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Re-considering the department concerned with aromatics, spices, honey and offerings at Knossos[1]

Richard J. FIRTH
Bristol

1. Introduction

In *Scribes* (p. 125), Olivier postulated that there was a bureau concerned with aromatics, spices, honey and offerings in the area above the Long Corridor of the West Wing at Knossos. He associated the scribal hands 103, 135, 136, 140, 220, 223 with this activity. However, he noted the possibility that hands 138, 139 and 141 might also be involved, extending the range of bureau to include the Room of the Clay Chest and the Room of the Column Bases.

Godart (1968) went further and suggested that the Fh series (of hand 141) was strongly linked to the Ga and Gg series of the bureau because they both included a number of references to *ku-pi-ri-jo* who, according to Godart, was an unguent boiler (Godart 1969, p. 52).

Foster (1977) took this another stage further and proposed that the bureau was an administrative department concerned with perfumery and offerings. This has remained the conventional view to date, although Bendall (2007, p. 12) notes that it would be desirable to make a fuller study.

The aim here is to consider a number of issues which have arisen subsequent to Foster's *Minos* paper and which are relevant to the study of this bureau. Sections 2, 3 & 4 consider olive oil. Section 5 discusses the Pp-series of tablets. Section 6 considers the Ga(5) set. Sections 7 & 8 consider wine and "Greek grog". Finally, Appendix A is a discussion on the inscribed pithoi found in the West Wing of the palace.

[1] I would like to thank José Melena for providing very helpful comments on the draft of this paper.

2. Considering the contemporaneity of the bureau and the Fh-series of oil tablets

In a recent study of handwriting styles, Firth & Skelton (2013) have demonstrated that the Fh-series tablets (by hand 141) have a Middle Knossian writing style whereas the tablets from the bureau (by hands 103, 135, 136, 138, 139, 140, 220 and 223) have a Late Knossian writing style. They go further and suggest that these two writing styles are not contemporaneous and suggest that the Middle Knossian style can be dated to LM IIIA2, whereas the Late Knossian style can be dated to LM IIIB1. These differences would suggest that the Fh tablets are not contemporary with the aromatics, spices, honey and offerings tablets of the bureau. The implication is that if *ku-pi-ri-jo*, on the Fh-series and the bureau tablets, is a man's name then it does not represent the same man.

There has been much discussion on the interpretation of the word, *ku-pi-ri-jo*[2] and the aim here is to list these different interpretations and consider the implications in the light of Firth & Skelton's findings. We will begin by following the interpretations listed by Himmelhoch (1990).

1. Chadwick (1964) suggested that *ku-pi-ri-jo* was a Cypriote merchant or "the man from Cyprus" (1976, p. 158). Clearly if this were the correct interpretation then there would be no requirement for the Fh-series to be contemporary with the tablets from the bureau.
2. Palmer (1963, pp. 260, 431) made the suggestion that *ku-pi-ri-jo* was the name of a spice, κύπριο□ (cf. κύπρο□, "henna", κύπρινον "oil made from henna"). There are serious difficulties with this suggestion (see discussion by Himmelhoch 1990, pp. 97-98) but if it were correct there would be no requirement for the Fh-series to be contemporary with the bureau tablets.
3. The third suggestion is that *ku-pi-ri-jo* is an ethnic used as a personal name (see for example, Godart 1968). Shelmerdine (1985, p. 138) notes that *ku-pi-ri-jo* is a fairly common name and suggests that it reflects some family connection to Cyprus. Himmelhoch (1990) draws attention to difficulties with this interpretation amongst the tablets of the Fh-series. Nevertheless, if this were the correct interpretation, then the fact that it is a fairly common name does not imply the contemporaneity of the Fh-series and bureau tablets. It implies instead that both sets of tablets refer to men with a connection to Cyprus.
4. The fourth suggestion is that *ku-pi-ri-jo* is an ethnic adjective, Cypriote, describing origin or destination (Melena in Bennett *et al*, 1989, pp. 202-203; Palaima

[2] For summaries of discussions on the interpretation of *ku-pi-ri-jo* see Himmelhoch 1990, pp. 97-100 and Killen 1995, p. 216.

1991, pp. 280-281). If this were correct then the absence of contemporaneity of the Fh-series and the bureau tablets would not be a problem since they are simply recording that the commodities have either originated from Cyprus or are to be exported to Cyprus.

5. Finally, Foster (1977, pp. 31-32) considers the possibility that *ku-pi-ri-jo* was a divinity. In this case, there would be no requirement for the Fh-series to be contemporary with the bureau tablets.

Thus we have shown that the appearance of the word, *ku-pi-ri-jo*, on both the Fh-series tablets and those from the bureau does not contradict the findings from the phylogenetic analysis of Firth & Skelton (2013) that the Fh-series tablets and the bureau tablets are not contemporaneous.

