manufacture and Deterioration* (PhD Diss., Royal Danish Academy of Fine Arts, Copenhagen, 1985), p. 58; Giovanna Menci, "Fabbricazione, uso e restauro antico del papiro: tre note in margine a Plinio, *HN XIII 74–82*," in *Proceedings of the XVIII International Congress of Papyrology* (Athens, 1988), Vol. 2, edited by Basil Mandilaras (Athens: Greek Papyrological Society, 1988), pp. 497–504. For an extended analysis of Pliny's description, in addition to Lewis, *Papyrus* (cit. above), see also Andrew D. Dimarogonas, "Pliny the Elder on the Making of Papyrus Paper," *The Classical Quarterly*, 1995, 45/2:588–590; for a summary of the obscure points of this passage, see Adam Bülow-Jacobsen, "Writing Materials in the Ancient World," in *The Oxford Handbook of Papyrology*, edited by Roger S. Bagnall (Oxford: OUP, 2009), pp. 3–19, esp. 5–11. On the other hand, brief references to ancient papyrus manufacture can be found in any of the studies just mentioned.

27 Plin., *HN* 13.8; my translation. Latin text edited by Harris Rackham, *Pliny the Elder, Natural History* (London-Cambridge: Loeb Classical Library, 1960), p. 146.

28 E.g. Frank Nigel Hepper, Tom Reynolds, "Papyrus and the Adhesive Properties of Its Cell Sap in Relation to Paper-Making," *The Journal of Egyptian Archaeology*, 1967, 53:156–157; Lewis, *Papyrus* (cit. note 26), pp. 62–63.

However, this idea is contradicted by the testimony of several ancient sources, like Cicero. At the beginning of one of his letters to his brother Quintus, Cicero uses the expression *dentata charta* to refer to the papyrus sheet he was about to use:

Calamo bono et atramento temperato, charta etiam dentata, res agetur; scribis enim te meas litteras superiores vix legere potuisse [the matter (i.e. the topic of this letter) shall be discussed using a good pen, well-mixed ink, and tooth-polished paper, since you write that you could hardly read my previous letter].²⁹

The expression *dentata charta* is, once more, an *unicum* that, according to Pliny's passage, has been interpreted as "papyrus sheets polished with a tooth." This meaning brings us back to the field of the writing and the papyrus' production. In fact, the participle *dentatus* points at a Latin equivalent to *odontizō*, or even a Latin calque. But, unlike Pliny's witness, Cicero's passage suggests that this *dentata charta* was a blank papyrus of fine quality. This conclusion is reinforced by Martial 14.209, the second testimony usually adduced against Pliny's assessment:

Levis ab aequorea cortex Mareotica concha / Fiat: inoffensa curret harundo via [Let the Mareotic husk be made smooth by a sea-shell: the reed will race along an unimpeded path].³⁰

Martial's epigram refers to the papyrus (metaphorically alluded to with the expression *cortex Mareotica*) polished with a seashell; once again, one of the tools mentioned by Pliny and the *MC* § 37. This quotation reasserts the fact that the preparation of at least some kinds of papyrus sheets involved the polishing of the writing surface.³¹ This process did not (only) aim to eliminate manufac-

29 Cic., *QFr.* 2.15.1–2; my translation. Latin text edited by William G. Williams, *Cicero. The Letters to His Friends with an English Translation* (London-Cambridge: Loeb Classical Library, 1960), p. 536.

30 Text edited and translated by Timothy J. Leary, *Martial Book XIV. The Apophoreta* (London: Bloomsbury, 1996), p. 276.

