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THE TABLET-MAKERS OF PYLOS: AN EXPERIMENTAL INVESTIGATION INTO THE PRODUCTION OF LINEAR B TABLETS

by Anna P. Judson

British School at Athens and University of Durham

The Linear B administrative texts of Late Bronze Age Greece were written on clay tablets, whose production therefore formed the first stage in the process of document creation, though it generally remains unclear whether the tablets' writers were also their makers. This study combines experimental archaeology with autopsy of the tablets from Pylos in order to investigate the methods by which the Linear B tablets were created at this site. It thereby sheds light not only on the physical processes involved in shaping the clay, but also on the decisions involved on the part of the tablet-makers, and hence on the relationship between the 'making' and 'writing' stages of the process of creating the Linear B documents.

INTRODUCTION

Documents in the Linear B writing system almost exclusively take the form of clay tablets, which were used for record-keeping in the administrative centres of Late Bronze Age Greece (*c.* 1400–1200 BCE). The tablets themselves generally receive less attention than the texts written on them, which provide a wealth of information on Late Bronze Age Greek society as well as representing the earliest recorded form of the Greek language. However, the process of shaping clay to form tablets prior to writing on them is a crucial stage in the creation of these texts: focusing on this less-studied aspect of the Linear B documents sheds light not only on their materiality, but also on the operation of the whole administrative recording process.

In this study, I combine experimental tablet production with autopsy of the original tablets from Pylos in south-western mainland Greece. As the majority of the *c.* 1000 Linear B texts from this palace are securely associated with its final destruction, *c.* 1200–1180 BCE (early Late Helladic [LH] IIIC),[1] this site provides an opportunity to investigate the practices of a single, contemporaneous community of tablet-makers and -writers.

Previous experimental work

Many Mycenologists will have made replica Linear B tablets at some point, with students or as a public engagement activity,[2] if not as part of experimental research. Examples of the latter include creating tablets to test the use of the styli found at Tiryns (Godart 1988, 248–50; 1994; on styli, see also Steele 2020); experiments carried out as part of Sjöquist and Åström's (1991,

[1] Vitale 2006; Vitale, Stocker and Davis 2022. For a refutation of the recent proposal to redate this destruction to an earlier period (*ARN*, xvii–xix; *LSP*, 85–91), see Davis et al. forthcoming.

The following abbreviations are used in this article: *ARN* = L. Godart and A. Sacconi, *Les archives du roi Nestor. Corpus des inscriptions en linéaire B de Pylos*, 2 vols (Pisa and Rome, 2019–20); *LSP* = L. Godart, *Les scribes de Pylos* (Pisa and Rome, 2021); *PT*^{3} = J.L. Melena, *The Pylos Tablets*, 3rd edn with R.J. Firth (Leoia, 2021); *PTT*^{2} = J.-P. Olivier and M. Del Freo, *The Pylos Tablets Transcribed*, 2nd edn (Padua, 2020).

[2] E.g., Palaima 2011, 111–12; crewsproject.wordpress.com/2019/05/21/late-bronze-age-clay-time; for my own public materials relating to this study, see www.bsa.ac.uk/videos/how-to-make-a-linear-b-tablet.

19–25) investigations into tablet production; demonstrations that dry tablets could be re-wetted in order to edit their texts (Pape 2002; Pape et al. 2014) and that they could survive being transported long distances (Hallager 2017); and an investigation of the means of smoothing tablet surfaces and edges (Greco and Flouda 2017, 149–51). The different methods used for creating tablets – and what reasons a tablet-maker might have to choose one over another – have, however, not previously been the subject of systematic experimental investigation. This study therefore seeks to improve our understanding of the processes involved in shaping clay to form tablets, the impact of the choice of particular methods of doing so, and hence the considerations in play for the tablet-makers during this procedure.

How were tablets made?

The first stage of creating a tablet is, of course, the collection and processing of the clay.[3] A wide range of different clays appear to have been used at Pylos, including both fine and coarse clays, as observed by autopsy (Palaima 1985; 1988), macroscopic petrographic analysis (Nakassis, Pluta and Hruby 2021, 168; Hruby and Nakassis forthcoming), and portable X-ray fluorescence (Wilemon 2017; Wilemon, Galaty and Nakassis 2020). However, pending full publication of the latter two studies, it is not possible to discuss this aspect of tablet production in detail, and this study focuses on the next stage of the process, shaping the clay to form a tablet.[4]

Linear B tablets are classified into two formats (Fig. 1), 'palm-leaf' (long and narrow; usually one or two lines of text recording a single piece of information) or 'page-shaped' (rectangular, orientated horizontally or vertically,[5] with more lines of text and usually containing multiple administrative entries), although this classification obscures the great degree of variation in size and shape within each format, as well as the extent to which they can overlap in size and function (cf. Driessen 2000, 42; Palaima 2011, 104 n. 134; Tomas 2017, 120–1; and 'Tablet-makers and tablet-writers', below). Other document types include labels – small pieces of clay attached to baskets or trays containing tablets (see, e.g., *PT*[3], xliii–xliv, lxxi) – and sealings, which are usually three-sided and formed around a knotted string, bearing a seal impression and sometimes short inscriptions with information about the goods they accompanied from other locations to the palace.[6] It is often said that palm-leaf tablets were used for preliminary documentation, before the information from a set of palm-leaves was transferred to a page-shaped tablet as the final document (e.g. Palaima 2010, 360; Del Freo 2019, 172). However, direct evidence for this multi-stage processing of administrative information is limited;[7] in many

[3] Existing tablets could also be either reused by erasing the text and writing a new, palimpsestic text, or recycled by using the clay to form new tablets. However, on recycling see Hruby and Nakassis (forthcoming); on palimpsests see section entitled 'Tablet shape and finishing', below.

[4] As the tablets were originally only air-dried, and then fired when the palace burned down, the exact composition of the clay is less crucial for the purposes of this study than for the experimental recreation of fired pottery.

[5] Page-shaped tablets are sometimes further sub-divided by size or orientation (e.g., Driessen 2000, 42; Tomas 2017); I prefer not to further sub-divide this already somewhat arbitrary modern classification.

[6] On Mycenaean sealing practices, see Younger 2010; Panagiotopoulos 2014; on Pylian sealings, see Flouda 2000; 2010; Shelmerdine 2012b. There are also small numbers of 'noduli' – small lumps of clay without strings which bear inscriptions and seal impressions – and inscribed but not sealed 'nodules'. Experimental work on document types other than tablets was outside of the scope of this study; for an experimental investigation of Cretan sealing practices (in a Linear A, rather than Linear B, context), see Finlayson et al. 2021. Some inscriptions also exist on media other than unfired clay: on inscriptions painted before firing on transport stirrup jars, see Judson 2013; on the very rare other types of inscriptions, see Pluta 2011, 95–118.

[7] The only instance where both shorter preliminary texts (mostly, but not entirely, palm-leaves) and page-shaped summary documents are certainly known is a group of landholding texts from Pylos: Hand (H) 41's **Eb** and **Eo** series were compiled in H1's **En** and **Ep** series, with both writers contributing to the related totalling **Ed** series (on the relationships between these series and the administrative process involved, see, e.g., Bennett 1956; Del Freo 2005, 88–93, 104, 108–10, 120–2, 131–5; Salgarella 2019; Judson 2020b, 538–9); see further below. The page-shaped tablet **MY Ue** 611, found in the 'House of Sphinxes', is a record either of the same delivery of vases represented

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Fig. 1. Illustration of tablet shapes: palm-leaf (**Fr** 1203, top left); vertical page-shaped (**An** 1, right); horizontal page-shaped (**Es** 647, bottom left). Photos: National Archaeological Museum, Athens/ Department of Collections for Prehistoric, Egyptian, Cypriot and Near Eastern Antiquities. © Hellenic Ministry of Culture and Sports/ Organization of Cultural Resources Development (H.O.C.RE.D.). Scale bar: adapted from photographic reference scale by Jim Elder, Ottawa, Canada (smallpond.ca/jim/scale), CC-BY-NC-SA 4.0.

cases, a basket of related palm-leaf tablets could have formed the final 'document', while a page-shaped tablet could have been the first and only stage of documentation.[8]

The most systematic previous discussions of methods of making tablets are provided by Palaima's (1988) descriptions of the characteristics of tablets written by different scribes at Pylos, which in some cases include the techniques used to create them, and by Sjöquist and Åström's (1985; 1991) studies of the palmprints on the Pylos and Knossos tablets, both of which will be further discussed below. General comments on the process of making tablets usually relate to palm-leaves, and describe sheets of clay being folded up to form long narrow tablets (e.g. Palaima 1985, 103; 2011, 105–6; Del Freo 2019, 172–3); however, palm-leaves could also be made by rolling out a cylinder of clay and flattening it with the palms (Sjöquist and Åström 1985, 44; 1991, 13–16, 18; Driessen 2000, 41; Fig. 2) or simply by moulding the clay into shape with the fingers.[9] Some tablets – usually, but not exclusively, palm-leaves – also had a piece of straw or string inserted longitudinally, identifiable by the channel left through the tablet (see Godart 1988, 248–9; Driessen 2000, 40; Palaima 2011, 105). The process of making page-shaped tablets is more rarely discussed, although Palaima (1988, 46, 59; 2011, 105) states that some were made by moulding fine clay over a coarser core (but see 'Experimental methodology' below), and Bennett (1996, 29) refers to the edges of page-shaped tablets being folded over 'to make nicely rectangular shapes'. The edges of tablets were also neatened by pressing against a flat surface (e.g. Driessen 2000, 41) or by burnishing (Greco and Flouda 2017, 149–50). Tablets were frequently cut along one or more sides, either to remove unused clay or to create multiple separate records (Palaima 1985, 103; 1988; Tomas 2013).

by the sealings found in the doorway of the same house (**Wt** 501–507), or of a similar delivery (Müller, Olivier and Pini 1998, 15–16; Sacconi 1999, 545–6; Shelmerdine 1999, 571–2; Panagiotopoulos 2014, 170–2).