3. Considering the internal evidence for perfumed oil at Knossos

In Section 2 it was shown that there was not a strong case to suggest that the Fh-series tablets and aromatics tablets from the bureau were contemporaneous. We can go further and show that there is not strong internal evidence to suggest that the olive oil at Knossos was perfumed. Unlike the oil tablets from Pylos, there is little on the Knossos Fh series of oil tablets to indicate that they might refer to perfumed oil (Bendall 2007, p. 104).

On Fh 340, OLE appears with the adjunct *te*. Bendall (2007, p. 249) notes Olivier's suggestion that *TE* on PY Un 219 could be an abbreviation for /*terminthos*/ or /*terebinthos*/ "terebinth". However, the word used for terebinth in the Ga(5)-series of tablets at Knossos is *ki-ta-no* and it would be surprising if an isolated example of an adjunct, *te*, amongst the Knossos corpus, on Fh 340, was also intended to be read as terebinth.

It is possible that, in Fh 386, OLE has been ligatured with *O*. The sign, *O*, is widely used as an abbreviation and on some occasions it is used to represent cyperus (see the discussion by Bendall 2007, pp. 193-198). Thus, it is possible that the sign on Fh 386 could be read as OLE+*O* and it is possible that, if this were so, then *O* could be interpreted as cyperus but this is a very tenuous argument and a weak basis for suggesting that the Fh-series lists perfumed oils.

There is also Sacconi's (1969) suggestion that *MU* on Fh 347, 371, 5452 is myrrh. However, this seems unlikely since myrrh does not appear in the more developed perfumed oil industry of Pylos (Shelmerdine 1985, p. 23). Furthermore, Faure (1987, p. 316) argues that the quantities listed would be too high relative to the amount of oil listed on these tablets. Faure (1987, pp. 109-110, 316) suggests that *MU* is an abbreviation for μύρον, an unguent, however that does not explain why there is a repeated ratio between the quantity of oil and the number of *MU*. Foster (1977,

p. 24) concludes her discussion on this topic with the suggestion that *MU* is a container since the ratio of *MU* to s units of oil is 1:4 on both Fh 347 & 371, implying that *MU* would be a large container capable of holding 38.4 litres. Melena (1983) suggests that *MU* is a leather bag. For the purpose of the present discussion, the point to note is that neither of these latter two suggestions identifies *MU* as being related to perfumed oil.

In addition, as we have already seen, there is Palmer's suggestion that *ku-pi-ri-jo* on the Fh-series tablets should be interpreted as henna. However, this suggestion has not been widely accepted because of the difficulties inherent in this interpretation.

It is also worth drawing attention to the experimental work of Giuseppe Donato (Donato & Seefried 1989) considering the practicalities of manufacturing ancient perfumed oils. Donato shows that ancient perfumed oils were made using oil from unripe olives, harvested in August. This oil has the property that it contains so little fat that, when it is spread over the skin, it is easily absorbed. This contrasts with oil from ripened olives, which we are familiar with and which is most unsuitable to be used as basis for a perfumed oil because it is not absorbed into the skin. Thus, there is a marked difference between oil olive for consumption and oil for perfumes and we would certainly expect that the Linear B tablets would draw a distinction between the two. Thus, the absence of this clear distinction amongst the Fh-series of tablets is another pointer towards questioning the presence of perfumed oils in this series.

If we accept a chronological separation between the Fh-tablets and the tablets from the bureau, there is no longer any clear evidence that the oil in the Fh-series of tablets was used for the manufacture of perfumed oil. Thus, if we were to suggest that some of the oil in the Fh-series is perfumed, then we would be relying on the analogy with the Pylos tablets rather than on the internal evidence from the Knossos oil tablets (Bendall 2007, p. 104).

Before concluding this section, we should also note OLE+*A* on F 726, from the Gallery of the Jewel Fresco. Following *Docs*[2] (p. 528), the *A* could be an abbreviation for ἀλοιφή, "anointing, laying on of unguents". Alternatively, OLE+*A* is could be made from OLIV+*A* which may indicate that they are from wild trees and so contain less grease (Melena 1983). Thus, there is a possibility that the oil on F 726 could be perfumed.[3]

4. Considering the storage of oil in the west wing

It is natural to assume that the olive oil that was recorded on the Fh-tablets was stored in the Western Magazines in close vicinity to their find-place in the Room of

[3] Shelmerdine (1985, p. 34) dismisses Palmer's suggestion (1963, p. 246) that OLE+*A* might represent almond oil because "it is unlikely that almond oil rather than olive oil is described by the word *elaiwon*".

the Column Bases (see for example, Hallager 1977, p. 71; 1987, p.172). However, despite the fact that the palace was destroyed in a conflagration, Evans and Mackenzie recorded little evidence of the remains of oil combustion in this location.