31 Lucas, *Materials* (cit. note 26), p. 164, concurs with the idea that, in the manufacture of papyrus, the burnishing of the writing surface was included as a kind of refinement process. Eric G. Turner, *Greek Papyri: An Introduction*, 1st ed. 1968 (Princeton: PUP, 2015), p. 3, mentions the polishing of the papyrus surface with a pumice after it has been dried, but this is a personal assumption based on the replication of papyrus manufacture conducted by Mr. S. Baker in 1964, see Turner, *Greek Papyri* (cit. above). In the ancient world, the use

turers' defects, as Pliny claims, but rather to obtain a smooth and fine sheet that was considered high quality. In fact, and contrary to the modern scholars' opinions cited above, Bridget Leach and John Tait point out that many Egyptian funerary papyri have an inside surface that is smoother than the outside, something they say is also a feature of Ptolemaic and Roman papyri. This characteristic serves, for as example, as hint for the identification of the recto in the case of blank fragments.³² This distinctive quality implies that the recto received some kind of additional smoothing treatment.³³

Either way, the above-quoted alchemical recipes for inks as well as Pliny, Cicero and Martial's testimony imply a craftwork context to the treatment of the writing material.

A further alchemical recipe, which describes a whitening process for treating pearls that could be also used to delete the writing from a papyrus (*P.Holm.* § 12; fol. γ, ll. 18–29), can be linked to the same context:

ἄλλο

αὕτη δὲ καὶ χάρτα γεγραμμένους πάλιν ψά, | (20) ὡστε δοκεῖν μηδέποτε γεγράφθαι. λαβὼν |ἀφρόνιτρον τήξον εἰς ὕδωρ. εἶτα κατὰ τὸ | γεγενῆς(θ)αι νίτρωμα προσέμβαλε γῆς ἐμπάσα(ς) | Σαμίας με ἄ καὶ γῆς Κιμωλίας με ἄ καὶ γάλα | βόϊον, ὡς πάντα μιγέντα γενέσθαι γλοιώδη, | (25) καὶ προμίσξας σχίνου χυλοῦ κατὰ χρι[ς]ον περὶ ῶ. καὶ ἑάσας ξηρανθῆναι, εἶτα ἀπολέπισον, εὐ|ρήσεις λευκά. ἐὰν δὲ κατὰ βάθους ἢ κισρρά, πάλιν | ἐπίχριε; ἐὰν δὲ εἰς χάρτην, μόνον τὰ γράμματα | χριε.

Another.³⁴ This [recipe] cleans written papyrus again to such an extent that they appear as though they had never been written upon. Taking soda, dissolve it in water. Then, after the solution of soda is produced, add 1 part of powdered Samian earth, 1 part of Cimolian earth, and cow's milk in such a way that the mixture becomes glutinous. Then, after mixing it with juice of mastic, dab it on [the pearls] with a feather. Let it dry and then peel it off and you will find [the treated pearls?] white. If they are a deep yellow, anoint again. If dealing with a papyrus sheet, only coat the characters.

of pumice for this operation, although possible, is never attested. On the contrary, several literary witnesses inform us that this tool was used to eliminate and/or smooth the fibres of the ends of the papyrus sheet; see, e.g. Tib. 3.1.10 and Ov., *Tr.* 1.1.2.

32 Bridget Leach, John Tait, "Papyrus," in *Ancient Egyptian Materials and Technology*, edited by Paul T. Nicholson, Ian Shaw (Cambridge: CUP, 2000), pp. 227–253; esp. 237.

33 See the previous note.

34 This recipe belongs to a group of recipes dealing with the whitening of pearls.

Although this recipe belongs to a group of recipes for whitening pearls, this process – as the proper text estates – also served to produce a palimpsest if applied to a written papyrus. There are multiple direct and indirect sources on the use of this kind of papyri in the ancient world,³⁵ but there is scant information about how palimpsests were made in the ancient world.³⁶ Either way, if one considers the treatment of written papyri in order to reuse them, it is difficult to locate this procedure in a context other than ancient workshops for the manufacture of ancient books.

3 An Overview of the Papyrus Craftwork Field

At the light of the testimonies analysed until now, we can place the use of a tooth to polish the papyrus surface in two craft contexts: (a) workshops for the production of writing materials and (b) workshops aimed at the manufacture of texts.

