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INSCRIBED STIRRUP JARS AND REGIONALISM IN LINEAR B CRETE*

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Stirrup jars with painted Linear B inscriptions have been intensively studied in recent years. The reasons for such keen scholarly interest are not difficult to understand. No other class of data relates so directly to so many topics of major concern to students of Aegean prehistory: trade between Crete

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Acta Mycenaea II: M. S. Ruipérez, ed., *Proceedings of the Fifth International Colloquium on Mycenaean Studies* (= *Minos* 12) (Salamanca, 1972).

Atti Roma II: Atti e Memorie del 1° Congresso Internazionale di Micenologia, *Incunabula Graeca* XXV, 2 (Rome, 1968).

*Docs*²: M. Ventris, J. Chadwick, *Documents in Mycenaean Greek*, 2nd ed. (Cambridge, 1973).

Emergence: C. Renfrew, *The Emergence of Civilization* (London, 1972).

GORILA: J.-P. Olivier, L. Godart, *Recueil des inscriptions en linéaire A*, *Études Crétoises* XXI, 1-4 (Paris, 1976-82).

Hiller-Panagl: S. Hiller, O. Panagl, *Die frühgriechischen Texte aus mykenischer Zeit*, *Erträge der Forschung* 49 (Darmstadt, 1976).

«KN Place-Names»: A. L. Wilson, «Preliminary Considerations on the Knossos Place-Names», *Minos* 16 (1977) 67-125.

KN Textiles: J.L. Melena, *Studies on Some Mycenaean Inscriptions from Knossos Dealing with Textiles*, *Minos Suppl.* 5 (Salamanca, 1975).

«LB ISJ»: H.W. Catling, J.F. Cherry, R.E. Jones, J.T. Killen, «The Linear B Inscribed Stirrup Jars and West Crete», *BSA* 75 (1980) 49-113.

«MIV 2»: L.R. Palmer, «Mycenaean Inscribed Vases II. The Mainland Finds», *Kadmos* 11 (1972) 27-46.

Myc. Geography: J. Bintliff, ed., *Mycenaean Geography. Proceedings of the Cambridge Colloquium September 1976* (Cambridge, 1977).

TABLE 1

Find-Site	Inscription N ^o .	Toponym
ELEUSIS	Z 1	da-*22-to, wa
MYCENAE	Z 202	e-ra
	Z 664]ka-mo
THEBES	Z 839	o-du-ru-wi-jo wa-na-ka-te-ro
	Z 864, 851, 853,	wa-to
	854, 878, 882	
TIRYNS	Z 27, 41	*56-ko-we
	Z 29	si-ra-]ri-jo wa-na-ka[-te-ro

TABLE 2

Group	
Outer (Western)	ku-do-ni-ja (Kydonia-Chania), a-pa-ta-wa (Aptera), o-du-ru-wo ¹¹ , *56-ko-we ¹² , si-ra-ro ¹³ , wa-to ¹⁴
Inner (Southwest Central)	da-wo, e-ko-so, e-ra ¹⁵ , ka-mo ¹⁶ , ku-ta-to, pa-i-to (Phaistos)
Inner/Outer (Northwest Central)	da-*22-to ¹⁷

¹¹ Outer: Godart, *Acta Mycenaea II*, 424 n. 11; Killen, *Acta Mycenaea II*, 431-33; «KN Place-Names», 90-91, 123-24.

¹² Outer: Godart, *Acta Mycenaea II*, 423-24; «KN Place-Names», 90-91. Notice its inclusion in the outer group on C 902. See «MIV 2», 32-33. Western Part of Inner: Killen, *Myc. Geography*, 46.

¹³ Outer: Godart, *Acta Mycenaea II*, 423-24; «KN Place-Names», 90-91; Olivier-Godart, *Tiryns VIII*, 42-43.

¹⁴ Outer: Killen, *Myc. Geography*, 45; «KN Place-Names», 90-91, 70-72.

¹⁵ Inner (near Phaistos): «MIV 2», 38-40 and fig. 5; «KN Place-Names», 91; Inner (near Knossos): *KN Textiles*, 125-27.

¹⁶ Inner (near Phaistos): «MIV 2», 40, fig. 5.