We will begin this discussion by demonstrating that the conflagration of large quantities of olive oil leaves traces, which are observable by archaeologists by considering the Palace of Nestor at Pylos. There is ample evidence from the tablets that there was a perfumed oil industry at Pylos (Shelmerdine 1985). However, even before the tablets were deciphered there was evidence from the archaeology that substantial quantities of oil been had burnt within the palace. For example, in one of the oil magazines rooms, Room 23 (Blegen & Rawson 1966, p. 135), "The surface of the pavement, moreover, when first uncovered had an oily, fire-blackened appearance". In addition, there was the finding that the earth in the storage jars was burnt red at the top but blackish towards the bottom, where there was more oil and less air (Shelmerdine 1985, p. 70). In another oil magazine (Blegen & Rawson, p. 158), Room 32, "Almost all the pots in this room were badly cracked and broken, though many still retained their form sufficiently for recognition and 19 could be restored. The fire had been particularly intense: many of the pots were blackened and the paint had in some instances turned gray. Certainly the pithoi must have contained olive oil of some kind. It may have been a specially refined type, since the storage jars were distinctly smaller than those in other oil magazines, but it certainly fed the flames". The finding that the effects of an oil fire leaves clear archaeological traces is not surprising but it is worthwhile including for completeness[4].

The excavators of Knossos were not so rigorous in noting the signs of intense burning caused by an oil fire. The following list is a gleaning of evidence from a variety of sources from which the author found four references to residues due to olive oil.

Western Magazine IV: This magazine was excavated in 1900 and there was no record of oil burning but, in 1901, Evans wrote, "An interesting feature of the upper receptacles of the Kasselles of the Fourth Magazine, is that their inner walls, together with the bordering slabs of the pavement and parts of the adjoining walls of the Magazine, are much blackened, evidently from the burning of some inflammable substance that had been contained in these receptacles. It is reasonable to suppose that this was oil".[5]

Western Magazine VIII: On Tuesday 8 May 1900, Mackenzie wrote in his *Daybook*, "Near the E end of the 8th gallery was a disturbed chest which had at the

[4] See also the description by Wace of the intense burning in the "House of the Oil Merchant" at Mycenae (in Bennett 1958, p. 8).

[5] Evans 1901, p. 48.

bottom traces of a greenish-yellow tough earthy substance such as the sediment of olive oil may have left".[6]

Vat Room (West Wing): Panagiotaki (1999, pp. 228-231) writes, "The floor consists of gypsum and burnt schist slabs … The schist slabs cover the N part (just S of the cist against the N wall) and are burnt; the gypsum slabs do not show traces of burning". "They [i.e. the vats] all appear to be made of material like that of the cist against the N wall. It may have originally been white/creamy, but now is mostly dark grey/brown. Specialists ascribe this discolouration to their contact with fire, since only their tops and parts of their W sides are burnt. The burning of the vats and the soil at the NE corner suggest that there was an intense fire". "The intense burning, in both the vats and the cist, might have been caused by burning oils".

Magazine of the Medallion Pithoi (East Wing): In 1913, Evans wrote in his *Notebook*, "Magazine of 'Medallion Pithos' - W of Olive Press Room - beneath central slab to earlier 'Mosaiko' pavement at .36 (white faced plaster in interstices). Upper part of earth much burnt. Black from oil permeating gypsum slabs. Lower part less burnt. In places traces of two intermediate plaster floors between the two pavements."

In the West Wing, all the examples are below floor level in cists and vats. If we assume that Mackenzie correctly identified oil residue in a cist (or chest) in Magazine VIII, then it must have been closed at the time of the conflagration, preventing the oil from burning. In the other cases, it seems likely that the cists and vats were open at the time that oil caught fire.

In the case of Magazine IV, there is a photograph included by Raison (1993, Plate XXXIV), which shows that the blackening by fire is very localised, implying that the amount of oil was not very great. Furthermore, Evans states that all six cists were found to be open when the Magazine was excavated (Evans 1900, p. 21) and it would not seem practical to have used the Magazine in this condition.

In the case of the Vat Room, although Panagiotaki describes intense burning within the vats, the cist and in the NE corner, this did not affect the floor of gypsum slabs. Furthermore, only one pithos was found in this room. This would lead us to conclude that the amount of oil stored in this room was limited.

By contrast, the brief description of the oil residue in the Magazine of Medallion Pithoi in the East Wing of the palace is more reminiscent of the amount of damage at Pylos. This suggests that a substantial amount of oil was stored in this Magazine.

[6] This is taken from the inked version of the 1900 *Daybook* as the original pencil version uses a different numbering system for the magazines, which for present purposes introduces an unnecessary confusion.

Appendix A considers the inscriptions on the pithoi found in the West Wing at Knossos. This shows that only one pithos was inscribed with the oil logogram, whereas four pithoi had the wine logogram. However, there are two important observations that should be made. Firstly, it would have been dark within the magazines and it would have necessary to work by artificial light. Under these circumstances it would have been unlikely that the signs on the pithoi would readily have been visible. Secondly, the pithoi were used over an extended period and it is most unlikely that their use would have been constrained by an inscription written on their sides when they were manufactured. It is more likely that the inscription represented the intended usage of the pithoi when they were initially manufactured. Nevertheless, it is evident from Table A1 that these pithoi were intended to be used to store wine, figs and oil and that the number of wine signs is much larger than the number of oil signs.