Regarding the first one, it is evident that, in the ancient world, the manufacture and sale of papyrus fostered the development of a great industry in Egypt,³⁷ which was responsible for satisfying the needs of the entire Mediterranean world. The ancient financial records, in fact, inform us that official offices of Greco-Roman Egypt, for example, consumed hundreds of rolls in

-
- 35 The production of a palimpsest was attested to already in Ancient Egypt, see Angel Escobar, “El palimpsesto grecolatino como fenómeno librario y textual: una introducción,” in *El palimpsesto grecolatino como fenómeno librario y textual*, edited by Angel Escobar (Zaragoza: Institución Fernando el Católico, 2006), pp. 11–34; esp. 13–18; and Edoardo Crisci, “Codices Graeci rescripti fra antichità e medioevo bizantino. Il caso dei palinsesti di Grottaferrata,” in the same volume, pp. 35–52. The processes for erasing the text depended on the writing material and the type of ink. The writings produced with carbon inks (ink produced by black soot solved in a liquid medium) were soluble in water, and for this reason, were obviously easier to erase: just washing the writing surface with a sponge was enough to remove the ink. Removing traces of iron-gallic ink (a kind of ink produced by a chemical reaction), on the contrary, would have required more sophisticated procedures.
- 36 See Sarah Dillon, *The Palimpsest: Literature, Criticism, Theory* (London-New York: Bloomsbury, 2007), pp. 13–15. A comparison of the equipment used by scribes in both Late Antiquity and the Middle Ages reveals that the implements used to erase text were, basically, the same in both periods, namely sponges and pumice; see Bernhard Bischoff, *Latin Palaeography: Antiquity and the Middle Ages*, 1st ed. 1979 (Cambridge: CUP, 1990), pp. 18–19 with special attention to the scribe’s *paraphernalia* described in some dedicatory epigrams (e.g. *Anth. Pal.* 4, § 62–68 and 295). However, due to the replacement of papyrus with parchment as the main writing surface, and due to the lapse of time, it is likely that the Medieval processes slightly differed from those used in Late Antiquity.
- 37 See above note 26.

brief periods of time,³⁸ a demand that could only be met with the support of a large and highly productive industry.³⁹ This is the context in which the papyrus manufacture described by Pliny would have taken place. However, historical witnesses remain shy about it.⁴⁰ Indeed, there is no direct evidence of such papyrus factories⁴¹ and the indirect sources are so scant that they can be listed here: the first one is a passage by Pliny that talks about the existence of a workshop located in Rome, owned by a certain Fannius (*HN* 13.75 and 78), where it seems that Egyptian papyri were re-worked in order to refine them.⁴² The second one is a military register of soldiers' departures and returns in which an entry records that one of these soldiers was assigned *ad chartam conficiendam*, which has been interpreted as "to where the papyrus paper was made."⁴³ The last one is *P.Tebt.* 1 112,⁴⁴ a financial account belonging to the so-called "Menches' archive" (a public scribe of Kerkeosiris, in the Arsinoites) that records a purchase of 10 rolls of papyrus. Their price is specified as *κάτεργον* (*kátergon*), which has been interpreted as "production cost" (col. ii, l. 25); as none dealer or intermediary is mentioned, scholars consider that the papyri were purchased directly from the place of production, and only manufacturing costs were paid.⁴⁵

38 Lewis, *Papyrus* (cit. note 26), pp. 101–102 (especially note 2), and pp. 117–119; Menico Caroli, "Il commercio dei libri nell'Egitto greco-romano," *Segno e Testo*, 2012, 10:1–74, p. 9.

39 Lewis, *Papyrus* (cit. note 26), p. 102.

40 Indeed, beyond the testimonies of financial accounts referred to by Lewis (*Papyrus*, cit. note 26), barely added to since the publication of his study, the majority of assumptions about the papyrus industry, its function, and regulation, are speculative. As a result, in contrast with the bibliography generated about related topics (the manufacturing process, the price, and value of different papyrus sheets in Antiquity, the commerce and production of books), with the exception of Lewis, scholars have rarely focused on the papyrus industry.