¹⁷ Inner (near Knossos): J. Chadwick, «Relations Between Knossos and the Rest of Crete at the Time of the Linear B Tablets», *Acts of the Third Cretological Congress* (Athens, 1973) 44; *KN Textiles*, 29-30, fig. 1. Inner/Outer (west of Tylissos, linked with *ku-do-ni-ja*): «MIV 2», 33. Inner/Outer (along route from Phaistos to Rethymnon): «KN Place-Names», 107.

these tables we can make three fundamental observations. First, no toponym occurs on ISJ's found at different locations. This makes it unlikely, although not impossible, that all such exports emanated from a centralized controlling authority. Second, the toponyms on the ISJ's from Thebes and Tiryns are associated with the outer, western area of Crete (Kydonia-Chania); those on the jars from Mycenae with the inner, south central area of the island (Phaistos); and the toponym on the single ISJ from Eleusis with the site of *da-^{*}22-to*, which is connected with both the inner and outer area, perhaps along the route from Phaistos to Rethymnon. This again seems to indicate a pattern of regional exportation. Third, since the appearance of the word *wa-na-ka-te-ro* on at most 3 of the 130 legibly inscribed ISJ's (EL Z 1, TH Z 839, TI Z 29) has been cited as supporting the existence of an LM III B palatial center at Knossos¹⁸, it is worth noting here that the word occurs in the context of toponyms associated entirely or partly with the outer, western area of the island. Such a concentration might imply not that many small independent centers were functioning, each with its own *wanax* — remember the word *wa-na-ka-te-ro*, whatever its exact connotations, appears on only three jars — but that the outer, western district had an administrative center of its own, perhaps at *ku-do-ni-ja* (Chania)¹⁹.

Let us now turn to the evidence that the Linear B tablets furnish, whatever their date, for the interest of Knossos in the 100 + securely identified toponyms listed in the Knossos records. Here we are fortunate to have thorough studies of the toponyms themselves and of the industries, major and minor, whose activities the tablets monitor in detail²⁰. Wilson stresses in his study of place-names that the total number of toponyms in the tablets amounts to only one-third of the identifiable Late Bronze Age settlements on the island of Crete²¹. This in itself seems to support Renfrew's observation that «Knossos controlled economically about one-fifth of the populated lands

¹⁸ Niemeier, *SMEA* 23 (1982) 224, n. 22. The inscribed *wa* on KH Z 16 does not conform to the style and formulaic pattern of the other stirrup-jar inscriptions and should not be taken necessarily as another instance of abbreviated *wa-na-ka-te-ro*.

¹⁹ Archaeological evidence proves the commercial importance of *ku-do-ni-ja* (Chania) in LM III. See I. Tzedakis, *BCH* 93 (1969) 415; *BICS* 20 (1973) 154-55; A. Kanta, *The Late Minoan III Period in Crete* (Göteborg, 1980) 257. The large number of Linear A finds from Chania (87 fragmentary tablets, 20 nodules, and 114 roundels), attesting to a considerable earlier bureaucracy, date according to Papapostolou no later than LM I B. I.A. Papapostolou, L. Godart, J.-P. Olivier, *Grammike A sto Minoiko Arkheio ton Khanion* (Rome, 1976) XI-XIV; *GORILA* 3, xvi n. 1, notes problems in pinpointing the date of Linear A at Chania.

²⁰ The wool and textile industry of Crete has been reconstructed thoroughly by J.T. Killen, «The Wool Industry of Crete in the Late Bronze Age», *BSA* 59 (1964) 1-15; «Minoan Woolgathering: A Reply», *Kadmos* 7 (1968) 105-23; «The Knossos Lc (Cloth) Tablets», *BICS* 13 (1966) 105-111; and «The Knossos Ld (1) Tablets», *Colloquium Mycenaicum* (Neuchâtel, 1979) 153-64; together with *KN Textiles*; and E.D. Foster, «*po-ni-ki-jo* Reconsidered», *Minos* 16 (1977) 52-66, esp. 52-57. Livestock: Godart, *Acta Mycenaea* II, 418-24; J.-P. Olivier, «La série Dn de Cnossos», *SMEA* 2 (1967) 71-93. See generally, Hiller-Panagl, 126-34, 183-92.