[8] The Pylos **Jn** series, recording bronze allocations, contains page-shaped tablets functioning as both preliminary and final records (Smith 1992–3).

[9] Driessen 2000, 40. During my autopsy, I observed only a single Pylos tablet, **Va** 1324, which had been roughly made in this way (which is more characteristic of the labels).

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Fig. 2. The author rolling out a cylinder of clay to form a tablet in the Fitch Laboratory. Photo: Evangelia Kiriatzi.

Where were tablets made?

At the time of Pylos' destruction, *c.* 80 per cent of the tablets were stored in the 'Archives Complex', two rooms next to the palace's main entrance.[10] The rest are mostly from other areas of the palace where items were processed and/or stored (Palaima 1988, 135–69), including a pottery storeroom (Room 20); three oil storerooms (Rooms 23, 32, and above Room 38: Shelmerdine 1985, ch. 4); the North-Eastern Building, a clearinghouse for receiving and recording goods (Bendall 2003); and the South-Western Building, where 'taxation' records were written.[11] Evidence that at least some of the tablets found in the Archives Complex had been transferred from other locations around the palace is provided by the **Sa** series of chariot wheel records: these were mostly found in the Archives Complex, but one remained in the North-Eastern Building, where presumably the whole series had been written (Palaima 1988, 179; Bendall 2003, 220). The **Sh** series, recording armour, were stacked in a labelled basket near the Archives Complex's doorway at the time of the destruction, and may also have just been transferred from the North-Eastern Building (Palaima 1996a; see also Kyriakidis 1996–7, 214–24). Presumably tablets were made in or near all of the areas in which they were found,[12] as well as potentially other areas in, or just outside, the palace. An outside area might often have been a more convenient place – with more space, better light, and less of a need to clean up clay – to make and write documents, especially compared to the Archives Complex's two small rooms (cf. Palaima and Wright 1985, 259). It is also increasingly frequently being suggested (though has not been conclusively proven) that some palm-leaf tablets, like sealings, may have been written away from the palace – whether by

[10] This includes tablets found in the Archives Complex during excavations and others which are likely to have been displaced from there (Palaima 1988, 162–9; Shelmerdine 1998–9, 309 n. 4).

[11] Shelmerdine 1998–9. Inscribed sealings were also found in the Wine Magazine (Shelmerdine 2012b). The tablets from the Megaron have been variously interpreted as evidence for an upper-storey textile workshop or storeroom (e.g. Jasink 1990–1, 228; Kyriakidis 1996–7, 217) and as earlier fragments from wall-fill (e.g. Melena 2000–1, 367; Skelton 2010); see Davis et al. forthcoming.

[12] Scraps of clay which may have been intended for making tablets were found in the Archives Complex and Room 23 (Blegen and Rawson 1966, 99, 136–7, pl. 276).

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writers based at another administrative centre or by palace-based writers who had travelled to other locations – and brought back for filing and/or compiling onto summary documents.[13]

Who made the tablets?

Whether tablets were made by the same person who wrote on them was a major question in Sjöquist and Åström's (1985; 1991) studies of the palmprints left by the tablets' makers. At Pylos, their results were inconclusive due to the limited number of identifiable prints: only four makers were found to have certainly or probably left prints on more than one tablet, while a further six could be distinguished by a single print each (compare the *c.* 30–40 identified scribal hands at this site).[14] The complex relationship between these prints and the scribal hands will be discussed below in more detail, but it suggests that in some cases the tablet's maker and writer may have been the same person, while in others different individuals were responsible for each stage of the process; whether the makers in the latter cases were other scribes or assistants is not clear.[15] In this paper, I use 'tablet-maker' to refer to each tablet's creator, and 'writer' to refer to the person who inscribed the text, regardless of whether a particular tablet-maker was or was not also a writer (of that or any other text) or vice versa. Combining experimental production of tablets with autopsy of the originals and analysis of the correspondences between their manufacturing technique, format, contents, palmprints, and scribal attributions will produce a fuller understanding of the relationships between the making and writing stages of Linear B tablet production, whether these were the work of one person or two.

INVESTIGATING TABLET PRODUCTION

Experimental methodology

The experiments described here were carried out in the Fitch Laboratory at the British School at Athens using clay from the region of Elis, to the north of Messenia (the clay available in the Fitch's reference collection which was closest both geographically and geologically to the region around Pylos). Although as stated above it was not possible, nor was it intended, to replicate the original clays used, I used three clays to imitate some of the range of clay types found: a fine, silty clay (Fitch Laboratory reference KAVGS17/06), a coarse clay (KAVGS17/15), and a very coarse clay (KAVGS17/04). The process of experimentation was, of course, also a learning process for me, involving a fair amount of trial-and-error in order to find out, for instance, what consistency of clay made it easiest to produce tablets using a particular method – something that an experienced Mycenaean tablet-maker would no doubt have known instinctively through long practice. It is important to bear in mind, particularly in the following discussions of the degree

[13] See, e.g., Hallager 2017; Wilemon 2017; Wilemon, Galaty and Nakassis 2020; Hruby and Nakassis forthcoming; but cf. *LSP*, 82. Only one other Messenian site, Iklaina, has produced any Linear B documents. Since the single tablet from this site is dated much earlier than those from Pylos – probably no later than the early/mid-14th century BCE (early LH IIIA2) – it is not clear whether it is the product of an independent administration or of a second-order centre under Pylian control (Shelmerdine 2012a).

[14] The identification of Pylos scribal hands is currently the subject of debate: a series of new publications (*PTT*[2]; *PT*[3]; *ARN*; *LSP*) each makes various changes to the identifications of Palaima (1988); for details see Judson 2020a. Unless otherwise stated, I use the attribution system of *PTT*[2] (whose system is also used by *PT*[3], with only minor differences), as this is more compatible with earlier publications and therefore more user-friendly than that of *ARN*/*LSP*; significant differences in attribution between these various works will be discussed where relevant to my argument. '-' indicates that a tablet is unattributed.

[15] See Palaima 1985; Kyriakidis 1996–7, 203–5. At Knossos, comparisons of the palmprints and scribal hands similarly found a mixture of one-to-one correspondences, associations of multiple prints with a single hand, and vice versa; some prints were also identified as belonging to children and to adults who had carried out rough labour, suggested to be apprentices and assistants respectively (Sjöquist and Åström 1991; Kyriakidis 1998–9).

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to which different production methods may have required more or less care or effort, that the tablet-maker's training and experience are unreplicable aspects of their practices.

The initial experiments were carried out in parallel to the autopsy of the tablets in the National Archaeological Museum, so that each study could inform the other. One notable impact of the autopsy was that I observed no evidence for the claim that certain page-shaped tablets (**Es** 644 and **Jn** 605) were made by covering a coarse clay core with a layer of finer clay (Palaima 1988, 46, 59). On **Jn** 605 (Fig. 3), the appearance of a smooth layer of clay over a rougher layer on both the top and bottom edges is the result of the common practice of removing clay by cutting partway through the tablet (leaving a smooth surface, on which cut-marks are clearly visible) and then tearing it the rest of the way, leaving a rough surface; note that large inclusions can be seen in the smooth upper part as well as the rougher lower part. On **Es** 644, a similar effect is due to breakages along ruled lines, both at the bottom and various points in the middle of the tablet, producing the appearance of a finer upper layer. I therefore did not experiment with using a coarse core covered by a layer of finer clay.