41 Lewis, *Papyrus* (cit. note 26), p. 115.

42 According to Pliny, in this workshop not only the quality of the papyrus' sheets was improved, but also their length. On the contrary, the idea that these papyrus sheets were produced from raw material in Fannius' workshop has been unanimously rejected: see Lewis, *Papyrus* (cit. note 26), p. 45, and Mario Capasso, *Introduzione alla papirologia* (Bologna: Il Mulino, 2005), p. 71.

43 *P.Gen.Lat.* 1, col. ii, see Lewis, *Papyrus* (cit. note 26), p. 122, note 11 for an extended bibliography. Since the register listed soldiers' missions, Lewis (*Papyrus* [cit. note 26], pp. 121–122) rejects the possibility that this soldier was sent "to work making papyri" and interprets the statement as a reference to a mission to perform guard duties in a papyrus workshop – a task referred to in several other entries.

44 Republished in 2005 as *P.Tebt.* V 1151 by Arthur Verhoogt, *Regaling Officials in Ptolemaic Egypt. A Dramatic Reading of Official Accounts from the Menches Papers* (Leiden-Boston: Brill, 2005), pp. 71–150.

45 Lewis, *Papyrus* (cit. note 26), p. 118; Verhoogt, *Officials* (cit. note 44), p. 67; Menico Caroli,

The activity of these workshops can be linked to the figure of the *χαρτοποιός* (*chartopoiós*, “paper-maker”), a professional category that emerges from an abbreviation – *χαρτοπ.* or *χαρτοπο.*⁴⁶ – frequently found in the aforementioned economic registers, as well as in other documentary witnesses to the purchase and sale of *χάρται* (*chártai*, rolls or pieces of blank papyrus).⁴⁷ An alternative reading of the former abbreviation has been *χαρτοπράτης* (*chartoprátēs*, “papyrus dealer”), a later term whose earliest occurrence is in *BGU* 1 319 (630–641AD).⁴⁸ Either way, according to the sold items, the figure behind these abbreviations must be identified with a supplier of writing materials; this identification can be extended to numerous dealers who are not referred to by any specific term, but only by their proper names. They appear in the documentary sources, which evince that such dealers provided private customers and public offices not only with blank papyrus, but also with inks, sponges, and *kalamoi*, as one can see in the financial accounts of the *γραφεῖον* (*grapheion*, “record-office, registry”) of Tebtynis, in the 1st century AD.⁴⁹ The blank *dentata charta* used by Cicero to write his brother could have been bought to this kind of dealers.

The making of a palimpsest, in order to reuse a written papyrus (cf. *P.Holm.* § 12), can also be placed in this same context. The above cited *P.Tebt.* 1 112 records a purchase in which blank papyri (*chártai ágraphoi* – ἄγραφοι) were bought along with *chártai diagegramménoi* – διαγεγραμμένοι. This term proba-

“Note su *chartotomos*, *trikollema*, *chartopoiós* e *chartopoles* nei papiri e nelle iscrizioni. Aggiunte e correzioni al *LSJ*,” *Zeitschrift für Papyrologie und Epigraphik*, 2016, 198:164–172, p. 168.

