In pursuit of Tabula Rasa: An Experimental Archaeology Approach to the Ancient Wax Tablet

The wax tablet was ubiquitous in the ancient Mediterranean. From the oldest known tablet dating back to the 14th century BCE to their use in the medieval period, wax tablets have played a critical role as a writing surface that is both reusable and portable.¹ Although literacy rates in ancient Rome were low², wax tablets were a prominent facet in the lives of Rome’s literate upper echelon. The majority of archaeological evidence demonstrates that tablets were used for notetaking, wills³, personal accounts, contracts, letters, and legal documents.⁴ Other sources detail the use of tablets for didactic purposes as well as composition⁵.

In theory, the use of a wax tablet is simple. There is a wooden board with a shallow recess⁶ (tabella), and a layer of wax (cera) is then poured into the recess. Once solidified, the wax is inscribed with the pointed end of an instrument (stilus) and can be smoothed back into place using the flat, blunt end of the same instrument (vertere stylum). The tablets can be used

³ Notably, in Jul. 83, Suetonius states that Caesar adopted Augustus in the final tablet of his will.
⁴ Willi, Manual of Roman Everyday Writing Volume 2, 2:22.
⁶ Some surviving tablets appear to be made of one solid piece, suggesting that the recess was formed through carving. Particularly, the Bloomberg tablets of London, dated from 50-80 C.E., are theorized to have been created from recycled barrel wood. Wood planks from barrels would be cleaved into boards, and a recess would be carved with a small mallet and chisel. However, it is also possible that a wooden rim could be placed around a flat board. Closer examination of other surviving tablets would be required to make a definitive statement.
individually or bound together with thread (*linum*). These aspects are well-known, and consistent with archaeological and historical records. However, this apparent simplicity is deceptive and does little to elucidate the intricacies of the creation and use of the wax tablet. This paper will explore the most feasible means of creating wax tablets in the modern era through both experimentation and analysis of the methods used historically in the ancient world.

The majority of surviving wax tablets are distributed across five prominent geographical areas: Southern Italy, Dacia, Egypt, Switzerland, and North Africa. Although used throughout the Roman empire, certain environmental conditions were more favorable to the preservation of the tablets over time. Generally, the depth of the wax was 2-3 mm deep, but wax recesses could be up to 5 mm deep and with varied dimensions. Typically, tablets were suitably sized for handheld use, approximately 10-15 cm wide by 15-20 cm long. Tablets could be used in either orientation. Some were much smaller while others were much larger, up to approximately 30 cm in length. The tablets could be used individually, or multiple could be bound together. A diptych was formed when two tablets were bound together, and a polyptich was formed when three or more were connected. Most commonly, two to three tablets were bound together. Some rare tablets include those backed with ivory or bone. Formally referred to a *tabula cerata*, with *tabula* meaning blank or board and *cerata* meaning spread with wax, the wax tablet could also

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10 Ibid, 50.
11 Ibid, 50.
be referred to as simply *tabula* or *cera*. The shortened colloquial language surrounding the tablets of Rome indicates their commonality and prominence.

In terms of tablet manufacture and distribution, there is little evidence or scholarship on the matter. There is one known potential wax tablet manufacturer, described as *pugillarius* on his funerary inscription.\(^\text{14}\) For the upper-class Romans who utilized the tablets, their cost would be no financial burden, and there would likely be little financial gain to using tablets as opposed to papyrus, the other prominent writing surface of the time. The price edict of Diocletian of 301 C.E., which outlines maximum prices for a variety of various goods, includes guidelines for five different wax types as well as papyrus ropes. However, the areas relating to wax on surviving manuscripts are fragmented, making it impossible to know many specifics, including what types of wax were used, the different prices of these waxes, and how the price of wax may compare to the price of papyrus.\(^\text{15}\) Beeswax was produced in Rome itself and was therefore more geographically accessible compared to papyrus, which was largely obtained from Egypt. However, it is unclear how the effort required for bee husbandry and the amount of wax produced per hive would compare to the effort required in papyrus production. Although to a wealthy Roman, presumably, a price distinction would be of no consequence. Thus, the use of the wax tablet in comparison to papyrus as scratch paper is derived from the beneficial properties of the tablet itself rather than any economic benefit.

Beekeeping was a significant activity in the ancient Greco-Roman world. Bee husbandry occurred in Rome and the surrounding areas, but the demand for wax and honey was such that these products were imported from elsewhere in the empire, such as Spain and Corsica.