Conversely, the most important impact of the experiments on the autopsy was – unfortunately – the observation that the traces left by creating rolled and folded tablets can be effectively indistinguishable: a folded tablet can appear identical to a rolled one if the seam on the verso has been entirely smoothed over and the ends have been pinched together or smoothed, and even the appearance of small seams on the ends does not necessarily indicate a folded tablet, since the ends of rolled tablets can be shaped in a similar way. Thus, although some tablets show clear signs of folding, many others are uncertain, and it is extremely difficult to be sure that a tablet has *not* been folded. In practice, therefore, it generally remains unclear how consistent any given series of tablets is in its method of manufacture.

Folded tablets

As stated above, although flattening out sheets of clay and then folding them up is often said to be the usual method of creating palm-leaf tablets, the simpler method of rolling out and flattening a cylinder of clay is also referred to; in his study of the Pylos tablets, Palaima (1988) only mentions folding in reference to a few groups of tablets (H1's **Aa** series, and the **Ma**, **Na**, and **Ta** series). Page-shaped tablets are also sometimes folded, probably by folding a flattened sheet in half, since when seams are visible this is along one or more edges rather than in the middle of the verso as on palm-leaves. The folding method evidently has more requirements than the rolling-and-flattening method, needing a means of flattening out a sheet of clay (in my case, a rolling pin; I imagine that a similar implement would have been the easiest way for a Mycenaean tablet-maker to create a flat sheet, but no evidence for this exists), and a large enough surface on which to do this; it also requires more time and effort in neatening the resulting tablet by smoothing over the seam where the sheet was joined. (In practice, tablets made in this way are

Fig. 3. **Jn** 605 *lat. inf.* Photo: National Archaeological Museum, Athens/ Department of Collections for Prehistoric, Egyptian, Cypriot and Near Eastern Antiquities. © Hellenic Ministry of Culture and Sports/ Organization of Cultural Resources Development (H.O.C.RE.D.).

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Fig. 4. **Ma** 123, *lat. sin.* and *verso*. The fold is clearly visible on the *lat. sin.* but there is only a trace of the seam at the left-hand end of the *verso*. Photos: National Archaeological Museum, Athens/ Department of Collections for Prehistoric, Egyptian, Cypriot and Near Eastern Antiquities. © Hellenic Ministry of Culture and Sports/ Organization of Cultural Resources Development (H.O.C.RE.D.).

much more often identifiable from the visible edges of the folded sheet than from the seam, which is normally completely or almost completely smoothed over: Fig. 4.) In addition, experimentation showed that creating a folded tablet is much more dependent on the clay type and consistency – it is easier to do with fairly wet fine clay than with drier and/or coarser clay, though even then the edges tend to crack while being folded, and clay that is too wet tends to stick to the surface beneath it or to the rolling pin. However, both coarse and fine clay can be easily rolled and flattened even while comparatively dry. Creating folded tablets therefore would have required more planning and work at all stages of the process, from clay preparation to neatening the finished tablet, not to mention cleaning up the wetter clay – so why was this method sometimes chosen by the tablet-makers?

In preliminary experiments, I observed that after partly drying, folded tablets were less prone to bending than rolled ones. To test whether this effect lasted after fully drying, and therefore whether folded tablets were ultimately sturdier than rolled ones, I created a series of folded and rolled tablets of fine clay (the former using relatively wet clay, the latter using both wetter and drier clay).[16] These were left to dry outside until they were too dry to inscribe properly, tested by writing signs on each tablet every hour until the resulting strokes were very shallow (as seen on actual tablets when additions have been made some time after the initial writing; outdoors in Athens in July this took five to six hours: Fig. 5).[17] Weighing each tablet every hour showed no difference in drying rate – all tablets lost similar proportions of their mass every hour – and by the end of this period there was no observable physical difference between the folded and rolled tablets, none of which were at all flexible. A repetition of this experiment in which I observed the tablets' flexibility – how much they naturally bent when held by the middle or (when dry enough that this did not happen) how much they could be deliberately bent without a risk of breaking – every hour showed that while initially the folded tablets were significantly less flexible than the rolled ones (Fig. 6), after one to two hours (depending on the clay's original consistency) all of the tablets were equally unable to be bent more than very slightly without cracking or breaking. Further experiments using the two coarser clays and with page-shaped tablets showed the same effect, although this was less pronounced for the very coarse clay (which produced less flexible tablets to begin with) and for page-shaped tablets (whose greater width relative to their length likewise made them less flexible even when wet).

Thus, the advantage of folding is a short-term one, increasing tablets' stability only during a relatively short period after their creation. This method therefore seems intended to produce tablets which can more easily be handled while still relatively wet, reducing the risk of them bending or breaking at this stage. Almost all of the series which were inscribed while the clay

[16] In general for each experiment I used approximately the same quantity of clay to make tablets of similar size and shape, but with some variation, as is seen in the actual tablets. These tablets' sizes, for instance, ranged between 19.5–21.1 cm x 3–3.9 cm x 1.2–1.7 cm.

[17] During these experiments, writing was done with a pointed metal tool, as I did not yet have access to a replica Mycenaean stylus (extant examples of which are made of bone, and have a flat blade with a curved end: see, e.g., Godart 1988, 248–50; 1994). A wooden replica of a Mycenaean stylus made for me by Philip Boyes was later used to write the replica tablets shown in my video at www.bsa.ac.uk/videos/how-to-make-a-linear-b-tablet. For a discussion of the impact on writing of using different shapes of styli, see Steele 2020.

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Fig. 5. The author writing on drying tablets to test their consistency. Photo: Emily Sherriff.

Fig. 6. Experimental tablets made of fine clay (left) and coarse clay (right) showing effects of holding by the middle while wet. Top: rolled; bottom: folded. Photos: author.

was still fairly wet contain at least some tablets with clear traces of being made by folding (cf. above on the difficulty of establishing how consistently this method was used),[18] so that in these cases the makers' intention could have been to facilitate the tablets' inscription, whether by themselves or other writers. The same is, however, true of many series inscribed – as appears to have been more usual – after the clay had partially dried, implying that the tablet-makers' concern may have been for the tablets to retain their shape until this point (for instance, if being moved to another position for drying). In this method of tablet-making, therefore, we may see interactions between multiple different stages of document creation: tablet-makers on some occasions chose a more complicated method, involving more steps and more care, in order to enable themselves and/or others to more easily handle the resulting tablet – whether during the rest of the manufacturing process or while inscribing the text.

[18] The **Aa**, **Ad**, **Es**, **Qa**, **Sa**, and **Sh** series were inscribed while still fairly wet (Palaima 1988, 46, 70, 79, 87, 91, 121; confirmed by my own autopsy). Of these, the **Sh** series was the only one in which I could not see clear traces of at least some tablets being folded (though several had traces which might be due to folding, and identification is particularly difficult in this series as several tablets have damaged ends and/or glue covering the *verso*).

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Straws/string

Evidence of the inclusion of a piece of straw or string,[19] usually running horizontally through the centre of the tablet and identified by the holes left at its exit points[20] and/or the channel left through the tablet (Fig. 7), is found in five main series. These are listed below along with the proportion of each series which, based on autopsy, originally contained a straw/string:[21]

Sh series (H5), palm-leaf records of suits of armour, found in the Archives Complex: 100 per cent (12/12).

Eb series (H41), palm-leaf first-stage landholding records, found in the Archives Complex: 97 per cent (61/63).[22]

Sa series (H26), palm-leaf records of chariot wheels, found in the Archives Complex and North-Eastern Building: 94 per cent (33/35).[23]

Eo series (H41), palm-leaf and page-shaped first-stage landholding records, found in the Archives Complex: 77–85 per cent (10–11/13).[24]

Ad series (H23), palm-leaf personnel records of groups of men and boys (described by their relationship to the women workers recorded in the **Aa** series by H1 and H4)[25] at various locations in Pylos' territory, found in the Archives Complex: 14–16 per cent (5–6/37).[26]

In addition, straw/string holes appear in a small number of other tablets, including two of H21's **Cc** series (**Cc** 1283 and 1285, sheep records from the North-Eastern Building; it is not clear what administrative relationship, if any, these have to the rest of the **Cc** series, which lack this feature);[27] two **Va** series tablets attributed (tentatively) to H42 (**Va** 404 and 482, ivory-working records from the Archives Complex; there is no clear relationship to the other **Va** series records tentatively attributed to this hand);[28] and a small number of isolated, unattributed tablets.[29]

The inclusion of these straws/strings has been suggested to have a variety of purposes: giving the tablet greater stability (Godart 1988, 248–50; 1994;[30] Palaima 1988, 27; 2011, 105–6;[31] Del Freo 2019, 172–3); allowing the tablet to be lifted while still wet without distorting its shape or smudging the inscription (Palaima 1996b, 104–5; 2011, 105); preventing the loss of any pieces broken off in handling or transportation (Bennett 1996, 28–9; Palaima 1996a, 382 n. 10; J.-P.