- 46 There has been much discussion of this abbreviation, which has been resolved by editors in two different ways: as *chartopoiós*, “paper-maker,” or *chartopolēs*, “paper-seller.” The former, not attested to in Greek until the Byzantine period (see Mario Capasso, *Volumen. Aspetti della tipologia del rotolo librario antico* [Napoli: Prima Edizione, 1995], pp. 47–49), is currently preferred by editors and scholars, see Caroli, “Il commercio” (cit. note 38), p. 10, and “Note” (cit. note 45), pp. 167–171.
- 47 On this meaning of *charta*, see Lewis, *Papyrus* (cit. note 26), pp. 70–78 with bibliography.
- 48 Pieter J. Sijpesteijn, *P.Wisc.*, vol. 1 (Madison: Wisconsin State University Press, 1967), pp. 103–106, esp. p. 105, and Capasso, *Volumen* (cit. note 46), pp. 50–51. Caroli, “Note” (cit. note 45), p. 171 rejects this with the argument that this term is not attested to before the 6th/7th century AD; but the same situation applies to *chartopoiós*, see note 46, above.
- 49 *P.Mich.* 11 123, for example, mentions Pakebkis (verso, col. iii, l. 11); Petesios and Patamon (verso, col. iii, ll. 24–25); Erodes (verso, col. v, l. 25); Filoxatos (verso, col. x, l. 8). The purchase mentioned in the verso, col. iv, l. 24 refers to an expenditure on writing materials, already referred to in the previous line and whose supplier is Eutyches (l. 23). *P.Mich.* 11 128, another register from the same *grapheion* and written by the same person, also registered a purchase of ink and papyri from another Herodes, son of Loumôs (recto, col. ii, l. 42).

bly refers to pieces of “second-hand” papyrus,⁵⁰ still useable on their blank side, and notably cheaper than new papyrus.⁵¹ The supplier of these materials was a *chartopoiós*, so we might infer that papyrus-makers, as well as papyrus dealers, also traded in second-hand writing materials. Reused papyri served for non-official accounting, receipts, or letters as well as for copying literary texts for private use.⁵² However, the most usual place for using recipes like *P.Holm.* §12 were, surely, scribal ateliers. Ancient *scriptoria*, obviously, may also have recycled pieces of papyrus using palimpsest techniques in order to obtain writing surfaces of low quality for private use. The continuity of this practice in a library context is illustrated by a famous Medieval miniature from the *Ms 1456* (f. 4^r) of the Biblioteca Universitaria in Bologna, which depicts a Medieval librarian workshop where an artisan is washing a text that will be written over.

Like the palimpsest techniques, the use of a tooth to give lustre to golden and silver texts leads us to the second craftwork field that has been just mentioned: the production of books.⁵³ The ancient literary witnesses, along with the extant papyrological documentation of Greco-Roman Egypt, demonstrate that upper- and middle-class people from all over the Mediterranean were interested in obtaining, copying, and exchanging technical and literary writings.⁵⁴ This originated a great librarian business aimed to the publication, copy, and distribution of books with commercial aims⁵⁵ that took place in private ateliers like the so-called *tabernae librariae*. This kind of business, exhaustively

50 In this case, it seems that they were legal documents that are no longer valid, due to expiration or annulment as the verb διαγράφω (*diagraphō*, in legal vocabulary viz. to annul documents by drawing a line through the text, see Pl., *Resp.* 387b) could indicate, see Caroli, “Note” (cit. note 45), p. 169.

51 On their value, see the detailed analysis of Verhoogt, *Officials* (cit. note 44), p. 67.

52 This practice led some scholars to argue for the existence of an ancient market of dismissed papyri, see Eric G. Turner, “Roman Oxyrhynchus,” *The Journal of Egyptian Archaeology*, 1952, 38:78–93, p. 89; Tatiana Gammacurta, *Papyrologica Scaenica* (Alessandria: Edizioni dell’Orso, 2006), p. 105, note 23.

53 I use the term “book” with the wide meaning of “manuscript text” in both roll and codex format.

54 Rosa Otranto, *Antiche liste di libri su papiro* (Roma: Storia e Letteratura, 2000), p. xxii.

55 Although we are better informed about the librarian procedures and activities of the Roman world from the 1st century AD onwards, the various scholars who have dealt with this topic agree that the librarian system of the Roman world was already developed in the Hellenistic period, see Tönnies Kleberg, “Commercio librario ed editoria nel mondo antico,” in *Libri, editori e pubblico nel mondo antico. Guida storica e critica*, edited by Guglielmo Cavallo (Roma-Bari: Laterza, 1977), pp. 25–81, esp. 36; Tiziano Dorandi, *Nell’officina dei classici* (Roma: Carocci, 2007), p. 87; Guglielmo Cavallo, “I rotoli di Ercolano come prodotti scritti. Quattro riflessioni,” *Scrittura e Civiltà*, 1984, 8:5–30, p. 22.