Agricultural texts such as Varro’s *De re rustica* and Vergil’s *Georgics* provide insight into beekeeping during this time. The wax coating of the tablets was explicitly stated to be beeswax.\(^\text{16}\) In Ovid’s *Amores* 1.12, when a girl sends him a tablet with a less than favorable message, he laments that the tablet wood is suitable for a funeral pyre and speculates the specific source of the wax itself. He stresses that the wax was gathered by a Corsican bee from a hemlock flower, resulting in a tablet with deep red wax as if dyed with cinnabar. Ominously, he adds that the color was a true blood red.\(^\text{17}\) Although tablets with red-colored wax were not unusual, black wax was more typical.\(^\text{18}\) Vetruius\(^\text{19}\) and Pliny the Elder\(^\text{20}\) both describe the process of creating black *atramentum*, a pigment that was commonly used as a coloring agent in paint and ink. This pigment, known today as lampblack or carbon black, was created by burning either resin or wood with a high resin content in an enclosed chamber, with soot serving as a cheap alternative.\(^\text{21}\) This specific pigment is the most likely source of coloring for black wax. Other wax pigments such as yellow or dark green have been found as well\(^\text{22}\).

Although wax does not decay over time, the substance is not particularly strong, and in most cases, the wax of tablets has been lost to time.\(^\text{23}\) However, the Bronze-Age shipwreck of Ulu Burun off the coast of Turkey featured a diptych with remarkably well-preserved wax.\(^\text{24}\) Even more significant is the chemical analysis performed on the tablet, in which it was revealed

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\(^\text{17}\) Ovid *Amores* 1.12.8-10 states, “quam, puto, de longae collectam flore cicitae / melle sub infami, Corsica misit apis. / at tamquam minio penitus medicata rubebas: / ille color vere sanguinulentus erat.”


\(^\text{19}\) Vetruius, *De Architectura* 7.10.

\(^\text{20}\) Pliny the Elder, *Historia Naturalis* 35.4.1

\(^\text{21}\) “The Tablets.” See 15 above.

\(^\text{22}\) Ibid.

\(^\text{23}\) Ibid.

that the wax itself was composed of 25% orpiment powder, a yellow mineral pigment, which also potentially explains the amphora of orpiment present on the ship.\textsuperscript{25} Although chronologically distant from the Roman period, no other equivalent chemical analysis exists for the wax composition of a \textit{tabula}.\textsuperscript{26}

In terms of modern reconstruction of wax tables, I have found small-rimmed chalkboards and empty wooden mosaic frames to be quite sufficient. Four different yellow pigments, one black pigment, different concentrations of these pigments, and various thicknesses of pigmented and unpigmented beeswax were tested. Orpiment, although historically accurate, is arsenic sulfide ($\text{As}_2\text{S}_3$) and must be handled with care. An orpiment tablet was created in these experiments, and all use of the substance was done with personal protection equipment including gloves, a smock, and an industrial-grade respirator.\textsuperscript{27} In pursuit of a suitable, safe alternative for modern recreation, I also created tablets using light yellow ochre, icles ochre, and Spanish yellow Earth.\textsuperscript{28} All are yellow mineral pigments, and the icles ochre used matched the color of orpiment best. Black iron oxide was used in the creation of a black pigment tablet.\textsuperscript{29} Given that the 25% pigment figure is derived from retroanalyzing already mixed wax, I have taken 25% to mean by weight as opposed to volume.