[19] These are variously referred to as straws, strings, cords, etc. In some cases, during autopsy I observed horizontal striations along the channel, implying a ridged stalk like a straw (e.g. **Eb** 364; **Sa** 1267; **Sh** 743); in the **Eo** series, the channels often curve through the tablet, implying a more flexible string. The remains of fibres are also occasionally visible inside the holes (e.g. **Sh** 734, 736?, 739; **Ad** 668?). However, as in most cases I could not identify the material used, I refer throughout to 'straws/strings'. See Palaima 1988, 121; *PT*^{3}, xxxix.

[20] Most often at both ends of the tablet, occasionally at only one.

[21] Cf. Palaima 1988, 87, 91, 98, 121 (though note that the presence of holes is not always consistently noted).

[22] Holes observed on all but **Eb** 886 (damaged) and 976 (fragmentary).

[23] Holes observed on all but **Sa** 1313 (from the North-Eastern Building; complete enough that this feature should be visible if present) and 1561 (fragmentary).

[24] Holes observed on all but **Eo** 160 (page-shaped) and 351 (palm-leaf); 444 (page-shaped) was not certain due to its state of preservation. See further below.

[25] On the relationship between these two series, as well as H21's **Ab** series recording the women's rations, see Chadwick 1988, and below.

[26] Holes observed only on **Ad** 664, 668, 679, 683, and 921, and perhaps 357 (the apparent hole on one end may be due to a straw/string or to folding).

[27] **Cc** 660 and 664, records of goats and of sheep and pigs, from the Archives Complex; **Cc** 1258 and 1284, goat records from the North-Eastern Building.

[28] Only 482 is universally attributed to H42; **Va** 1323 and 1324, records of weapons from the North-Eastern Building, are attributed to H42, and 404 to H42?, only by *LSP*/*PT*^{3}.

[29] These include the palm-leaf tablets **Ua** 407 and **Xa** 1558, and the page-shaped tablets **Un** 1482 and **Xn** 1466.

[30] *Pace* Godart, however, they are certainly not essential to create viable tablets (cf. Driessen 2000, 40).

[31] Palaima (1988, 27) also suggests that they may have 'facilitated the manufacture of the tablets'; it is unclear to me how incorporating the additional element of a straw/string would do this.

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Fig. 7. **Eb** 149 *lat. dex.*, with straw/string hole (left); **Sh** 740 *recto*, with partially exposed straw/string channel (right). Photos: National Archaeological Museum, Athens/ Department of Collections for Prehistoric, Egyptian, Cypriot and Near Eastern Antiquities. © Hellenic Ministry of Culture and Sports/ Organization of Cultural Resources Development (H.O.C.RE.D.).

Olivier in Palaima 1996b, 105); or attaching sealings to tablets for authentication (E.L. Bennett in Palaima 1994, 334–5; Palaima 1996b; Flouda 2010, 65–6; Younger 2010, 334; Panagiotopoulos 2014, 190–1, 252–4). The last of these hypotheses is not, in my opinion, a plausible one: sealing as an authentication practice seems to have been required only at the administrative stage represented by the sealings – extremely short documents likely to have been written in multiple locations and sent to or from the palace along with the goods they registered – whereas the act of writing a palm-leaf or page-shaped tablet, whether this took place in or away from the palace (as discussed above), seems to have constituted all the authentication required. Otherwise, we would expect far more examples of tablets which could potentially have had sealings attached to them – or, indeed, the impression of seals directly onto the tablets themselves, as was frequently done on Ancient Near Eastern cuneiform documents.[32] Palaima (1996b) argued that the particular tablet series which show this feature at Pylos could have required special authentication, but also (since relatively few sealings have been found within the Archives Complex, where these series of tablets were all stored and where other records important enough to require authentication of this type would be most likely to have been kept)[33] that the individuals concerned in the records would have retained these sealings as 'receipts'. However, if the sealings were not to be retained with the tablets, there would be no need for them to be attached in this way, and Palaima's (2011, 105–6) own more recent summary of tablet manufacturing processes favours different suggestions (listed above).[34] The experiments therefore focused on the hypotheses that straws/strings provided extra stability, a means of moving the wet tablet, and/or a protection against the loss of broken fragments.

[32] For an overview of this practice in the Near East, see 'Use of seals', *cdliwiki: Educational Pages of the Cuneiform Digital Library Initiative*, last modified 20th August 2015 (available online <https://cdli.ox.ac.uk/wiki/doku.php?id=use_of_seals> accessed 19th September 2022); for details of the periods in which this practice is attested, see 'Diachronic overview of the use of seals in the ANE', *cdliwiki: Educational Pages of the Cuneiform Digital Library Initiative*, last modified 16th October 2015 (available online <https://cdli.ox.ac.uk/wiki/doku.php?id=seals_diachronic> accessed 19th September 2022).

[33] Between 8 and 13 'hanging nodules' (sealings attached to an object with a string) were found in the Archives Complex, of which only one (**Wr** 1457) is inscribed (two more, **Wp** 1415 and **Wr** 1416, found in the South-Western Area, may have been displaced from the Archives Complex: Shelmerdine 1998–9, 309 n. 4), while 35–56 (12 inscribed) hanging nodules were found in the North-Eastern Building and 35–42 (four inscribed) in the Wine Magazine (Shelmerdine 2012b, 399–402, table 2; Panagiotopoulos 2014, 296–302). The concentration of this type of sealing in two outer buildings used for the receipt and recording of goods, and the fact that many are found deliberately broken and discarded in doorways, supports the view that they were used to authenticate the movement of goods to the palace, rather than at later stages of the administrative process (see Flouda 2000; Shelmerdine 2012b; Panagiotopoulos 2014, 189–210).

[34] Panagiotopoulos (2014, 59–60, 190–1, 253–4) points out that one hanging nodule in the Archives Complex – which was, unusually, not broken, implying it may still have been an 'active' document at the time of the destruction – was found in close proximity to a tablet with a straw/string-hole (**Eb** 169; sealing 38A), while **Eb** 1176 and sealing 30 (also unbroken) were both found in the Propylon. However, the latter, at least, have certainly been displaced from their original locations within the Archives Complex, and the other tablets cited as being found close to unbroken sealings do not have straw/string holes. Panagiotopoulos' (2014, 253–4) alternative suggestion that straws/strings were used to attach tablets such as the **Sa** and **Sh** series to the objects they referred to is contradicted by the evidence for the latter being transported in a basket to the Archives Complex while still very wet (see 'Where were tablets made?', above).

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Fig. 8. Experimental tablets showing effects of holding by the middle while wet. From top to bottom: rolled, without straw; rolled, with straw; folded, without straw; folded, with straw. Photo: author.

The experiments described above already demonstrated that the effect of folding was to give the tablet greater stability in the initial stages of drying. Subsequently, I tested the effect on this of incorporating a straw/string,[35] by creating rolled and folded tablets of fine and coarse clays with and without straws. Although incorporating the straw made a slight difference, folding made a much larger one – the unfolded tablets with straws were still very prone to bending (the thickness of both the straw and of the tablet also had some effect on this), while the folded tablets with straws, although the most stable option, were only slightly more so than the folded ones without straws (Fig. 8).

Tablets made with a straw/string frequently have visible channels near one or both ends of the *recto* or *verso*,[36] sometimes even cutting through the beginning or end of the text,[37] while in the **Sa** and **Sh** series, whose clay was especially wet while inscribing, the edges of the straw/string holes are also sometimes distorted (e.g. **Sa** 487, 682, 794; **Sh** 739). Both of these features initially implied to me during autopsy that the straw/string had been partly pulled up out of the clay, as also happened in experiments if using the straw/string to lift a tablet that was wet enough to stick to the surface underneath, or if the straw/string was very near the surface of the tablet. However, experiments showed that trying to lift a sticking tablet in this way tended to result in a much longer portion of the straw/string being pulled out of the clay, significantly damaging the tablet; in addition,

[35] The straws used in my experiments were stalks of einkorn wheat (*Triticum monoccocum*), of varying thicknesses (where using a thicker or thinner straw had a significant impact on results, this is noted); the string was commercially available twisted string.

[36] **Ad** 683; **Eb** 169, 321, 339, 347, 369, 416, 473, 477, 495, 498, 566, 818, 846?, 871, 874, 890, 893, 895, 905, 915, 985, 993, 1176, 1440; **Eo** 211, 268, 269, 471; **Sa** 751, 755, 758, 760, 763, 766, 768, 787, 843, 1265, 1266, 1267; **Sh** 735, 739, 743, 744; Va 482.

[37] **Eb** 566, 893, 993; **Eo** 211, 268, 269; **Sa** 751, 755, 760, 763, 766, 768, 787, 1267; **Sh** 743.