This finding can be taken together with the evidence for intense oil fires within the West Wing. The conclusion must be that there is no evidence for large-scale storage of oil in the West Wing at Knossos when the palace was finally destroyed. Nevertheless, it remains possible that at the time when the Fh tablets were written then there could have been oil storage in the West Wing (as suggested by Hallager). It is also possible that immediately before the destruction, the Vat Room could have been used for transferring oil from large vessels into smaller vessels suitable for disbursement (Hallager 1987, p. 172).

5. Considering the Pp-tablets found in Magazine VIII

The logogram in the Pp-series of tablets (**168*) has been the subject of much discussion and there have been number of suggestions about its meaning.[7] Duhoux (1975) and Melena (1975, 2014) both associated **168* with items from the textile industry, namely loincloths and baskets for holding wool during textile manufacture. These suggestions were prompted by the shape of **168* and by the fact that the Pp-tablets were written by hand 119 which is also associated with the Dk(2) series of tablets on wool production and therefore with the textile industry.

In this paper, we will favour instead the suggestion put forward by Davaras (1986) that **168* represents a clay beehive of the cylindrical pipe type. This satisfies the criterion of matching the shape of the logogram. However, this suggestion does not conform to the association of hand 119 with the textile industry. There are two arguments that can be put forward to overcome this perceived problem.

[7] See Duhoux 1975, including footnote 7, for a summary of preceding suggestions; Melena 1975a, pp. 129-134; Vandenabeele & Olivier 1979, pp. 281-282; Davaras 1986; Melena 2014.

The first is to note that there is no evidence that a high level of specialist skill was required to record the items in the Pp-series and so, in principle, such tablets could have been written by any scribe. The second argument is that the "Knossos textile industry" is a modern label that has been coined by Linear B scholars, applying to activities including wool production and textile manufacture at Knossos. However, there are no instances where scribes who were involved with livestock at Knossos also wrote tablets associated with textile manufacture. If we re-align the categories and refer instead to "agricultural production" and "textile manufacture", then this provides an equally rational basis for dividing scribal activities. However, in this case the production of honey and wool both fit neatly into the category of agricultural production, thus it would not be anomalous if the same scribe writes tablets on both subjects, thus removing the objection raised most recently by Melena (2014, p.151 apropos of **168*).

The main objection to Davaras' suggestion is the apparent absence of archaeological evidence for the use of the cylinrical beehive on Crete at the time when the Linear B tablets were written. Although it is known that the ancient Greeks used two different types of beehive, the cylindrical type discussed above and a less common type which is shorter and conical in shape, all four sites with examples known from the MM-LM I period conform to this latter type (Melas 1999). Thus, Davaras' suggestion rests upon the unproven assumption that the cylindrical type was in use on Crete at the time of the Linear B tablets. However, it is worth noting that in 1986 when Davaras wrote his paper, he did not know of *any* recording of a beehive being found in Minoan Crete but, by 1999, Melas was able to list MM-LM I finds at four sites on Crete. Thus, it would seem probable that, with time, an increasing number of sites with beehives will be identified, with the possibility that cylindrical beehives will be included when the sample size increases.[8]

Davaras gives two reasons for identifying **168* as a beehive. Firstly, the logogram is a good representation of the cylindrical pipe type of beehive in terms of its relative dimensions. The double line at the ends would correspond to grooves where a lid could be fastened by a cord.[9] Secondly, U 7505 includes the term]*ṃe-ṛi-te-o*, "honeyed" (Melena forthcoming), which Davaras suggests could be taken literally as

[8] This rapid increase in the number of beehives identified appears to have arisen because of confidence gained from analytical chemical analysis permitting the identification of "combed ware" as beehives (see, for example, Evershed *et al.* 2003).

[9] Davaras 1986, Plate 1 is a photograph of a "modern" Cretan clay beehive found near Hierapetra. He gives it the name διψέλι or κυψέλη. There are also photographs of this type of "modern" cylindrical beehive in the book by Betty Psaropoulou, pp. 45 (Rhodes), 91 (Kalymnos), 175 (Lesbos). In the former case, it is given the name, κούακι. Since the totalling on Pp 499 implies a masculine noun, Davaras suggests that the beehive could have been called σίμβλο□ or κύτταρο□.

an adjective applying to the logogram (rather than a man's name that is coincidentally associated with a logogram that has the appearance of a cylindrical beehive).[10]