²¹ «KN Place-Names», 75.

of Crete»²². Killen and Chadwick have noted repeatedly that in regard to the major wool production and textile manufacture industry Knossos was the chief administrative center for the central part of the island, but that Knossos's interest in the western areas was greatly reduced and in the eastern areas virtually non-existent²³. In fact, the degree of autonomy suggested by the tablets for sites in the western regions of Crete stands in distinct contrast to the rigid supervision of all aspects of economic activity by the Palace of Nestor at Pylos over the nearly two hundred identifiable Late Bronze Age sites in the two provinces, near and remote, of its region of Messenia²⁴. We should remember the vast difference in scale between the territories being compared (Crete ca. 8300 km².; Messenia ca. 2200 km².) and consider what the geographical limits for regional control by a Mycenaean palatial center on Crete might have been.

Even within the central territory over which Knossos exercised closest control, measures were apparently adopted to allow for a degree of local supervision in outlying areas. The tablets of the various D- series reveal that a system was in place to control locally the wool-producing flocks vital to the cloth industry. The greatest use of this system of «collectors» was in the region of Phaistos, which lay at the furthest limit of Knossos's central zone²⁵. This fact combined with the division of the island into discernible inner and outer administrative areas makes it completely plausible to view the whole of Crete at the time of the Linear B tablets as a system of natural sub-regions, each having its own controlling center and each responsible in radically varying degrees to the central administrative authority of Knossos²⁶. In fact, Wilson notes that each of the identifiable toponym groups can be linked with a palace at which LM II pottery has been reported²⁷.

Still the tablets do attest to Knossos's regulation of all phases of the large-scale cloth manufacture industry: from the management of the wool-producing flocks (series Da-Dg, Dn), to the supervision of textile production,

²² *Emergence*, 254-55.

²³ Killen, *Myc. Geography*, 45; Chadwick, *Myc. Geography*, 50-51; *Acts of the Third Cretological Congress*, 45.

²⁴ Chadwick, *Myc. Geography*, 50-51.

²⁵ The flocks listed without collectors, mainly from locales closer to Knossos, are thought to be directly responsible to the palace at Knossos. Those with collectors refer less directly to the palace. See Olivier, *SMEA* 2 (1967) 84 and n. 26 where he suggests that three collectors named in the D- series may have controlled female linen workers, in locally based textile workshops. Chadwick, *Myc. Geography*, 50-51, stresses that the remoteness of *pa-i-to* from Knossos was responsible for such a system. See also «KN Place-Names», 48, 100.

²⁶ *Emergence*, 258-59 fig. 14.14; «KN Place-Names», 99.

²⁷ «KN Place-Names», 108 n. 142. See M.R. Popham, «Late Minoan II Crete: A Note», *AJA* 79 (1975) 372-74.

workshops and workers (series L-, Ak-Ap)²⁸, to the growth, delivery and production of dye materials²⁹. It is then interesting to consider the kinds of interest that Knossos had in the toponyms from the stirrup jars. In table 3 I list the number and relative frequency of occurrences for these and for the three well-established toponyms in their respective groups (*pa-i-to*, *ku-do-ni-ja* and *a-pa-ta-wa*), first for all tablets and then excluding the disproportionately large number of sheep tablets in the D- series³⁰. In table 4 I list the non-D- series in which the toponyms occur.

TABLE 3

Group	Toponym	ALL TABLETS			D- SERIES EXCLUDED				
		Definite	Possible	Total	Frequency	Definite	Possible	Total	Frequency
INNER	e-ra	24	13	37	0.039	10	4	14	0.035
INNER	ka-mo	2	3	5	0.005	1	1	2	0.005
	[ka-mo/ka-ma] ³¹	4	5	9	0.009	3	3	6	0.015
INNER	pa-i-to	48	11	59	0.062	16	9	25	0.062
INNER/ OUTER	da-*22-to	48	4	52	0.054	25	3	28	0.069
OUTER	*56-ko-we	30	3	33	0.035	7	0	7	0.017
OUTER	si-ra-ro	3	0	3	0.003	3	0	3	0.007
OUTER	wa-to	5	0	5	0.005	5	0	5	0.012
OUTER	o-du-ru-wo	4	1	5	0.005	4	1	5	0.012
OUTER	a-pa-ta-wa	4	1	5	0.005	4	1	5	0.012
OUTER	ku-do-ni-ja	10	2	12	0.013	10	2	12	0.030

²⁸ *KN Textiles*, 32-47, discusses the role of local supervisors in textile production. On the L- series, see Killen (supra n. 20).

²⁹ Foster, *Mimos* 16 (1977) 52-57.

³⁰ Following «KN Place-Names», 109-11, and adding *ka-mo/ka-ma*.

³¹ For the identity of *ka-mo/ka-ma* see «MIV 2», 38.