\textsuperscript{25} Ibid.
\textsuperscript{26} Ibid.
\textsuperscript{27} “Safety Data Sheet: Orpiment.” Department: rare & historical dry pigments. KAMA Pigments, 2019. https://www.kamapigment.com/docs/msds/PS-IN0019_SGH_EN.pdf.; For a photo of the protection equipment used in the production of this particular tablet, see this link.
\textsuperscript{28} These pigments were obtained from ColorRare, as part of “The Yellow Collection - Pack of 3 Natural Mineral Pigments”. Interestingly, each of the pigment originated from an area within the Roman empire (France, Spain, and Italy) although no discernible correlation between these specific minerals and ancient wax tablets.
\textsuperscript{29} Although not consistent with the historical record, black iron oxide was used simply due to its availability at the time of experimentation. Black iron oxide and other mineral pigments have similar chemical and mechanical properties, resulting in similar interaction with other molecules and reactions to applied pressure. It is possible that lampblack, as a soot-derived pigment not of mineral origin, could potentially have different properties as a powder. Future experimentation would be required to determine the exact impact of the use of lampblack.
For a 4.5 in. x 6 in. wax recess, approximately 10 g of pigment and 30 g of wax was sufficient. Surprisingly, the process of creating the tablets was fairly mess free. Overall, the greatest success was found by simply pouring wax directly into the recess. It is critical that the wax used be as hot as possible, particularly for obtaining a smooth writing surface. Although wax could be melted in the microwave, this method results in uneven heating and is comparatively difficult to monitor. Greatest success was obtained through the use of a double boiler on a stovetop, in which the wax was heated for an additional 5-10 minutes after the wax had completely melted. Beeswax has a relatively low melting point, between 61-65°C, and full melting occurs fairly quickly. The mineral pigment can be added either at the beginning before the wax has melted or after the wax has melted, with no discernable difference between each method.

Most notable is the sheer quantity that is 25% pigment powder. Although a sizable addition of powder, I found no issue in mixing the powder into the wax to generate a homogeneous mixture. Then, the mixture can be poured into the tablet recess. A smooth surface is best achieved if the tablet itself is lightly shaken and tilted as the wax is poured, akin to tapping a cake pan on the counter before baking. Additionally, the use of hot wax ensures that an even spread can be achieved before the wax solidifies. A thinner wax surface can be achieved by pouring wax into the recess, allowing it to set for a moment, then pouring the remaining liquid wax out. Wax overflow occurred but proved to be of little issue, as a knife or spatula could be scraped along the tablet border to easily remove any excess. The use of a modern spatula also

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31 For a visual aid of adding pigment to wax and mixing, see this video. 25% icles ochre was added to the wax, and despite being a large quantity, mixed in without issue.
32 I used both an offset baking spatula and a flipper spatula. Each worked well. Further experimentation could involve a square tip palette knife that more closely resembles the Roman spatula.
played a similar role in spreading the wax in the recess itself as an ancient spatula. In the ancient world, a wide, flat spatula could be used to peel up old wax in need of replacement and was also used when spreading new hot wax around the surface of the tablet. Although occasional air bubbles may occur when the wax is poured, they can be smoothed fairly easily using a spatula while the wax is still hot. Any residual air bubbles are akin to the pockmarks found in surviving tablets. Although the use of the spatula as a spreading tool suggests the existence of wax in a semisolid paste, I have found achieving this wax state and working with it to be wholly impractical. Attempts at using the wax at lower temperatures, as well as whipping semi-melted wax to achieve a softer wax surface only resulted in writing surfaces too rough to be practically used. Additionally, alternative methods of creating a wax surface included rubbing a stick of wax over the board to create a thin layer. This method was also unsuccessful, as achieving a sufficiently thick wax layer was highly difficult, and the resulting surface was rough, splotchy, and uneven.

The Roman wax tablet is inscribed using a stylus, typically composed of iron or a copper alloy. Bone styli have also been found, but the majority date prior to the 1st Century AD. Broadly, a stylus consists of a tip, a shaft, and a flat eraser. Styli typically were within the range of 11-12 cm in length and exhibited a broad range of decoration. Some are barren whereas others tout intricate carvings, witty or erotic sayings, or shaped erasers in figures such as dolphins.

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34 Willi, *Manual of Roman Everyday Writing Volume 2*, 2:76-78; Also see Ovid *Ars Amatoria* 1.437
36 With the objective of achieving a wax coating as thin as possible, applying the hot wax onto the tablet with a flat brush could potentially be an option. However, this method may negatively impact wax smoothness, and experimentation is required.
38 Ibid.
39 Ibid.
So long as the point of any stylus is sharp enough, there is no discernable difference in the quality of writing. However, wax composition makes a substantial difference in the feasibility of writing on a wax tablet. On a wax surface approximately 2.5 mm thick, pure wax is thick and very difficult to move the stylus through. A pure wax surface approximately 1 mm thick yields greater success but still does not yield an entirely smooth writing process. However, the addition of mineral powder both serves as a coloring agent that increases wax legibility and drastically improves wax malleability. Across the various pigment powders attempted - whether orpiment, ochre, or iron oxide - there was no discernable difference between the surface texture of the produced tablets. Each was an equal improvement from the pure wax tablets and created a far more forgiving and malleable wax surface. It appears as though the addition of a mineral pigment plays the largest role in altering the texture of the wax, rather than any particular chemical properties of the individual pigments themselves.