Davaras very briefly mentions the association between the Pp-tablets and the Gg-series of tablets describing distributions of honey. Let us expand on this further. Following *Documents*[2] (p. 553), we will interpret *KE+RO*$_2$ as "honeycomb" so that, by association **172* is the ideogram for honeycomb (based on U 746).[11] Thus, Gg 701 lists 16 jars of honey and 8 honeycombs.[12] This tablet was found in the Long Corridor near the door to West Magazine VIII (i.e. close to the find-place of the Pp-set of tablets). The Pp-tablets were found on the floor in the SE corner of Magazine VIII, close to the doorway, so that they most probably had not fallen from an upper floor. There is no indication from the excavation notebooks whether Gg 701 was found at ground level or whether it had fallen from an upper floor. Nevertheless, there would appear to be the possibility of a close association between the Pp-series and Gg 701. We could go further and note (Bendall 2007, p. 146) that]*i-to da-nwa* on Gg 701 could be read as *pa-*]*i-to da-nwa* which would be in the same format as most of the Pp-series of tablets and recording the delivery of honey and honeycombs from *da-nwa* of Phaistos.[13] Bendall (2007, pp. 146-7) also speculates that Gg 521 (which was found in two pieces with one in Magazine VIII and the other in Magazine IX) might be the totalling tablet recording the total amounts of honey and honeycomb delivered to the palace.[14] In this way, we could interpret the Pp-series and Gg 701 as recording the different ways in which honey and honeycomb were delivered to the palace; in the former case, the beehive is delivered complete with honey and honeycomb, in the latter case, the honey and honeycomb have been separated. Thus, the Pp-series and Gg 701 (and possibly Gg

[10] If **168* is a beehive, then the key information to record is whether it contains honey or whether it is empty. In the case of U 7505, this is done explicitly. However, in the Pp-series, the logogram appears as **168+SE*. It is possible to speculate tentatively that this could be an abbreviation for a word based on σειρά, "cord", indicating that the contents of the beehive had been sealed in with a lid bound by a cord in the manner suggested by Davaras. Alternatively, Duhoux (2013) has suggested that *SE* could be an abbreviation for σέμβλο□ (cf. σίμβλο□), if this were the case then, the adjunct would be removing any ambiguity in the interpretation of the logogram (see previous footnote).

[11] It is worth noting that one of the uses of beeswax was as a fuel for lamps (Evershed *et al.* 1997, 2000).

[12] The other tablets at Knossos listing honeycombs are U 746 and probably U 436. However, these were found under a blocked doorway and in the Room of the Niche (respectively) and so are most unlikely to have been current at the time of the destruction of the palace.

[13] Note that this is a different interpretation from that given in *Documents*[2] (p. 538) where it is assumed that *da-nwa* is the recipient of offerings (possibly divine). Bendall (2007, p. 146) argues that the amount of honey listed on Gg 701 would be exceptionally high for a religious offering.

[14] In addition, Bendall speculates that the *KE* on Gg 711 (found in the Temple Repositories Room) could refer to honeycomb. However, Melena (2014, p. 133) suggests that *KE* is a generic word for a vessel (κέραμον).

521 & 711) could be regarded as part of the same activity even though they were written by different hands.

6. Considering The Ga(5)-Set

Melena (1975b) proposed that *ki-ta-no*, on the Ga(5)-set by hand 221, should be interpreted as /kirtanos/; cf. later κρίτανο□ "terebinth". Further, he suggested that *ki-ta-no* was a *Pistacia* product, probably terebinth fruits.[15]

There are now two more recent findings that should be taken into account. Firstly, during the excavation of the Uluburun shipwreck, the majority of the 149 Canaanite jars contained *Pistacia atlantica* (terebinth) resin (Pulak 1998).[16] Thus, it has been proposed the *ki-ta-no* should be interpreted as terebinth resin (Palaima 1991, p. 279; Pulak 1998). The second finding arises from chemical analyses of the residues from ceramics. These show that terebinth resin was added to wine during the Greek Bronze Age (Tzedakis & Martlew 1999, pp. 148-9; McGovern *et al*. 2008), which helps to explain why such a large quantity of resin was being transported.

We will now re-consider the Ga(5)-series in this light. It is clear that the *ki-ta-no* in tablets Ga 1530 and 1532 record deliveries to the palace and Melena suggests that all the Ga(5)-series are delivery tablets. The toponyms on the Ga(5)-series are *da-wo, pu-na-so, e-ko-so, tu-ni-ja?, pa-i-to, ti-ri-to and ku-ta-to* and it would follow that these represent the areas from which *ki-ta-no* was sent. Although there is much uncertainty about the location of some of these toponyms, they are all associated with sheep flocks and so it is most unlikely that they are all coastal regions. Therefore, we can rule out the possibility that these were places where *ki-ta-no* was imported and so it follows that this *ki-ta-no* was harvested in these areas. The question is what is the nature of this locally produced *ki-ta-no*. The other piece of information we should consider is the quantities listed. For present purposes it is sufficient to note the totals given on Ga 1530 of AROM *58* and AROM *31* owed.[17]

[15] Surprisingly, Foster (1977) did not consider the suggestion put forward by Melena (1975). Instead, she argued that, since *ki-ta-no* was not listed with the perfume ingredients on PY An 616, Un 249, Un 267, Un 592 or with the word *ku-pi-ri-jo* at Knossos, then there was no reason to regard it as a perfume ingredient and instead she assumed that it was something associated with the textile industry. However, once *ki-ta-no* had been identified as a terebinth product then we can find terebinth at Pylos listed as *TE* on Un 219 (see the discussion by Bendall 2007, pp. 248-255). This suggests that the Ga(5)-set should be considered alongside the tablets from the aromatics bureau.