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many tablets were clearly handled while the clay was wet, as shown by the presence of finger-marks on the top and bottom edges (e.g. **Sa** 753, 758, 766, 769, 790, 791, 834; **Sh** 743, 744). I therefore think it more likely that these channels were the result either of the tablet being formed in such a way that the straw/string exited the clay slightly before the end of the tablet, or (where the channel cuts through the text) of later accidents – the straw/string catching on something during handling or transportation, or the loss of the thin layer of clay above a straw/string running close to the tablet's surface after drying (as happened in one experimental case – see below).[38]

Experiments in using straws/strings to lift tablets for a few seconds, in order to simulate a use such as transferring the wet tablet to another location to dry, produced mixed results. The end of the first trial example cracked and broke off completely after drying; further experiments demonstrated that it was possible to avoid this result, but that this was very variable and related to a variety of factors. In a second experiment, a tablet whose clay had been rolled around a straw cracked while one that had been folded did not; in a third, none of the range of tablets of various thicknesses (1–2.1 cm) made of relatively dry clay cracked or broke, but a single tablet made with much wetter clay (of medium thickness: 1.5 cm) developed a large crack near the middle. Finally, a series of tablets were made to test more systematically the impact of the consistency of the clay and of folding the clay around the straw/string or rolling it, as well as whether lifting by only one end of the straw/string, rather than both, could prevent breakage. In this case nearly all of the tablets (rolled or folded; containing straw or string; made of drier or wetter clay or fine or coarse clay; carried by one end or both ends of the straw/string) remained undamaged, while a single tablet (made of drier clay, folded, and carried by one end) cracked slightly. Thus, although damage to tablets from this use was not inevitable, it is certainly unreliable and carries the risk of greater damage than would be caused simply by handling the clay itself – as the finger-marks mentioned above imply frequently happened. There is also no correlation between the consistency of the clay while inscribing and the presence of straws/strings: the **Sa** and **Sh** series were inscribed while the clay was still relatively wet, but so were the **Ad** series (with only a minority containing straws/strings) and the **Aa**, **Es**, and **Qa** series (with no straws/strings); conversely, the **Eb** and **Eo** series were not particularly wet when inscribed (cf. Palaima 1988, 70, 87, 91, 98–9, 121).

Finally, to test the ability of straws/strings to prevent the loss of broken fragments, eight tablets were created (of fine and coarse clay, rolled and folded around straws and strings), left to dry, and then transported from Athens to the UK and back in hand luggage.[39] Two were deliberately broken in the lab, a third broke before leaving when accidentally dropped, and two further tablets broke in transit. On returning to Athens, three of the broken tablets – including one which had broken into five pieces – were still held together by their straws/strings (Fig. 9:1–3), one had lost a fragment from the end where the string had been pulled out of the tablet before drying (Fig. 9:5), and only one had lost a piece that had contained the string (Fig. 9:4): as the string had been very close to the tablet's edge, damage to the surface resulted in the string coming loose (or, alternatively, the surface was broken by tension on the string).[40] While not a fool-proof method, then, using a straw/string would have significantly lessened the risk of losing fragments from any tablets which broke during transportation – whether they were being transported from another part of the palace to the Archives Complex, or to Pylos from another location within the Pylian territory.

These experiments suggest that the most likely purpose(s) of the straws/string were to increase the tablets' stability (in combination with folding) and/or to keep fragments together in case of breakage during short- and/or long-distance transportation. Unfortunately, the series with straw/string holes show no particular patterns in terms of findspot or subject-matter to suggest that

[38] Cf. cases where the channel is exposed in the middle of the tablet due to clay loss (e.g. **Cc** 1285 *verso*; **Eo** 224.2, 278 *lat. inf.*, 371.B; **Sa** 403, 483, 1267; **Sh** 740: Fig. 7) or where a crack has developed in the clay on top of the channel (e.g. **Sh** 737, 740, 741; **Eb** 818 *verso*).

[39] Cf. Hallager's (2017) similar experiment, though this did not incorporate straws/strings and was intended to test the ability of tablets to survive transportation *without* breaking.

[40] Several weeks later, on taking the tablets to the lab to recycle them, I noticed that the two straws in the broken tablets had snapped, perhaps because by this point they had more completely dried out in the increasingly hot weather – another factor which tablet-makers might have needed to take into account.

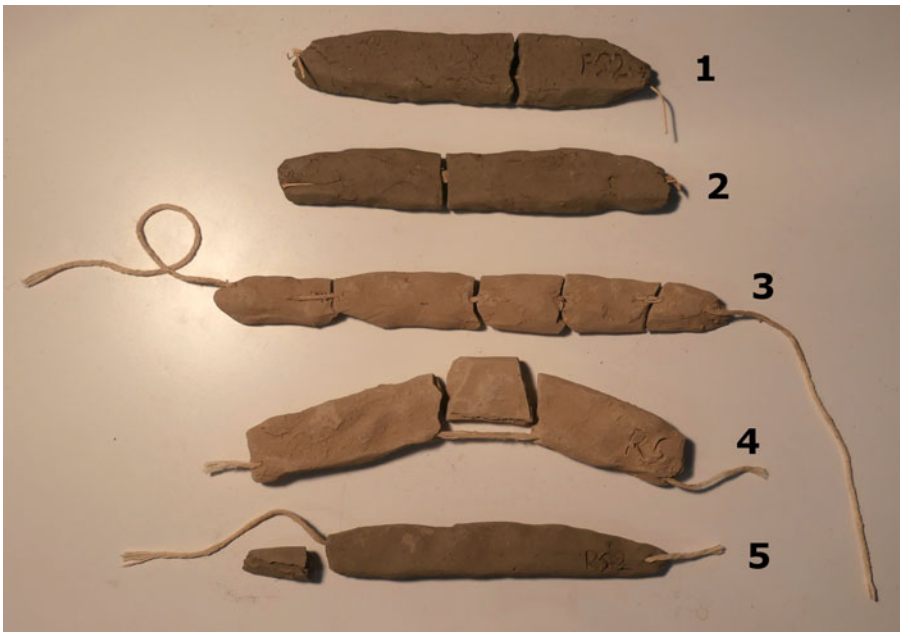

Fig. 9. Broken tablets containing straws/strings on their return to Athens. Photo: author.

they are more likely than others to have been transported either to or within the palace. As said above, the **Sa** and **Sh** series may well both have been transferred to the Archives Complex from the North-Eastern Building; however, of the tablets actually found in the North-Eastern Building only two of H21's four **Cc** series tablets have straw/string holes.[41] Of the series containing (some) straw/string holes, only the **Ad**, **Eb** and **Eo** series explicitly record activities taking place in locations outside of the palace.[42] In the **Ad** series, which records work-groups located in both the 'Hither Province' (southern and western Messenia, including Pylos itself) and the 'Further Province' (the area to the east of the Aigaleon mountain range),[43] there is no correlation between the presence or absence of straw/string holes and the location referred to.[44] Moreover, neither H1's **Aa** series tablets, which list the related work-groups of women and children in the Hither Province records, nor H4's, which list the same for the Further Province, contained straws/strings (H21's **Ab** series, which also lacks this feature, contains records of rations only for the Hither Province work-groups). The **Eb** and **Eo** series refer to landholdings at a place called *pa-ki-ja-ne* (perhaps /Sp^{h}agianes/), the site of a religious sanctuary near the palace, but whether they were written on a 'site visit'[45] or based on information conveyed orally or on other written materials from that location remains unknown. H43's **Ea** series of palm-leaf tablets, which record similar (though less detailed) landholding information about another, unknown, location (Lejeune 1997), are made without straws/strings; it is possible that this reflects a difference in writing location, but there is no other positive evidence for this. The

[41] As noted above, the North-Eastern Building's single **Sa** series tablet and two **Va** series tablets attributed (tentatively) to H42 all lack straw/string holes, in contrast to the other members of each series found in the Archives Complex.

[42] The **Sa** and **Sh** series and **Va** 404 and 482 presumably refer to items and activities in or around the palace, since they contain no indications of their location. **Cc** 1283 is fragmentary; while **Cc** 1285 refers to sheep going *ma-se-de* 'to *ma-se*', their original location is not specified.

[43] For a summary of Pylian geography, see Bennet 2011, 151–5.

[44] Twenty-four **Ad** series tablets refer to locations in the Hither Province, of which 679, 684 and perhaps 357 had straws/strings; 12 tablets refer to Further Province sites, of which 664, 668 and 921 had straws/strings. See Chadwick 1988, 47–59.

[45] As recorded on **Eq** 213, which refers to the official Alksoitas – possibly to be identified as the scribe H1 – travelling to collect landholding information (Kyriakidis 1996–7, 220–4; Bennet 2001, 31).

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hypothesis that an administrative reason (such as the need to transport these preliminary documents from the location of their writing) underlies the use of straws/strings, rather than a purely physical reason relating to tablet manufacture, is supported by the lack of a relationship between the distribution of straws/strings and tablet shape/size in the series in which these are used inconsistently (the **Ad** and **Eo** series).[46] It is similarly supported by the fact that, in the only series to contain straws/strings in page-shaped tablets (the **Eo** series), these are functionally identical to the palm-leaves as first-stage administrative documents.[47] However, the lack of a definite correlation between tablets' likely movements and the presence or absence of straws/strings, along with the probability that more than just these fairly restricted groups of tablets were moved around, make it most likely that incorporating straws/strings was an option for tablet-makers to consider, not a requirement when making tablets that would be moved around within, and perhaps to, the palace.