studied by Pietro Cerami,⁵⁶ included editors (*editores*) and book dealers ($\beta\iota\beta\lambda\iota\sigma\pi\acute{\omega}\lambda\eta\varsigma$ /*bibliopola*):⁵⁷ editors managed the editorial process of the works they published, from their composition to the revision and correction of the final text for its publication. Under their management could work a numerous and specialized editorial staff,⁵⁸ as the case of Tito Pomponio Atticus – the *editor* about whom we have the more detailed information – proves.⁵⁹ However, since the editor was usually also responsible for the commercialization of the works, as the ancient sources show, both professional categories – editors and book-sellers – were not always different.⁶⁰

However, in Antiquity, not all the librarian production was intended for sale. The *scriptoria* belonging to libraries and archives, pertaining to private or public entities,⁶¹ copied books without commercial aims for enhancing the

-
- 56 See e.g. Caroli, “Il commercio” (cit. note 38), and Pietro Cerami, “*Tabernae librariae*. Profili terminologici, economici e giuridici del commercio librario e dell’attività editoriale nel mondo romano,” in *Annali del seminario giuridico dell’Università degli Studi di Palermo*, vol. LVIII, edited by Gianfranco Purpura, Giuseppe Falcone (Torino: AUPA, 2015), pp. 9–36.
- 57 Plin., *Ep.* 9.11.2; Mart. 4.72.1–2, 13.3.4. This calque replaced the Latin polysemic *librarius*, which remained a specialized term for the copyist; see Cerami, “*Tabernae*” (cit. note 56), p. 14.
- 58 Cornelius Nepos, biographer of Atticus, mentions *pueri litteratissimi*, *anagnostae* and *librarii*, “servants highly educated,” “lecturers,” and “copyist” (Nep., *Att.* 13.3). On these categories see Horst Blank, *Das Buch in der Antike*, translated with additions and revisions by Rosa Otranto (Bari: Edizioni Dedalo, 2008), pp. 162 and 302; Cerami, “*Tabernae*” (cit. note 56), pp. 24–25. To this staff, confirmed by the letters of Cicero – for the most part, undoubtedly, a slave workforce (see Rex Winsbury, *The Roman Book* [London-New York: Bristol Classical Press, 2009], p. 82) – we can also add the *glutinatores*, who were specialized in the restoration of damaged or split rolls (Cic., *Att.* 4.4a.1 and 4.8.2).
- 59 The information we have about Atticus’ work is provided by Cornelius Nepos (Nep., *Att.*) and, above all, Cicero, who was his friend and client (Cicero collected his letters to Atticus in Cic., *Att.*). On the other side, the economic – or not – nature of Atticus’ editorial work has been discussed in detail by Cerami, “*Tabernae*” (cit. note 56), pp. 22–28; see also p. 18 on other editors from the Roman world.
- 60 Kleberg, “Commercio” (cit. note 55), p. 54; Cerami, “*Tabernae*” (cit. note 56), p. 19. On different book dealers of the Greco-Roman Egypt, see Caroli, “Il commercio” (cit. note 38), pp. 13–24. Yet, the ancient sources are clear regarding the existence of booksellers who did not perform tasks of correction and revision, and were solely focused on the copy, sale (or loan) of manuscripts. In these ateliers, books were produced without passing an editorial process, which prompted the circulation of inaccurate versions of literary works, much to vexation of ancient authors such as Cicero, see Cic., *QFr.* 3.5.6. Strabo, in talking about the history of Teophrastus’ library, refers also to this fact, see Strabo 609.19–22.
- 61 On the public and private libraries of the ancient world, see Blank, *Das Buch* (cit. note 58), pp. 181–244.