[16] Haldane Ward (1990) estimates that the total quantity of resin was about a ton. We can also note that, 45 of the 67 amphorae from the Uluburun shipwreck considered by Negbi & Negbi (1993) contained resin from *Pistacia atlantica* and 12 of the amphorae contained dark organic material, leaves, seeds, resin chips arising from fruits of the *Pistacia* species.

[17] This is equivalent to approximately 5568 litres collected and 2976 litres owed.

There are two species of *Pistacia* growing on Crete today, *P. lentiscus* and *P. terebinthus*. *P. lentiscus* is widespread across the island but favouring coastal regions, growing in areas including scrubland, rocky banks, maritime sands and forming impenetrable thickets, growing at an altitude of up to 500 metres. *P. terebinthus* is more concentrated in the western half of the island, growing in rocky woodland, maquis and on calcareous cliffs, at an altitude of 100-700 metres.[18] These represent the two quite distinct species of *Pistacia* that can readily be distinguished, "All of the species in *Lentiscus* are evergreen with a paripinnate leaflet arrangement whereas *Terebinthus* species lose their leaves in the autumn and have imparipinnate leaves. Seed size in *Lentiscus* species is much reduced compared with that of the *Terebinthus* species".[19]

There are two major sources of *Pistacia* resin, *P. lentiscus* and *P. atlantica* (Mills & White 1989) both of which were added to wine in ancient times. The resins produced are different in character (Negbi & Negbi, 1993). *P. lentiscus* produces mastic resin, which dries into small solid lumps soon after tapping and can be transported in baskets. *P. atlantica* is the main source of turpentine-resin. This does not dry out like mastic but is collected as a viscous semi-fluid material, which flows like pitch, and therefore has to be transported in vessels, rather than baskets. However, *P. terebinthus* is a small tree or shrub and therefore does not yield much resin compared to the *P. atlantica*, which can grow up to 12 metres tall with a trunk up to 2 m in diameter (Mills & White 1989). Nevertheless, *P. atlanctica* and *P. terebinthus* are closely related (Parfitt & Badenes 1997) and in the past the former was sometimes considered to be a variety of the latter (Mills & White 1989).

In view of the volume of *ki-ta-no* listed in the Ga(5)-set, it seems more likely that they are recording resin rather than fruit (Bass 1994). The quantities of resin are recorded using AROM, which is a dry measure, which would tend to imply that the resin was in the form of pellets rather than a viscous resin.

7. Considering wine

From a Linear B standpoint, Palmer's (1994) study of Wine in the Mycenaean palace economy should be the starting point of any discussion of Mycenaean wine since it provides a comprehensive survey of the subject. However, for the purposes of this paper, Palmer's study unfortunately pre-dates the beginning of chemical analyses of residues from archaeological samples. Thus, it tends to treat wine as though it was a product made purely from grapes.

[18] Turland *et al.* 1995 pp. 36, 205-206.
[19] Parfitt & Badenes 1997.

There are two exceptions to this. Palmer suggests that *me-ri-ti-jo*, inscribed on the *verso* of nodule PY Wr 1360 with VIN on its *recto*, might imply that the wine is either sweet like honey or flavoured with honey, although Palmer (1994, p. 63) concludes that it could equally plausibly be a name of a person or a place. Similarly, in the discussion of *me-tu-wo ne-wo* on PY Fr 1202, Palmer (1994, p. 64) refers to the usual interpretation as "at the time of/at the festival of New Wine" but then goes on to suggest tentatively that it might refer to mead and not wine within the context of a festival name.

Subsequent to Palmer's study, there have been a series of publications based on the chemical analysis of residues (see for example, McGovern 2007; Tzedakis & Martlew 1999; Tzedakis, Martlew and Jones, 2008). These reveal that the wine residues are often not simply the produce of fermented grapes but contain additives.

It was clearly important to try to stop wine that was being stored turning to vinegar. The primary way of doing this was to seal the container to stop the supply of oxygen. An additional method was to add tree resins that have bacterial properties which slow down the process of forming vinegar. Pliny states that, "In the East, the best and finest resin is produced by the turpentine-tree [i.e. terebinth], and next by the lentisk – the latter being also called gum-mastic; afterwards comes the juice of the cypress, which has a very sharp flavour".[20] However, McGovern *et al.* 1996 (see also McGovern 2007, pp. 67-70) describe the finding of terebinth in wine as early as in a Neolithic Iranian residue dating to 5400-5000 B.C. It has also been found in residues from Middle Minoan Crete at Apodoulou (Tzedakis & Martlew 1999, pp. 148-149).