Additionally, there is a significant distinction between the legibility of different wax colors. On plain beeswax, there is very little visual contrast between the inscribed and blank portions of the tablet, resulting in substantial difficulty when reading. Each of the yellow pigments works sufficiently well, with the darker pigments being slightly more legible than the

40 I purchased a bronze stylus online here, from Scribal Works Shop, a Texas-based historic writing supplies shop. However, a variety of history-centric online stores sell similar styli. Alternative methods of inscription attempted in this series of experiments included the pointed end of a wooden skewer, a nail art dotting tool with the rounded tip cut off with wire cutters, and a small knitting needle. All were mechanically very similar when scratching into the wax writing surface.

41 In terms of modern recreation, the specific properties of toxic orpiment are indistinguishable from any of the safe pigment alternatives. Orpiment does not possess any unique properties that would need to be substituted for. I found icles ochre to resemble the color most closely, but any of the pigments used in these experiments would sufficiently recreate the ancient tablet. From a chemical standpoint, beeswax is composed of over 300 compounds, the majority of which are hydrocarbons. In its pure, solid state, beeswax that has melted and then solidified forms a homogeneous mixture that generates tightly packed, condensed molecules, resulting in a thick, solid sheet of wax. Hence, the difficulty of writing on pure beeswax tablets. The addition of pigment powder, in simple terms, results in pigment molecules being present between the wax molecules. This distances the wax molecules from one another, and weakens the intermolecular bonds between them, thus resulting in a less condensed writing surface. My thanks to Jacquelin Woodford, Ph.D. for her comments in conversation on December 8, 2022.
lighter ones. Above all, the black tablets exhibit the most clarity and possess a distinct difference in sheen between the wax surface and the carved letters. Although legible when viewed from a flat front angle, tilting the wax tablet under light can also create a sheen on certain areas and cause the inscribed letters to be even more distinct.

There is also uncertainty surrounding the depth at which styli were applied. The wax of Roman wax tablets was relatively thin. Particularly given that wax does not hold up well over time, the majority of wax tablets have no surviving writing whatsoever. Others, even though the wax has long since eroded, are legible because the stylus went all the way through the wax and scratched the tablet behind. In some cases, there are multiple texts overlapping one another on the wood.  

Although fully scratching through the wax enables the writer to more clearly read the inscriptions, this method seems wholly impractical if the writer's objective was to be able to easily re-smooth the wax and write again. There are surviving examples of both wax tablets scratched through to the wood and tablets with more surface-level wax inscriptions.

Martial describes wax tablets as “gloomy” and suggests ivory written on with ink as an alternative for unclear wax tablets, stating, “Languida ne tristes obscurent lumina cerae, / Nigra tibi niveum littera pingat ebur.” However, it is unclear whether the gloomy tablet is the cause of the reader's tired eyes or if the reduced legibility of the tablet is merely due to poor eyesight. Similarly, Quintillion states that tablets can be difficult to read and offers papyrus as an

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43 British Library Digitised Manuscripts. “School Exercises with Menander’s Sententiae, Multiplication Table and List of Words.” The British Library Board. Accessed December 17, 2022. https://www.bl.uk/manuscripts/Viewer.aspx?ref=add_ms_34186_f001r. - i.e., a didactic Greek text from Egypt in which a student has copied a phrase a teacher wrote at the top of the tablet. The wax appears very thin and the writing is bright white in comparison to the tablet’s black wax.
44 “Wooden Writing Tablets.” - a black wax tablet in which markings are clearly inscribed, but not distinct from the board backing.
45 Martial *Epigrams* 14.5.
46 Ibid.
alternative. In my experience, scratching through to the wood requires either extremely thin wax or a substantial amount of force. On plain beeswax, thick enough wax to be visually distinct from the backboard is very difficult to write through. On thinner, plain beeswax, the semi-transparent beeswax is nearly the same color as the backboard regardless of the wood color of the backboard. It is only with opaque, colored wax applied extremely thinly that the wax can be scratched through with any success. The experience is not aurally unpleasant, and the stylus against the wood is somewhat akin to the sound of a pencil scratch on paper. Re-smoothing wax that has been cut down to the wood is not impossible, but it is far more difficult to reachieve a clean surface in comparison to a less aggressive stylus stroke. Particularly if the wax has been scratched through on multiple occasions, when inscribing newer writing, the stylus has a tendency to catch on the older inscriptions in the wood. Additionally, Roman tablets typically had cross hatching across the back. In my experience, the stylus catches on the cross hatching, disrupting the writing process and creating an overall unpleasant user experience. It is possible that a tablet could have intentionally been scratched more harshly if it was meant to serve as a long-standing document for which frequent revisions would be less of a concern, such as a will or a contract. Or, the difference could simply be a matter of the user's preference and handwriting tendencies.