library's literary heritage. This task was surely developed by a similar workforce as that of the *tabernae librariae*. At least, this is what Guglielmo Cavallo thinks about Philodemus' library in the Villa of the Papyri. In fact, Philodemus' private library, which was considered a representative – albeit small-scale – example of the operations of large public ones,⁶² was nourished by an internal system of book production intended for enriching its personal collection.⁶³ The correspondence between Cicero and Atticus allows us to see that, however, private libraries had a smaller staff, mainly composed of domestic slaves – *servuus literati* – that simply took care of the library.⁶⁴ In the case of specific needed, their owners turned to the personnel of the *tabernae librariae*.⁶⁵

4 Concluding Thoughts (with Some Final Remarks on Recipes for *Chrysography*)

The aim of this last excursus about the production of writing materials and books has been to delineate the technical field in which the meaning of *odontizō* that the recipes of the alchemical papyri display may have originated. That said, it is worth considering also, in brief, the textual context that has preserved this meaning for us: the recipes for *chrysography*.

Due to the value – real and symbolic – of silver and gold, *chrysography*, like any other decorative technique, was used to produce valuable texts. Although the first direct witnesses of texts written using this type of inks date from the 5th/6th century A.D.,⁶⁶ there are pieces of evidence to sustain the continued use of *chrysography* for writing texts from Hellenistic period to Late Antiquity. In fact, the first attested testimony of its use is a Greek papyrus from the 2nd century B.C.⁶⁷ On the other hand, *P.Leid.* demonstrates that this technique

62 Dorandi, *Nell'officina* (cit. note 55), p. 90.

63 Cavallo, "I rotoli" (cit. note 55), p. 20.

64 Blank, *Das Buch* (cit. note 58), p. 302.

65 We know, for example, that Cicero asked Atticus for some *glutinatores*, see, Cic., *Att.* 4.4a.1 and 4.8.2. The episode is commented in detail by Cerami, "Tabernae" (cit. note 56), p. 24.

66 These manuscripts are listed by Vera Trost, *Gold- und Silbertinten: technologische Untersuchungen zur abendländischen Chrysographie und Argyrographie von der Spätantike bis zum hohen Mittelalter* (Wiesbaden: Harrassowitz, 1991), pp. 12–28.

67 TM 59770 (= Paris, Louvre N 2329 Ro + N 2388 Ro). The papyrus contains an astronomic treatise attributed to Eudoxos from Knidos in which the astronomical drawings of the moon and the sun were illuminated by using a golden-yellow shiny ink. The letter written in the verso, dated on 21. Sept. 164 B.C., allows to date the astronomical treatise ca. 100 B.C., see Kurt Weitzmann, *Ancient Book Illumination* (Harvard: HUP, 1959), p. 6.

was fully developed in the 4th century AD. On the basis of such argument, the manuscript of Homer written in golden letters on purple parchment described by the *Historia Augusta* (ca. 4th century AD) seems likely,⁶⁸ but also the assertion by Publilius Optatianus Porfirius (4th century AD) that his panegyric to the Emperor Constantine was written with gilded ink in purple parchment.⁶⁹ The production of such texts can be placed in *scriptoria* – either connected or not connected to the sale of books – of certain prestige, like the above mentioned.

The written codification of technical wisdom had already been used for centuries by physicians and healers,⁷⁰ but from Hellenism on almost all technical and artisanal fields started to produce their own writings (recipe collections, handbooks, theoretical treatises, etc.). This phenomenon, which probably started as an *aide-mémoire* in the daily practice of different arts and crafts, quickly became a widespread custom; books were considered a sign of social prestige and technical authority.⁷¹ Book production, as a technical area of expertise, probably also developed its own sets of recipes. Although there is no evidence of the existence of such a recipe collection in Antiquity, we have numerous witnesses to recipes belonging to this field: *P.Leid.* contains 15 recipes for the production of golden and silver inks for book decoration, to which we can add *P.Holm.* § 12 for the production of palimpsests; a similar number of *chrysographic* recipes is preserved in the *MC*, whose origin – as already noted – was a Greek source; Thomas Christiansen identifies at least six recipes for practical black inks in the Greek magical papyri.⁷² The *Zīnat al-Katabah* (“The Ornament of the Writing”), written by the physician and chemist Abū Bakr Muḥammad ibn Zakariyā al-Rāzī (ca. 4th/8th century), offers us a good example of what such treatises on book production would have looked like. The main subjects discussed in al-Rāzī’s work include⁷³ ink-making techniques (including some on the production of invisible inks), methods for removing ink traces from writing surfaces and from clothes (something no doubt very