TABLE 4

<i>Toponym</i>	<i>Series (non-D-)</i>
e-ra	Ap, F, Fh, L, Lc, V, X, Xe
ka-mo	As, X
[ka-mo/ka-ma]	Am, As, F, L, X
pa-i-to	Ak, Ap, E, F, Ga, L, Lc, Le, Od, Og, Pp, Sd, So, V, X
da-*22-to	Ak, As, Ce, E, F, Ga, Lc, Ld, Mc, Uf, V, Wb, X, Xd, Xe
*56-ko-we	Ap, C, G, Ga, Le, X
si-ra-ro	C, Co, Lc
wa-to	C, Co, Np
o-du-ru-wo	Ai, As, C, Co
a-pa-ta-wa	Am, C, Ce, Co, V
ku-do-ni-ja	C, Ce, Co, Fh, G, Gg, L, Lc, Sd, Wb

From these tables we can draw several important inferences about Knossos's interest in activities at these selected sites. First, we should note that none of the five sites that are totally dissociated from the Central (inner) Region (*si-ra-ro*, *wa-to*, *o-du-ru-wo*, *a-pa-ta-wa*, *ku-do-ni-ja*) is listed at all in the records of wool-producing flocks of the D- series³². This contrasts with the other five sites (*e-ra*, *ka-mo*, *pa-i-to*, *da-*22-to*, **56-ko-we*³³), each of which has over forty-six percent of its occurrences in these series.

Second, only two sites in the narrowly defined outer group are referred to at all in textile contexts: *si-ra-ro* (Lc 512) and the chief site *ku-do-ni-ja* (L 588, Lc 481, Lc 7377). The Lc references are from the Lc (2) set which records amounts of *pa-we-a* TELA and *to-u-ka* LANA, a particular variety of woven cloth and wool allotted for its special finishing respectively, in these instances handled by female work groups apparently right at *si-ra-ro* and *ku-do-ni-ja*³⁴. On L 588 *ku-do-ni-ja* is listed in allative form again in a TELA context pertaining to the finishing of cloth³⁵. These Lc records of Hand 113/

³² This narrowly defined outer group was first identified and placed in western Crete by Hart, *Mnemosyne* 18 (1963) 8-9.

³³ See note 12 above for discussions of the location of **56-ko-we*, especially Killen, *Myc. Geography*, 45-46.

³⁴ For interpretation of this set and its vocabulary, see J.T. Killen, *Colloquium Mycenaeanum*, 153-64; *BICS* 13 (1966) 105-11; and *KN Textiles*, 43, 106. Killen, *BICS* 13 (1966) 108, emphasizes that these records give evidence of «a decentralized 'crofting' industry: wool is supplied to weavers located in various parts of Crete, who weave it into cloths of specific weights». Hiller-Panagl, 187, further support this view of regionally based workshops.

³⁵ Killen, *Colloquium Mycenaeanum*, 169.

115 are concerned with sites in the western part of the island³⁶. Again this limited number of references can be contrasted with the larger number of references to the five locales of the expanded inner group, four of which are mentioned in records monitoring: (a) «stints» for production of various work groups (Lc (1) set), (b) receipts of finished material from these Lc (1) workshops (Le set), or (c) deliveries of specially finished cloth from weaving or textile work groups (Ld (1) set)³⁷:

e-ra Lc 528.B, Lc 561.b
pa-i-to Lc 546, Le 641.2, Le 5629.3
*da-*22-to* Lc [7901], Ld 5955.1
 *56-*ko-we* Le 5646.2B.

In regard to the stirrup-jar toponyms the interest of Knossos in both the working of raw materials and the finished products of the wool industry is concentrated decidedly upon its own central province.

Third, further references to stirrup-jar toponyms are principally connected with herds of types of livestock other than sheep (C- series), personnel identified by ethnics derived from the toponyms (*e-ra-ja* [Ap 639.5], *ka-ma-jo* [Am 5882], *a-pa-ta-wa-jo* [Am 826]), single individuals from these sites mentioned in lists of personnel (*da-*22-to* [As 40], *56-*ko-we* [Ap 618], *o-du-ru-wi-ja* [Ai 982]), and deliveries of a few special commodities, such as *cyperus rotundus* (*da-*22-to* [Ga 464]), *po-ni-ki-jo* (*56-*ko-we* [Ga 424]) and saffron (*wa-to* [Np 7423]), which one or another of these sites produced.