Although writing in Latin is most commonly associated with the capital letter forms incised into monuments or the literary letter forms of early Latin manuscripts, Roman cursive

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47 Quintilian *Institutio Oratoria* 10.5.31.
48 It has been suggested that the purpose of this cross hatching was to help keep the wax in place. However, I have observed no discernable difference between tablets with cross hatching and those without. The wax adheres perfectly well on its own. That being said, I cannot fathom any other purpose that the cross hatching might serve.
was more commonly utilized as a tool for quotidian composition such as note taking, administrative records, and correspondence.\textsuperscript{49}

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Old Roman Cursive\textsuperscript{50}

Bernhard Bischoff has termed the following “wax tablet script,” characterized by angular, short strokes with minimal curves.\textsuperscript{51}

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Wax Tablet Script\textsuperscript{52}

The script, in essence, minimizes traditional Old Roman Cursive to contain as many strokes in the same direction as possible. It has been suggested that “the use of the tablet had inhibited the development of a flowing and looped cursive script,” and as such, flowing scripts only became prominent with the later development of parchment codices.\textsuperscript{53} However, my


\textsuperscript{50} Thompson, \textit{An Introduction to Greek and Latin Palaeography}.

\textsuperscript{51} Clark, “Early Latin Handwriting and Plautus’ Pseudolus.”; Thompson, \textit{An Introduction to Greek and Latin Palaeography}. Key examples include the graffiti inscriptions of Pompeii, and writing on the old roman fort at Vindolanda in England.

\textsuperscript{52} Clark, “Early Latin Handwriting and Plautus’ Pseudolus.”

experimentation found that flowing scripts are not particularly impeded by the wax tablet medium.

In my experimentation, modern English, Roman square capitals, Old Roman Cursive, wax tablet script, Greek, and either Arabic or Farsi were inscribed upon each tablet. When applied to the tough pure beeswax tablets, the difference in scripts is most notable. Particularly, English was the most difficult, whereas flowing scripts such as Greek or Arabic were etched more easily in comparison. Through further experimentation, I’ve determined that letters with sharp, angular changes in the same stroke, such as the letters M and L found in modern English and Old Roman Cursive are most difficult to inscribe. Flowing scripts and short, single-direction linear marks can be applied comparatively smoothly. Additionally, when a stylus sharply changes direction in a single stroke, as is most common in English and Old Roman Cursive, more wax is displaced onto the tablet surface in comparison to other scripts and can impede legibility. The wax tablet medium does not hinder curved lines. Rather, it hinders sharp changes in stroke direction. On the softer, pigment-containing waxes, the writing experience difference between scripts is far less noticeable and is only substantial when significant, if not excessive, pressure is exerted when forming letters. A wax texture soft enough to successfully erase is malleable enough that writing in any form is not seriously hindered. It is my belief that the proposed “wax tablet script” is simply the most effective way of writing the more rigid capital letter form and traditional Old Roman Cursive.\(^\text{54}\)

The most distinctive feature of the wax tablet is the ability to erase easily. Although portions of papyrus could be wetted to clear away ink, the process requires a sponge, a source of

\(^{54}\) Perhaps flowing connected cursive could not have developed without an intermediary script with more connected letters. This would likely take the form of script with short-stroke, rounded characters, but any conclusive statements would require further investigation into the development of writing scripts.
water, and time to let the water dry before additional ink can be applied. Additionally, through experimentation on handcrafted papyrus sheets, I have found that repeatedly wetting papyrus gradually degrades the quality of the papyrus sheet and eventually may be stained a displeasing gray when ink cannot be fully removed. Only small errors can effectively be corrected on papyrus. On the contrary, the flat end of a stylus can be applied to the wax in a motion similar to the modern use of a pencil eraser and create a smooth surface without any additional materials. Although both formats would be sufficient for the erasure of a single error, which would be relevant to composition and in-process revision, only wax tablets enable full erasure, which would impact reusability. Even for positions that would not strictly require abundant erasing, writing on papyrus would require a separate flat writing surface, ink, sponge, and a reed stylus. Although there is evidence of ink transport through inkwells and pen cases, the overall system for wax tablets is far more suited for casual transport.