Tablet shape and finishing

Palm-leaf tablets characteristically have a tapering shape, with one or both ends narrower than the middle in width and/or height, the latter meaning that the ends of the *verso* frequently curve up (Fig. 10). My experiments showed that this shape naturally occurs when a cylinder of clay is flattened with both hands positioned near the ends, or when a sheet of clay is flattened using a rolling pin before folding up, since in both cases more pressure is put on the edges than the middle. Of course, the exact shape could be adjusted both in the course of rolling/flattening (by shifting hand position or altering the amount of pressure) and once the basic tablet had been formed, by either drawing out or blunting one or both ends (cf. Palaima 1985, 103).

During an autopsy session, Evangelia Kiriatzi observed that the tablets' surfaces and top and bottom edges had been not merely flattened, but smoothed in a way that resembled the burnishing of pottery, as already remarked on by Greco and Flouda (2017, 149–51) based on their studies of tablets from Knossos. In line with the results of Greco and Flouda's experiments, I found that this effect could be achieved using the rounded edge of a wooden clay-shaping tool: wetting the tool made it easy to draw it across the clay surface, producing a smooth finish on the writing surface and edges. The various shapes of smoothed tablet edges – which can be either rounded or flattened, with rounded or slanted edges – could easily be produced by altering the angle and pressure of the tool. Note that this smoothing can produce an appearance very similar to that of an erasure (since it is, effectively, the same process); it is therefore possible that at least some of the tablets identified as palimpsests due to showing 'erasure' marks, but which do not preserve any identifiable traces of previously written text, may in fact be showing traces of this smoothing process.

Page-shaped tablets, whether simply flattened or folded, require shaping to form a rectangular tablet rather than one with the curved edges that are naturally produced by flattening a lump of clay. From autopsy observations, page-shaped tablets' edges were frequently either folded over onto the *verso* (cf. Bennett 1996, 29) and/or flattened, often sloping onto the *verso* with a raised area of clay behind them (Fig. 11). Although the page-shaped tablets are often cut on one or two sides to trim off unused clay, like the palm-leaves, and occasionally larger tablets are cut to create two smaller

[46] The **Ad** series' length ranges from 16.8–27.3 cm; all the tablets with string/straw holes (see n. 26) are in the upper half of this range (22.3–27.3 cm), but so are many without holes (e.g. **Ad** 326, 26.2 cm long). In the **Eo** series, in addition to there being both page-shaped and palm-leaf tablets with and without strings (see n. 24), there is no clear correlation with size in either category. The one page-shaped tablet which certainly lacks a hole, **Eo** 160, is the shortest and narrowest of this format (17.7 x 5.1 cm) – the others are 18.5–21 cm long (excluding broken tablets) and 6.6–8.6 cm wide – but the one palm-leaf tablet without a string, **Eo** 351, is the widest of the palm-leaves at 3.9 cm (the others are 2.9–3.5 cm wide; as almost all the palm-leaves are broken the lengths cannot be compared).

[47] Compare, for instance, **Eo** 351 – a palm-leaf tablet recording the amount of land held by *a-da-ma-o* and a single lease of part of this land – with the structurally identical, but longer, page-shaped text **Eo** 247, recording the amount of land held by a_3*-ti-jo-qo* and six leases of this land.

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Fig. 10. **Ad** 683 *recto* and *lat. inf.* Note the tapering right-hand end and the curvature of the *verso* at both ends. Photos: National Archaeological Museum, Athens/ Department of Collections for Prehistoric, Egyptian, Cypriot and Near Eastern Antiquities. © Hellenic Ministry of Culture and Sports/ Organization of Cultural Resources Development (H.O.C.RE.D.).

Fig. 11. **Jn** 415 *verso* showing folds and ridges of clay along the bottom edge and sides (the top has been cut). Photo: National Archaeological Museum, Athens/ Department of Collections for Prehistoric, Egyptian, Cypriot and Near Eastern Antiquities. © Hellenic Ministry of Culture and Sports/ Organization of Cultural Resources Development (H.O.C.RE.D.).

ones,[48] they are never cut on all four sides to the desired shape.[49] In experiments I found that the flattened and sloping edges could be produced by squashing the tablet's edge with a flat surface; using a hand-held object such as the side of the rolling pin or a plastic block allowed the angle and pressure to be more easily adjusted than when pressing the clay against the surface it was sitting on. Pressing this object down on the edge of the clay at an angle produced the characteristic straight edge sloping towards the *verso*, with a ridge of clay pushed up behind it. Both of these methods served to produce rectangular tablets with neater, straighter edges, which could then be further neatened by smoothing the edges and *recto* as described above.

This experimental investigation has thus shed new light not only on the processes involved in creating tablets, but also on the decision-making of the tablet-makers in choosing between those processes, and the ways in which this relates to the next stages of document production and use. In the final section of this paper I shall investigate this last issue further by using a series of case-studies to explore the relationship between the tablets' makers and writers.

TABLET-MAKERS AND TABLET-WRITERS

No clear connection can be seen between a tablets' format and/or production method and the identity of their makers, where this is known. As mentioned above, Sjöquist and Åström (1985, 47–56 and table 1) were able to identify prints (probably) belonging to the same maker on more than one tablet in only four cases:

'Dokimastikos': **Qa** 1292, 1294, and 1311 (all H15).

'Energetikos': at least one **Ab** series tablet (H21),[50] at least five **Ea** series tablets (H43),[51] at least three **Eb** series tablets (H41),[52] and perhaps **Eo** 268 (H41).

'Mikros': **Ea** 801 and 823 (H43), perhaps also **Ea** 305 (H43) and **Aa** 94 (H4).

'Anon I(?)': perhaps **Ea** 922 (H43) and **Eb** 477 (H41).[53]

We thus have one instance of the same maker's prints being found on multiple tablets inscribed exclusively by a single writer – 'Dokimastikos' in H15's **Qa** series – where the simplest assumption is therefore that these may be the same person; unfortunately there are no identifiable prints on the three **Qa** series tablets inscribed by a different writer, H33.[54] All tablets within this series are similar in format and probably also in production process (they are relatively small and thin palm-leaf tablets, with flat rather than curved *versos*; at least some of both the H15 and H33 tablets have been made by folding). It is not possible to say whether this is because 'Dokimastikos' made all of the tablets regardless of their eventual writer, but looking at the instances of prints being found in multiple series by different writers implies that this assumption is not necessary. No significant differences are visible between the **Ea** series tablets made by 'Energetikos', 'Mikros', or 'Anon I(?)', or the **Eb** series of 'Energetikos' and 'Anon I(?)'; nor do tablets from different series showing prints of these makers appear more similar to each

[48] E.g. **Jn** 389 and 415 (H2) are two halves of a large tablet cut before writing, as observed by Melena (1992–3, 82 n. 8), and confirmed by my own autopsy (*pace ARN q.vv.*).

[49] **Ep** 212, 539, and 705 (H1) are, unusually, cut on three sides after writing.

[50] **Ab** 558; a further five possible **Ab** series examples.

[51] **Ea** 421, 803, 811, 817, 825; a further eight possible **Ea** series examples.

[52] **Eb** 149, 842, 1188; a further 10 possible **Eb** series examples.

[53] Prints distinct from the above but identified on only one tablet each: 'Anon II': **Fr** 1205 (H2), 'Anon III': **Fr** 1229 (-), 'Anon IV': **An** 1281 (H12), 'Anon V': **Fr** 1217 (H18), 'Anon VI:' **Va** 1323 (H42?: see n. 28), 'Anon VII': **Ad** 318 (H23).

[54] Note that *LSP* merges H15 with H14 and H33 with H23 (*PT*[3] also follows the latter), but following this, two different writers would still be responsible for the **Qa** series.

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other than to other members of the same series.[55] The **Eb** series, for instance, consistently contained straws/strings, and although the 'Anon I(?)' tablet has a more blunted left-hand end than those attributed to 'Energetikos' (which, when not broken, are either rounded or left without neatening), this is a feature which varies considerably both in general and within this series. As far as can be seen, then, variation in tablet format/manufacture does not relate to individual preferences of the tablets' makers.