The above observations suggest a good deal of autonomy for these individuals sites. Knossos was interested in these sites on a case by case basis when they could satisfy a particular economic need. It is important to emphasize here, too, a point that this analysis of references makes clear. The occurrence, even frequent, of a toponym and its related forms in the Linear B tablets of a palatial center does not necessarily translate into total palatial control of that site. Consequently, the removal of the central palatial authority does not mean that the various local textile workshops in what Killen (supra n. 35) describes as a decentralized home industry would completely cease production, nor would the herds producing the raw materials near these workshops cease grazing and producing, nor the special agricultural commodities used for dyes and such cease to grow. Each of these sites had a measure of self-control even under the palatial redistributive system so well outlined by Renfrew³⁸. Moreover, we should not lose sight of the fact that these local

³⁶ Killen, *Myc. Geography*, 43.

³⁷ Killen, *Colloquium Mycenaeum*, 151-54.

³⁸ *Emergence*, 296-97. For a general discussion see M.I. Finley «The Mycenaean Tablets and Economic History», *Economic History Review* 10 (1957) 128-41, esp. 135.

settlements were the basis for the redistributive economy³⁹. In a way the period of palatial control can be viewed as an intensive training course for these settlements, a period in which local productivity would have to satisfy peak demand. The more closely a site was attached to the palatial economy, the more severely that site would have been affected by the palace's demise. Yet we must conclude that just as local settlements in the various sub-regions survived the disappearance of the Minoan palaces and re-employed their same productive skills for Linear B Knossos, so too even the sites in the central region could continue to produce, albeit at reduced levels, after the destruction of the palace, particularly if there were still a market to which the finished product could be rechannelled through established networks that would not be crippled by the removal of the palace. For those western sites which were, as we have seen, less tied into the economic life of Knossos, the transition would have been even smoother.

Our major concern is the olive-oil and stirrup-jar industry. We have already deduced from studying the distribution of the stirrup-jar toponyms a possible pattern of regional exportation. Such a pattern is entirely consistent with the degree of independence that we have just discussed as probable for these sites within the other well-documented industries. What the widespread distribution of exported jars indicates is that a market for this Cretan product did exist⁴⁰, and the existence of a market is the primary requirement for the survival of a locally based industry. This applies whether or not it once fit closely into a palatial redistributive economy.

What is the evidence for Knossos's interest in the production and exportation of olive oil? What relationship between Knossos and local centers do the tablets document? What is the role of the stirrup-jar sites in this industry? How would this entire industry have been organized?

The textual evidence for the manufacturing, storage, handling and shipment of various types of olive oil at Knossos comes primarily from the Fh

³⁹ P. Warren, «The Emergence of Mycenaean Palatial Civilization», *Myc. Geography*, 69. S. Hiller, «Amnisos in den mykenischen Texten», *Kadmos* 21 (1982) 62, stresses that even the basic communities that supplied the Linear B palace at Knossos were «vom Palast offenkundig nicht verwaltet oder kontrolliert».

⁴⁰ For the extensive distribution of stirrup jars, see J. Raison, *Les vases à inscriptions peintes de l'âge mycénien et leur contexte archéologique* (Rome, 1968) 193-209, and now H.W. Haskell, «The Coarse-Ware Stirrup Jars of Crete and the Cyclades», Diss. (Univ. of North Carolina, 1981). There is no convincing evidence that the coarse-ware stirrup jars exported from Crete, inscribed or uninscribed, contained perfumed oil that had to be manufactured in palatial workshops. Yet Palmer considers this a reasonable supposition from the contextual association of stirrup-jars (*ka-ra-re-we*) and unguent boilers on text Fr 1184 from Pylos. However, Cretan stirrup jars are notably absent from Pylos. None of the ISJ's designates its contents as perfumed. For Palmer's views, see *The Interpretation of Mycenaean Greek Texts* (Oxford, 1963) 276.

and Fp series, which deal directly with olive oil⁴¹, and the Ga-Gg series, which are concerned with various spices and ingredients that could be used in the production of different types of perfumed oil⁴². Only one stirrup-jar toponym, again located in the South Central Region, occurs on Knossian records of oil:

e-ra F 726 .1]wi-jo-jo *e-ra*[
 .2]wō OLE + A V 1 [
 F 357 .2 *e-ra-de* OLE 2 V 1
 F 1059 *wi-na-jo* / *e-ra-jo* OLE V 1.