While the majority of archaeological evidence of surviving wax tablets is that of letters, administrative records, or school work, the significance of wax tablets in poetic composition cannot be erased. Although utilized for more long-standing documents such as contracts or wills, there exists the understanding that the materials could be revised. Additionally, the creation of elaborate polyptychs, with some having as many as 10 leaves, indicates a need for lengthy writing surfaces that would exceed the need of educational aids. The ability of the wax tablet to be erased is quintessential to its function as a writing material. In fact, Quintilian states that the

55 Willi, Manual of Roman Everyday Writing Volume 2, 2:75.
56 Willi, Manual of Roman Everyday Writing Volume 2. - Papyrus required a scrinium, a cylindrical book box for transform, and required substantial effort to ensure that the papyri were not bent or damaged. Tabulae on the other hand, particularly when enclosed in a diptych or other bound form, would be far sturdier and less prone to breakage due to the wooden encasing. Each writing medium exists for a distinct purpose.
57 Poirier, “The Roll, the Codex, the Wax Tablet and the Synoptic Problem.”
58 Ibid.
ability of the stylus to erase is equally as important as its ability to write. Whereas the wax tablet medium was a convenience for administrative purposes, for composition it was a significant virtue.

When viewed through the context of the creation of a Roman poetry book, a unique relationship exists between a poet and their tablets. The width of the tablet itself is well suited to verse. Tablets are widely referenced in Roman poetry, and in some cases, poets display substantial attachment to their tablets. Horace states that writing on a wax tablet is a private matter, as the writer can make unsavory facial expressions, gestures, or strike themselves, which those watching may find ridiculous. In other instances, tablets play a role in less formal social interactions. Catullus describes a day of merriment with Lucius Calvus spent passing a tablet back and forth and playing around with little verses in a variety of meters.

The very existence of the wax tablets lends itself to change and revision. Quintillian specifically laments that unlike writing on wax tablets, writing on papyrus requires frequently dipping a reed stylus into ink, disrupting not only the writing itself but the writer's train of thought. The infinitely-erasable wax tablet creates a space in which improvement and alteration are encouraged. In his Satires, Horace states that a good writer is no stranger to turning the pen and that the stylus must be inverted often (stilum vertas) if the writer hopes to create a work.

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59 Quintilian, *Institutio Oratoria* 10.4.1.
60 Quintilian *Institutio Oratoria*. 10.3.32 describes an instance in which a student, who measured his compositions in terms of line length, wrote texts that were excessively long as a result of a too-wide wax tablet. When the student switched to a tablet that was less wide, the issue disappeared.
61 See Catullus 42, in reference to an ex-lover who refuses to return his wax tables, the poet is rather upset and emphasizes “Moecha putida, redde codicillos, / redde putida moecha, codicillos!” trans. Rotten slut, return the tablets, return, rotten slut, the tablets!
62 Horace, *Ars poetica* 293.
63 Catullus 50. 1-6.
64 Quintilian, *Institutio oratoria* 10.3.32; In practical experimentation on papyrus sheet, it is difficult to get through a few words or lines before having the redip the reed used for writing. Additionally, if when attempting to complete a phrase, the reed stylus goes too long without redipping, there is a visual distinction between the beginnings and end of a given phrase. The pause in thought and writing is not only experienced but permanently marked on the papyrus as well.
worth reading again.\textsuperscript{65} \textit{Stilum vertere}, or some variation thereof, is the specific terminology commonly used to describe the process of erasing on a wax tablet.\textsuperscript{66} Drawing attention to the fact that the two processes are conducted through the same writing implement draws an inherent connection between writing and erasing. The two processes coexist and are two sides of the same coin (or stylus). As the writer composes, the eraser itself is visible, serving as a reminder that mistakes are a critical part of the writing process. To invert and change the position of the stylus is to change one’s mind. As soon as a work has been transcribed from tablet to papyrus, the work itself has become fundamentally more permanent. It is an indicator that, at least for the time being, that portion of a poetic work is complete. While a poet might write their work on a wax tablet initially or dictate to a secretary who held a tablet, the distribution of their work would be done on papyrus scrolls individually hand-copied by scribes.\textsuperscript{67} Just as tablets were for the poet and papyrus for the scribe, tablets existed for writing and papyrus for reading. Each material serves a distinct purpose.