Of the writers of tablets with straws/strings, H5 (**Sh** series), H23 (**Ad** series), and H26 (**Sa** series) are not known to have written any other tablets,[56] but H21, H41 and H42 have all written palm-leaf tablets made both with and without this feature.[57] As already discussed, it is harder to be certain how consistently tablets have been rolled or folded, but comparing tablets' size and shape is more straightforward, and again there is no evidence for any preference by writers beyond the needs of the individual texts. For instance, as a fairly crude measure of this, H1's complete palm-leaf tablets range in surface area from 9.9 cm^2 (**Na** 530) to 68.4 cm^2 (**Ed** 236), and page-shaped tablets from 27.7 cm^2 (**An** 199) to 412.8 cm^2 (**En** 74); note the considerable overlap in size between the largest palm-leaves and smallest page-shaped tablets, as well as variation in other aspects of formatting such as the orientation of page-shaped tablets (e.g. the **En** and **Ep** landholding series contain both vertical and horizontal tablets). Thus, there is also no clear connection between writer and tablet format or manufacturing method: we are not dealing with consistent preferences on the part of writers any more than that of makers (remembering again that these may often have been the same person).

In fact, even within broad groups of tablets relating to similar topics and written by a single person there is considerable variation. The **Fr** series, for instance, consists of records of small amounts of olive oil being issued, mostly for religious purposes (to deities or sanctuaries), written by at least six people (H2, H4, H17, H18, H19, H41). Although the texts display a very similar structure – brief descriptions of the type of oil and recipient (e.g. 'In the territory of Lousos: to the gods: sage-scented: *c.* 5 litres of olive oil' [**Fr** 1226, H2]) – their format varies widely. The writer responsible for the largest number of these texts, H2, has used both one- and two-line palm-leaves, the latter of which may contain one or two entries, of very different sizes (length 8.9–21.5 cm, width 1.9–3.3 cm, thickness 0.9–1.6 cm) to write distribution records, in addition to one small page-shaped tablet for the single record relating to perfume production (**Fr** 1184). Other writers have mostly also used palm-leaves, but again these vary considerably in size and shape (e.g. H4: tapering; H17: narrow rectangular; H19: rounded, one- and two-line); H18 has the widest variation in this respect (Fig. 12), with tablets including a palm-leaf with a two-line single entry (**Fr** 1225), a small horizontal page-shaped tablet (**Fr** 1218), and a rounded three-line tablet which in shape resembles an enlarged palm-leaf but is formatted like a horizontal page-shaped tablet (**Fr** 1217).[58] The findspots of these tablets, almost all of which were found in the palace's oil storerooms (Rooms 23, 32, and above Room 38),[59] suggest that they were created and written on the spot (or in some cases selected from existing tablets which could be re-used)[60] whenever an issue of oil had to be made: this variation in size, shape and

[55] For photographs of tablets not illustrated in this article, see *ARN* or Judson, Meißner and Thompson 2016.

[56] Unless *LSP*/*PT*^{3}'s merger of H23 with H33 (**Qa** 1289, 1300, 1305) and additions of **Fa** 16 (otherwise H42), **Fa** 1195 (-), and **Ua** 434 (H42) are followed.

[57] Tablets without straws/strings: H21: **Ab** series, some **Cc** series (as listed above), **Fg** 368 (and **Fr** 374?, H21(?) in *LSP*/*PT*^{3} only). H41: **Ed** 411 (.1 and probably [[.2]] by this hand), **Fr** 1207. H42: **Ae** series, **Fa** 16? (see n. 56), **Ja** 1288? (H42 in *LSP*/*PT*^{3} only), **Ua** series, **Va** 1323 and 1324 (see n. 28).

[58] **Fr** 1240 and 1242 are broken, but the former resembles 1217 while the latter appears to be a single-entry palm-leaf. **Fr** 1223, a two-line two-entry palm-leaf, is also attributed to this hand by *LSP*/*PT*^{3}.

[59] Exceptions: **Fr** 1184 (H2), Archives Complex (a perfume-manufacture record); **Fr** 1251 (H2) in Court 63 (dropped between the oil storerooms and the Archives Complex?: Palaima 1988, 169); **Fr** 1338 (H19/34?, *LSP*/*PT*^{3}; - in others) and 1355 (H30, *PT*^{3}; - in others), near Room 103; **Fr** 1255 (H30, *PT*^{3}; - in others), Rooms 71–2.

[60] Many of the **Fr** series tablets are identified in all recent editions as possible palimpsests, including several on which one of the two lines has been left blank (**Fr** 1216, 1219, 1226, 1232, 1236). **Fr** 1218, however, which has two inscribed and four blank lines, is not identified as such. Such partial uses of a tablet's writing space might be due to circumstances changing in the course of its inscription as much as to selection of an overly large existing tablet.

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Fig. 12. H18's **Fr** series tablets. From top to bottom: **Fr** 1225, 1218, 1217. Photos: National Archaeological Museum, Athens/ Department of Collections for Prehistoric, Egyptian, Cypriot and Near Eastern Antiquities. © Hellenic Ministry of Culture and Sports/ Organization of Cultural Resources Development (H.O.C.RE.D.).

format therefore represents the results of a series of separate decisions made by the tablets' makers and/or writers to fulfil the recording needs of each separate transaction.

Where some level of consistency can be seen is within groups of tablets that are not just on the same topic but are closely related in administrative terms – ones that were clearly written as components of a single administrative action and, arguably, collectively form a single 'file' of information; this applies to some tablet series and in other cases to sub-groups of series known as 'sets'. The creation of tablets to specific sizes and formats for specific (sets of) texts, as mentioned above, has frequently been pointed out, and it is often stressed that many tablets appear carefully designed in size and shape for the needs of their particular text, implying at the very least a close collaboration between maker and writer, if not a shared identity (e.g. Palaima 1985, 101; 2011, 84–5; Del Freo 2019, 173; *LSP*, 15). An examination of the Pylos personnel tablets shows, however, that the details of tablet design can go beyond the demands of the particular text and speak to the individual preferences or choices of the tablets' maker and/or writer.

We have already seen that the **Aa**, **Ab** and **Ad** series, while representing separate administrative recording actions, are closely linked by their references to the same or related groups of workers:

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work-groups of women and children in Pylos and the Hither Province, designated by their occupation or place of origin, are recorded by H1's **Aa** series and by H21's **Ab** series, which also records their monthly rations (as the numbers differ slightly these two series were presumably not written at the same time); similar work-groups in the Further Province are recorded by H4's **Aa** series, without corresponding ration records; and H23's **Ad** series records men and boys in both provinces who are related to the women of the **Aa** and **Ab** series. The following example of three related Hither Province texts, plus one Further Province **Aa** series text, shows their similarity in structure and content:

'21 Knidian women, 12 girls, 10 boys, one male supervisor(?), one female supervisor(?)'[61] (**Aa** 792, H1, Hither Province)

'At Pylos: 20 Knidian women, 10 girls, 10 boys: 640 l. figs, 640 l. grain; female supervisor(?), male supervisor(?)' (**Ab** 189, H21, Hither Province)

'At Pylos: sons of Knidian women: five men, four boys' (**Ad** 683, H23, Hither Province)

'textile decorators: 12 women, 16 girls, eight boys, one male supervisor(?), one female supervisor(?)' (**Aa** 85, H4, Further Province)[62]

The textual variations which occur do so for both administrative reasons (the **Ab** series contains additional ration information; the **Ad** series work-groups do not include supervisors) and due to writers' differing choices about how to present the information; the latter are comparatively minor (H1 does not specify the workers' location when they are at Pylos, unlike H21 and H23; H1 and H4 include numerals for the supervisors while H21 does not). However, in format they are entirely different (Fig. 13) – even H1's and H4's **Aa** series tablets are strikingly dissimilar, with H4 using extremely long tablets (mean length 23 cm, mean height 2.5 cm), while H1's are much shorter and wider (mean length 14.6 cm, mean height 2.8 cm; in both cases, at least some of the tablets have been folded). That these differences reflect preferences of the writers rather than the tablet-makers (or, if those are the same people, preferences based on writing practices rather than on the process of tablet production) is shown by the way they correspond to differences in the writing of the text – H4's signs are written much larger and are more spaced-out than H1's – as well as the fact that nearly all of H1's tablets are cut after writing to remove excess clay; this writer therefore had extra space they chose not to fill. Meanwhile, the **Ab** series (at least some of which, again, were folded) falls mid-way between the two **Aa** sets in terms of length (mean 17.4 cm), despite having more content to include (the details of rations); H21 chose to do this by ruling a short line at the right-hand end of each tablet to create a two-line space to record the rations (and supervisors), a peculiarity of this series which makes what is presumably the most important part of these records stand out clearly (an effect generally achieved by other writers through spacing out the ideograms and numerals, e.g. frequently in both H1's and H4's **Aa** series). As discussed above, the **Ad** series is the only one to include straws/strings (intermittently, and with no clear pattern relating to content or size); these tablets are nearly as long as H4's **Aa** series (mean length 21.7 cm) and even taller than H1's (mean height 3.3 cm).[63] This group of related texts therefore suggests a highly individual, even idiosyncratic set of preferences for tablet manufacture and formatting on the parts of their makers and/or writers.