Indeed, the practice of adding resin continues today in Greek retsina. The amount of resin in modern day retsina is about 1% (Negbi & Negbi 1993). If we were to assume that this was the sole use of the terebinth resin and that 1% of resin was added to Mycenaean wine, then the resin delivered to the palace on Ga(5) 1530 would have been added to 556,800 litres of wine (cf. 14,342 litres of wine listed on Gm 840 and 11,808 litres listed on PY Vn 20). Thus, it seems possible that the quantities of resin in wines at Knossos could have exceeded 1%. In addition, there would undoubtedly have been other uses for resin. For example, in wine making, it could have been used to coat the inside of unglazed vessels to seal the inner surface. Resin in its natural form would not be very suitable for this because it is soluble in the wine, however, if it were treated by heating to form pitch then it would be less soluble (Singleton 1996). It is also, of course, possible that resin was used in the manufacture of aromatic oils.

Finally, it is worthwhile briefly considering the type of vessels associated with wine. During the fermentation phase, oxygen is required and so the wine could

[20] Pliny, *Natural History*, BK. 14, XXV 122 (Loeb, 1952).

be made in open pithoi (i.e. vessels which are not sealed). However, if oxygen is still available once fermentation is completed, then this leads to a multiplication of bacteria, which convert the alcohol to acetic acid, and the wine turns to vinegar. Therefore, at the completion of fermentation, the wine would have been drunk or it would have been necessary to store it in sealed containers. If the wine was fermented in pithoi with large openings then, in practical terms, these would have been too difficult to seal effectively and so, if the wine was stored, it would have been transferred into jars with narrow openings. Therefore, for these practical reasons, it is likely that a lot of the wine would have been drunk as soon as it was fermented and that the special care required for longer term storage would only have been given to higher quality wines. In these terms, it is likely that much of the wine that was made at Knossos was consumed as soon as fermentation was completed would not have been recorded on the tablets.

8. Considering "greek grog"

McGovern (2007, pp. 262-278) describes how a different type of beverage was found in the laboratory analyses of residues on a number of Late Minoan ceramics. This was a combination of resinated wine, barley beer and honey mead, and he refers to this combined beverage as "Greek grog" (see also Tzedakis & Martlew 1999, pp. 166-173; McGovern *et al.* 2008, pp. 202-203; Pain 1999).[21]

McGovern (2007, p. 267) suggests that the two words used to modify wine at Pylos may be related to Greek grog, i.e. *me-ri-ti-jo* and *de-re-u-ko* (cf. γλευκο□) suggesting "honeyed" and "sweet". However, these seem to be words describing what is essentially wine rather than grog. Because beer is a key constituent of grog, then it is most unlikely that grog was intended to be kept for significant periods. Essentially it would have been a brew with a relatively high alcohol content that was fermented and then drunk. Therefore, we should probably not expect it to be recorded on the writing tablets.

The alternative approach is to look for tablets that list together the ingredients of grog: wine, barley and honey. We find these in the Fs-series from Knossos. The contents of this series are summarised in the following Table.[22]

[21] This seems a strange brew to us, however, cf. "Phrygian grog" (McGovern 2007, pp. 286-288, 296), which was similar to Greek grog though it was not resinated; also the Homeric mixed drink, *kykeon*.

[22] All the quantities are expressed in units of V (following Bendall 2007, p. 110). The sign "-" indicates that the item has deliberately been omitted from the tablet. However, in cases where the item is missing or incomplete because the tablet is damaged then the cell has been left blank. Tablets 20 & 29 have been excluded because, for these tablets, all the items are missing or incomplete.

Fs	HORD	*NI*	OLE	FAR	VIN	*ME+RI*
2	6	3	0.5	1	1	0.25
3	6	3	0.25	1	-	-
8	6	6		2		
9						0.25
12		3	0.5		1	
17	6	3	0.5	1	1	0.25
19	6	3	0.5	1	1	0.25
21	6			1	1	
22	6	3		1	1	
24	6	3	0.5	1	1	
25	6	3	0.5	1	1	
26				1		
4	12	6	1	2	2	0.5
11	12	6	1	2	2	0.5
23	12	3	1	1	2	0.25

Chadwick (1966) dismissed the possibility that the Fs-series might represent rations because the quantities are too small. There have been two other suggestions. One is that these are sacred offerings (Weilhartner 2003), the other is that they list food for a small number of prosperous individuals at shrines (Palmer 1994, p. 142).