The creation of a wax surface that can be erased is perhaps the most difficult aspect of wax tablet recreation. In terms of erasing the tablets, both wax composition and stylus technique are of equal importance. If applied to the wax vertically, as a pencil eraser would typically be used, the flat end of the stylus will effectively smooth the wax but cause pieces of the wax to curl up off of the surface. This method works by scraping off the surface layers of the wax. Although the written text is definitely erased, a slight indentation is made in the wax surface, which could cause an uneven surface through continued use of the tablet. It is possible that this method could

\textsuperscript{65} Horace \textit{Satires} 10.72-73., “\textit{Saepe stilum vertas, iterum quae digna legi sint / scripturus}”

\textsuperscript{66} See Cicero, \textit{In Verrem}, 2.2.101 Erasmus also uses the phrase repeatedly in \textit{Adagia}

explain the writing visibly etched onto the boards of wax tablets, as the wax tablet could be at the end of its life cycle after a great deal of the top wax had been scraped away. However, given the mess this method creates and a lack of evidence regarding wax curls being an issue in writing, I find this method unlikely. Additionally, in pure beeswax tablets, applying the stylus eraser vertically was wholly unsuccessful, as the stylus catches on the wax and creates a choppy, ridged surface. Although it is possible that the Roman process for purifying beeswax could have differed and resulted in a softer wax texture, or that the properties of modern beeswax differ from the beeswax from the ancient Mediterranean, this seems unlikely. Rather, the wax surface can effectively be pressed back into its original form by positioning the stylus nearly horizontally to the wax surface. By placing the thumb or pointer finger over the blunt end of the stylus, additional downward pressure can be applied to the wax. Holding the stylus flat to the wax is a bit more laborious, but not excessively so, and results in a far more feasible wax erasure.\(^{68}\)

In terms of appearance post-erasure, due to the semi-transparent nature of beeswax itself, tablets without pigment were incredibly difficult to erase fully. Even when a texturally smooth surface was achieved, the wax pushed back into the incisions had become aerated and was more opaque. For marks that were particularly deep, no amount of attempted smoothing could clear the marks marring the surface. Hence, an opaque wax surface is critical to the erasing process. Initially poured wax has a matte sheen, but once it is erased it adopts a more glossy sheen. Although this distinction makes evident which areas have and have not been erased on a brand-new tablet, well-used tablets achieve a homogenous surface. Once a tablet has been worked across its entire surface, as long as erasure is done with care, the more recently erased and rewritten portions of the tablet are visually indistinguishable from the rest. The change of a single word in the center of a sentence is visible at times but can be difficult to distinguish from

\(^{68}\) For a demonstration of applying the stylus vertically versus horizontally, see this video.
prior eraser marks. Additionally, the more the wax is worked and manipulated, the softer and easier to erase the wax surface. This increased malleability could potentially explain writers’ fondness for their personal tablets. The tablets created with 10% pigment were visually indistinct from those crafted with 25% pigment and as such were on equal grounds in terms of legibility. However, a major distinction exists in terms of the erasing quality. Those composed of 10% pigment were far more difficult to erase than 25%.

Complications arise when attempting to smooth the wax using styli with rounded edges, as was common with bone styli. Although the wax could be scraped off with decent success to create a smooth surface, the issue of wax shavings arose once again. Unlike with flat, metal styli, it was far more difficult to smooth the wax back into the board. The stylus had to be held nearly flat, and the wax pressed back into the board surface was more unevenly distributed in comparison. Attempts at a burnishing movement were also attempted, although with minimal success. The overall process was far more laborious than the use of a metal stylus, and potentially explains why bone styli are scarcely found after the first century CE. The impracticality of a rounded eraser, combined with the erodibility of bone, also explains why far fewer bone styli have been found in comparison to their metal counterparts.

It is possible that bone styli could have served an ornate or decorative role in instances where functionality was less critical. It is also possible that bone styli served as a more accessible alternative when metal was difficult to acquire and that the brittle nature of bone is more conducive to a rounded edge. However, further investigation is required.