[61] On the interpretation of the abbreviations *DA* and *TA* as standing for male and female supervisors, see Chadwick 1988, 71–3 (with further references).

[62] The corresponding **Ad** 290 shows that these women are located in the Further Province site of Leuktron.

[63] **Ad** 684 is often said to have originally been made for H4's **Aa** series on the basis of its size and shape (Palaima 1988, 87, 89; *ARN q.v.*; *PT*^{3}, xxxv). Presumably this refers to 684's height (2.3 cm), which is shorter than any of the other **Ad** series (2.6–4.4 cm) but only just outside the range of H4's **Aa** series (2.4–2.7 cm); in length (19.4 cm) and thickness (1.4 cm), 684 falls within or very close to the ranges of both series (**Ad**: length 16.8–27.3 cm, thickness 1.0–2.9 cm; H4 **Aa**: length 21.2–24.5 cm, thickness 1.3–1.8 cm [note that these measurements exclude **Aa** 96, whose attribution to H1 or H4 is debated]). However, the **Ad** series shows a very wide variation in all three dimensions, as well as in shape, while H4's **Aa** series is more consistent. I therefore do not find this argument convincing.

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Fig. 13. Personnel tablets. From top to bottom: **Aa** 792 (H1), **Aa** 85 (H4), **Ab** 189 (H21), and **Ad** 683 (H23). Photos: National Archaeological Museum, Athens/ Department of Collections for Prehistoric, Egyptian, Cypriot and Near Eastern Antiquities. © Hellenic Ministry of Culture and Sports/ Organization of Cultural Resources Development (H.O.C.RE.D.).

However, we can also see consistency within a single administrative 'file' where that includes texts written by more than one person. The **Qa** series, produced by two different writers whose fairly distinctive tablets are physically indistinguishable, has already been discussed above; the **Jn** series of page-shaped bronze allocation records, written by H2 and H21, similarly shows no significant differences in tablet manufacture or format between the two writers (cf. *LSP*, 15–16), or between the different stages of the administrative process (finished tablets, works-in-progress, and discarded tablets) which can be identified within this series.[64] Whether this means in each case that all of the tablets were made by the same person, that two (or more) makers followed a common set of instructions from the writer(s), or that the two writers made their own tablets in accordance with a shared idea of the appropriate way to create them for this particular purpose remains unknown.

Conversely, in the landholding tablets referring to the site of *pa-ki-ja-ne* (including H41's preliminary **Eb** and **Eo** series; H1's summary **En** and **Ep** series; and the totalling **Ed** series, with contributions by both writers: see n. 7), we see notable differences in format and production between and even within series of tablets referring to the same location and written by the same person.[65]

[64] Smith 1992–3. The **Jn** series tablets do vary in size and shape, largely due to some originally larger tablets being cut to produce smaller ones, but not in a way that correlates with scribal hand. A far bigger contrast is seen between this series and **Jo** 438, also a page-shaped tablet containing a large number of entries relating to metal (in this case gold), than within the **Jn** series. **Jo** 438 is a very tall, narrow, and thick vertical tablet measuring 23.2 x 8.3 x 2.5 cm; the **Jn** series' largest tablet, **Jn** 829, is 22 x 11.2 x 2.5 cm, and many have a much squarer shape and a thickness of 1.1–2.1 cm.

[65] **Ed** 411, which was begun by H41 and continued by H1 (whereas the rest of the series is entirely by H1), has been suggested to have been made by a different person – usually assumed to be H41 – based on its distinctly different height (4.3 cm, compared to the others' 3.3–3.6 cm: Palaima 1988, 38; *PT*^{3}, xxxv).

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Sometimes this is clearly due to administrative reasons: H41's use of a mixture of palm-leaf and page-shaped tablets in the **Eo** series, compared to their consistent use of palm-leaf tablets in the **Eb** series, is due to the former including several cases of the same person leasing several plots, each recorded on a single page-shaped tablet (H43 has made a similar administrative choice in writing a single page-shaped tablet, **Ea** 59, to record multiple landholdings held by the same individual, in a series otherwise consisting entirely of palm-leaves). At other times, this variation may provide evidence for the process followed by the writer, including changes to their preferences or decisions in the course of compiling the 'file' of documents. The variation in size and format of H1's page-shaped tablets (whose surface areas range from 92.6 cm^2 to 412.8 cm^2) is evidently partly related to the number and length of entries to be recorded on each tablet, but may also reflect a changing process of recording: Bennett (1983, 44–7) argued that the variation between vertical and horizontal orientations in the **Ep** series is due to the writer switching from the former (**Ep** 301, 613) to the latter (**Ep** 705, 212, 539, 704 – in the order suggested by Bennett) in order to better accommodate this series' relatively long entries. Similarly, we have already seen that the inconsistent use of straws/strings in the **Eo** series is difficult to explain on the basis of the tablets' clay, size and shape, or potential place of writing; could this be due to the situation changing between making the tablets with straws/strings and those without (or vice versa) – which might have been done at different times – or simply to the maker or writer changing their mind about this series' requirements?[66] Although reconstructing the circumstances in which particular tablet series were created and written, and the precise factors underlying the makers' and writers' decisions in doing so, is generally not possible, considering questions like this reminds us of the potential complexity of different, possibly changing situations in which even those groups of tablets we now regard as relatively consistent series might have been produced.

CONCLUSIONS

This experimental investigation into the various methods used to produce the Linear B tablets at Pylos has shed significant light on the effects of these methods on the tablets, and thus on the probable reasons behind tablet-makers' choices of different methods in different circumstances. In particular, creating a tablet by folding up a sheet of clay has been shown to provide increased stability while the clay remains relatively wet – an advantage if the tablet is being handled and/or written on at this stage – while the primary benefit of using a straw/string is in keeping fragments together if the tablet is broken in transit. These results demonstrate that consideration for both the experience of the tablet's future writer (whether that writer was also its maker or not) and for the further administrative processes the tablet would undergo (such as transportation to or within the palace) played a part in the tablet-makers' decisions as to what process(es) to use when creating a tablet.

However, investigating the relationship between tablets' production processes and contents in the light of these results has also shown that these decisions are frequently very difficult to reconstruct for any given tablet or group of tablets. Tablet-makers' and/or writers' preferences for how tablets were made (and written on) are highly individual, and not always based purely on clearly reconstructable administrative reasons. Although the administrative unity of groups of texts which collectively record a single operation is frequently also shown in their format and/or production process – regardless of how many people were involved in their making and/or writing – these individual idiosyncrasies, together with the potential for circumstances to alter or for makers or writers simply to change their minds, frequently create a more complicated situation. What this reinforces, though, is that the relationship between the making and writing

[66] It has previously been suggested that the surviving **Eo** series represents two phases of writing, with the page-shaped tablets being 'secondary' texts copied from now non-existent 'primary' palm-leaf tablets similar to the surviving **Eo** series palm-leaves (Bennett 1983, 42; Salgarella 2019, 75, 80–1). As noted above, however, this division by tablet format does not correspond to the presence or absence of straws/strings.

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stages of the process was a very close one, as demonstrated by the consistency in tablet production in cases where palm-print evidence shows the involvement of multiple makers, compared to instances where this process changes across a series of documents in accordance with the writer's administrative needs. Regardless of the identity of a tablet's maker in any given case – most likely in some instances writers made their own tablets, while in others this was done by another writer or an assistant – careful consideration of the needs of the writer was inherent in the production of a tablet as the first stage of the Mycenaean administrative recording process.

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apj454@gmail.com

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Οι κατασκευαστές πινακίδων της Πύλου: Μια πειραματική εξέταση της παραγωγής των πινακίδων Γραμμικής Β΄

Τα διοικητικά κείμενα Γραμμικής Β΄ της Ύστερης Εποχής του Χαλκού στην Ελλάδα γράφονταν πάνω σε πήλινες πινακίδες, των οποίων η παραγωγή ήταν και το πρώτο στάδιο στην διαδικασία δημιουργίας αυτών των εγγράφων. Παραμένει ασαφές κατά το πόσον οι συγγραφείς των πινακίδων ήταν οι ίδιοι με τους παραγωγούς των πινακίδων. Η παρούσα μελέτη συνδυάζει τις πρακτικές της πειραματικής αρχαιολογίας με αυτοψία των πινακίδων από την Πύλο με στόχο την διερεύνηση των μεθόδων δημιουργίας των πινακίδων στην Πύλο. Η μελέτη στοχεύει να διαλευκάνει όχι μόνο την διαδικασία παραγωγής και διαμόρφωσης του πηλού, αλλά και τις αποφάσεις οι οποίες πάρθηκαν από τους παραγωγούς των πινακίδων, και επομένως την σχέση μεταξύ των σταδίων δημιουργίας και της συγγραφής των εγγράφων της Γραμμικής Β΄.

Μετάφραση: Χρ. Κωνσταντακοπούλου

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