Thus, there is general acceptance that the Fs-series represent items that were distributed to religious figures but there is not agreement on the use to which these items were put. The suggestion here is that the wine, barley and honey listed on the Fs-series tablets were the basic ingredients for brewing an alcoholic grog. In this context we could interpret the contents of the tablets as being a "party kit". The commodities listed could then be readily be understood as flour for baking "bread" which would be consumed with the olive oil and figs and, of course, the ingredients for brewing grog.[23] This interpretation would explain why the different items can be frequently seen to be distributed in the same proportions (i.e. the quantities on Fs 4 & 11 are precisely double those on 2, 17 & 19) as in a recipe.[24, 25]

[23] It is also possible that the figs were also used in the grog (see McGovern 2007, p. 94 for an example of figs in Egyptian wine).

[24] It has been suggested (José Melena, *priv. comm.*) that the doubled quantities could be allowances for religious festivals of two-days (cf. Theban *di-wi-ja-me-ro*).

[25] We will briefly consider the curious inscriptions,
di-we-si-po-ro-ti-mi-to-qo-re (Aq 218.v)
di-we-si-po-ro-ti-mi-to (Tn 316.r)
di-we-si-po-ro-ti-mi-to-qo [(Xa 412.v)

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which were discussed by Duhoux (2013). One of the possibilities that Duhoux considers is that these words could have the meaning, *di-we si-po-ro ti-mi-to*…, Diwei simblos tirminthos, To Zeus (we offer) beehives, terebinths etc. From the above discussion, we can see that there is a relationship between beehives, representing honey, and terebinths, representing wine, as ingredients of Greek grog. However, whilst this is worth noting, we should also note that the interpretation of these inscriptions is particularly difficult and the line of interpretation considered here might be completely spurious.

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APPENDIX A: CONSIDERING THE INSCRIPTIONS ON PITHOI FOUND IN THE WEST WING AT KNOSSOS

TABLE A1 is a list of the inscriptions on pithoi or other vessels found in the West Wing at Knossos as given by *GORILA* IV.[26]

TABLE A1

Inscription no.	Inscription	Find-place	Brice (1961)
KN Zb 27	DI-NA-U • VINa 117	Temple Repositories	*ILA* II 5
KN Zb 34	VINa+TE	West Mag. III (?)	
KN Zb 35	]JA[ ]DI-[ ]WI[ ]OLE 100 FIC 2	West Mag. X	*ILA* II 6i
KN Zb <36>	VINa	West Mag. IX	*ILA* II 6ii
KN Zb <37>	VINa	West Mag. IX	*ILA* II 6ii
KN Zb <38>	VINa	West Mags.	*ILA* II 6iii
KN Zb <39>	FIC	West Mags.	*ILA* II 6iv

[26] For completeness, it is worth noting that the following inscriptions were not discussed in the recent 5 yearly reports to the International Colloquia (Olivier 1999, 2000; Del Freo 2006). The abbreviation, *ILA* = Brice 1961.

KN Zb 34 was excavated by Minos Kalokairinos some years prior to the beginning of the main excavation by Evans and Mackenzie and therefore its find-place is not known exactly. The other inscriptions given in the table are based on Brice (1961, p. 15 and plate XXIII) [but see Olivier (1992) for KN Zb 27 and Pope & Raison (1975) for KN Zb 35]. However, Brice (1961, p. 15) states that, according to Evans' notebooks, the two signs that he listed as ILA II 6ii (i.e. KN Zb <36> and <37>) were both incised on the fifth pithos from the northwest corner of the Ninth Magazine (cf. *GORILA* IV pp. XXXII-XXXIII which simply states that these signs were found in the Ninth W. Magazine). Boskamp (1996) confirmed that the pithos in this position does indeed have two signs corresponding to KN Zb <36> and KN Zb <37>. Thus these inscriptions are no longer missing and the <...> brackets should be removed. It is also suggested that KN Zb 36 & 37 should instead be listed as, say, KN Zb 36a and KN Zb 36b since they both appear on the same vessel.

Boskamp (1996, p. 107) goes further and states that there is a third copy of the wine ideogram on the same pithos[27]. Indeed, Christakis (2005, p. 60) states the wine ideogram is in fact incised four times on this pithos. Moreover, Christakis stresses that this pithos should be dated to the LM III period. In this case it is open to question whether the inscribed signs should be taken as Linear A or Linear B (since the same sign is used for *VIN* in both writing systems).[28, 29]

[27] Boskamp suggests that this third sign should be identified as KN Zb <38>. This seems unlikely as it would imply that Brice had misrepresented Evans' notes. However, in order to verify this it would be necessary to examine the archive of documents used by Brice for his publication, if these still exist.

[28] Boskamp (1996, p. 103) claims that the *FIC* sign labelled as KN Zb <39> can be found on the pithos he has identified as KN 055 also in Magazine IX, but Christakis (2005, p. 59) judges that this is a mark due to the manufacturing processes rather than an inscription and should be ignored.

[29] Boskamp (1996, p. 110) also identified inscriptions on numerous other pithoi. Some of these were rejected by Christakis (2005, p. 59) as incidental marks due to the manufacturing process. Nevertheless there remain a number of marks which are not disputed by Christakis and which might be worth considering further.