68 *Historia Augusta, Vita Maximini iunioris* 4.

69 Publilius Optatianus Porfirius, *Panegyricus in Constantinum imperatorem* 1–4.

70 Laurence Totelin, *Hippocratic Recipes: Oral and Written Transmission of Pharmacological Knowledge in Fifth- and Fourth-Century Greece* (Leiden-Boston: Brill, 2009), pp. 91–98.

71 Winsbury (*Roman Book* [cit. note 58], pp. 67–78) dedicates an eloquent chapter to this issue entitled “Books for Looks.”

72 Thomas Christiansen, “Manufacture of Black Ink in the Ancient Mediterranean,” *Bulletin of the American Society of Papyrologists*, 2017, 54:167–195.

73 For a detailed description, see Mahmoud Zaki, “Early Arabic Bookmaking Techniques as Described by al-Rāzī in His Recently Rediscovered *Zīnat al-Katabah*,” *Journal of Islamic Manuscripts*, 2011, 2:223–234, pp. 227–229.

useful for any scribe or writer), as well as recipes for the re-use of parchment (palimpsests). The author also mentions procedures associated with the treatment of writing materials, such as methods for pasting and thickening paper (in order to improve the quality of the writing material as Fannius did), as well as a recipe for ageing papyrus, a trick already employed by booksellers in Late Antiquity to swindle potential antique buyers.⁷⁴

In conclusion, although the recipes for inks in the alchemical papyri were collected by a user interested in a wide spectrum of crafts that, as already noted in the introduction, we can call alchemist, the analysis of the verb *odontizō* make it possible to establish an undeniable link for the recipes in which it appears to a context related to the production and use of papyrus. In this regard, two main craft milieus have been pointed out: on the one hand, a craftwork environment linked to the manufacture of papyrus prior to its use as a writing material. At this step of the papyrus production, ancient literary witnesses indicate that a tooth (or a seashell) was used to treat the papyrus surface in order to smooth any irregularities or, simply, to achieve a fine writing surface. It is likely that these same tools may also have been used by *glutinatores*⁷⁵ in ancient libraries to equalize and smooth the surface of the *volumina* after their restoration works. On the other hand, the use of these same tools to give lustre to golden and silver texts, as was just said, is a process that must be placed in the field of the book's production. In this regard, the recipes of the alchemical papyri intended for the production of inks and palimpsests are fundamental pieces of evidence about the technical literature not only written by ancient *scriptoria*, but produced by and for this artisanal milieu.

These considerations about the background of the vocabulary and processes transmitted in alchemical papyri of Leiden and Stockholm help us both to better define the kind of artisanal fields that ancient alchemists knew, and to better reconstruct the craftworks context where some of the recipes of the Greco-Egyptian alchemical treatises originated.

Acknowledgments

This publication is part of the research project *AlchemEast – Alchemy in the Making: From Ancient Babylonia via Graeco-Roman Egypt into the Byzantine, Syriac, and Arabic Traditions*. The *AlchemEast* project has received funding

74 See Carolyn Higbie, *Collectors, Scholars, and Forgers in the Ancient World: Object Lessons* (Oxford: OUP, 2017), p. 15, for several citations.

75 See above, note 58.

from the European Research Council (ERC) under the European Union's HORIZON 2020 research and innovation programme (G.A. 724914). I warmly thank Prof. Matteo Martelli and the anonymous reviewers for their precious suggestions on this paper.