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70 Ibid.
It has been suggested that tablets were smoothed by heating the blunt end of the stylus in a flame, then applied to the wax.\textsuperscript{72} Theoretically, if a writer wanted to achieve a particularly smooth surface without repouring the wax of the entire tablet, the addition of heat could be a viable option. On my own tablets, I compared iron, bronze, brass, and copper in terms of smoothing ability. Putting the metal directly into the flame causes the tool to blacken, which would rub off and discolor the tablet. Better success was achieved by holding the metal slightly above the flame until the part being held, approximately 1.5 inches from the edge of the stylus, felt warm. The heating process took about 5-10 seconds, and the stylus could be applied to the wax without issue. Unlike an unheated stylus, a heated stylus could successfully be wiped across the wax vertically without issue, and could successfully erase pure beeswax. However, it must be recognized that while a Roman would have had ample access to lamps or other heat sources, any reliance on a lamp diminishes the portability aspect of the tablets. Additionally, resorting to the addition of heat is only necessary if a wax tablet has been made without a colorant to soften the texture. Although it’s possible that a heated stylus could be applied to a tablet on occasion, the use of a heated stylus would be unnecessary for day-to-day use. Additionally, there is no literary evidence for this particular technique, and descriptions of frenzied switching between writing and erasing\textsuperscript{73} do little to suggest that pauses to heat the stylus were taken. Although lamps have been found near writing materials in archaeological settings,\textsuperscript{74} it is far more likely that the presence of lamps served as illumination when writing rather than any specific role in the writing process itself.


Alan Cole, the consultant of the Museum of Writing Research Collection at the University of London, conducted experiments using genuine roman styli and a genuine Roman lamp.

\textsuperscript{73} See Ovid, \textit{Metamorphoses} 9.522-525., in which Byblis writes a letter.

It is far more feasible that should a surface be particularly marred, the entire surface would be replaced instead. The process of replacing old wax in the tablets is relatively painless. A spatula can be pried under the wax and lift the remainders off in large pieces. The wax scraps can be remelted and repoured fairly easily as well. If refilling a tablet with the same color, additional wax could be poured over the remnants without issue.

Through these preliminary studies of the ancient wax tablet, functional wax tablets have been achieved. Based on current experimentation, greatest success is achieved when beeswax is heated to a high temperature, 25% mineral pigment is added to the wax, and a thin wax sheet is created by pouring wax into a wooden recess, then pouring the excess out. While the tablets are fairly forgiving in terms of writing, successful erasing requires a specific technique. Holding the stylus angled horizontally near the tablet and applying moderate pressure through repeated short strokes has yielded the greatest success. Although not impossible, the use of a tablet in which the wax is entirely composed of beeswax without additives is highly impractical. Predominant future directions for research include a comparison of historic lampblack pigment to mineral pigments, and the addition of an oil to soften the wax further. Although the tablets generated with only pigment and wax are functional, the wax is still generally tough and not the most workable. Although the addition or lack thereof of additional agents to wax tablets is inconclusive, the addition of a small quantity of oil may greatly improve the texture of the wax and prevent excessive wax curls from forming. Future environmental conditions involve analyzing the integrity of the wax in different humidity and temperature conditions, as the Massachusetts winter these tablets were constructed in is rather different from the warm, humid Mediterranean.

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75 In terms of practicality, shea butter, coconut oil, mineral oil, or vegetable oil would all likely achieve a similar effect on the rigidity of the wax. Olive oil would likely be the most suitable option in regards to historical feasibility.
climate. Additional analysis regarding whether the texture or usability of wax tablets changes over time would also be of benefit.

Ultimately, the convenience and practicality of the wax tablet served the medium well and led to its use for thousands of years. Although the wax tablet may not be a modern individual's first choice for a writing surface, the standards for what constitutes a convenient, handheld writing surface have not changed. Whether it be for communication, didactic purposes, or creating drafts for important documents, the need for an erasable and portable means of writing lives on. With the advent of modern paper, the notepad has become ubiquitous in every classroom, on every home office desk, and in every work conference. The use of erasable media such as the chalkboard and whiteboard provide portability and erasibility, but lack permanence. It is only with the emergence of technology that we have returned to a means of conveying information that is reusable, erasable, portable, and meets the longevity needs of users. It is no coincidence that the modern iPhone and iPad are within the exact size range of a wax tablet. Whether jotting down class notes on an iPad or dictating text through an iPhone, written communication has come full circle. As the modern era shifts towards the digital tablet and stylus, the impact of the *tabela* and *stilum* are more prevalent now than ever.
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*All translations are by the author unless specifically stated.


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