These three tablets are among those identified by Foster as records of cult offerings and small distributions to individuals, e.g. *wi-na-jo*⁴³. Even adding the major sites in Table 4 associated with stirrup-jar toponyms (*pa-i-to*, *a-pa-ta-wa*, *ku-do-ni-ja*) only produces one further reference in oil-related texts, again from the same set: *ku-do-ni-ja* on Fh 359 and 383. The total quantity of oil in the three *e-ra* tablets OLE 2 V 3 amounts to only 62.4 liters⁴⁴. The tablets in which *ku-do-ni-ja* appears are fragmentary and have no quantities preserved.

Such a low number of references in oil-related texts could be due to the hazards of archaeological excavation. But even within the more fully documented wool and textile series we have seen that the proportion of references to these sites was correspondingly low. One might also attribute the limited number of oil tablets in general to historical chance. For example, Melena has proposed that Knossos was destroyed in August-September. This would have been before the olive harvest was fully underway⁴⁵. However, we do have a coherent set of records, the Fh *a-pu-do-si* group, that registers shipments of olive oil to Knossos from local settlements⁴⁶. We should note here that this oil was produced locally and then transported to Knossos. Significantly the one identifiable toponym in this set of nine tablets, *a-mi-ni-si-jo*, fixes the area

⁴¹ See Hiller-Panagl, 155-62, and literature cited there on p. 155 n. 2. Most pertinent to our discussion is L. Godart, «Les quantités d'huile de la série Fh de Cnossos», *Atti Roma II*, 598-610.

⁴² E.D. Foster, «An Administrative Department at Knossos Concerned with Perfumery and Offerings», *Minos* 16 (1977) 18-51; and «*po-ni-ki-jo* Reconsidered», *Minos* 16 (1977) 52-66, esp. 56-58.

⁴³ *Minos* 16 (1977) 28.

⁴⁴ Using equations in *Docs*², 394: S = 9.6 l.; V = 1.6 l.; Z = 0.4 l.

⁴⁵ J. Melena, «Reflexiones sobre los meses del calendario micénico de Cnossos y sobre la ficha de la caída del palacio», *Emerita* 42 (1974) 77-102. Yet there are fairly large quantities of olives listed in the tablets, e.g., E 669, E 670, F 841 + 867, F 844.

⁴⁶ Fh 340, 349, 366 [+] 5503, 374, 377, 379, 5434, 5444, 5451, 5459. See L. Godart, *Atti Roma II*, 28-30, and the convenient table in Foster, *Minos* 16 (1977) 28.

supplying these shipments of oil in the immediate vicinity of Knossos⁴⁷.

The total quantity of oil in this set, whether calculated from its presumed totalling tablet (Fh 366: 6107 V = 9,771.21.) or from addition of the individual tablets having restored average quantities where missing (6615 V = 10,584 l.), is fairly large. Is there any way of determining the actual needs of the palace of Knossos for olive oil? Two bits of evidence, one archaeological, the other philological, present themselves. It has been estimated that the large complex of western magazines at Knossos could have provided space for as many as 420 large storage pithoi⁴⁸. Using the revised calculations of Ventris and Chadwick (ca. 200 l. per pithos) one arrives at a figure of 84,000 l. for the total storage capabilities of these magazines⁴⁹. It is improbable to assume that these areas were devoted totally to the storage of oil⁵⁰. In fact, the Linear B tablets found in various magazines record large quantities of other storable commodities. For example, three tablets of H 103, E 668-670, from western magazine XV record amounts of grain and olives totalling *GRA* 1321 T 2 (126,835.21.) and *OLIV* 222 (21,312 l.). The Gg tablets of H 220 from western magazine VIII list vases full of honey. Still when we consider the possibilities for storage of oil elsewhere in the vicinity of the palace, it is acceptable to take 84,000 liters as a reasonably unbiased estimate — neither intentionally high nor intentionally low — of the oil storage capacity of the palace. This means that a single shipment of oil from eight local sites would fill about one-eighth of the palace's storage area. How extensive a region then would Knossos have to draw from to reach its production and storage limits?

The other side of the oil industry is, of course, shipment and distribution. In the F- series we have no evidence of large-scale shipments of finished oil from the palace. The Fh, Fp and Fs tablets concern offerings in small quantities⁵¹. We should also remember that Knossos itself has produced only a single ISJ, KN 1716 from the Unexplored Mansion, although larger numbers of stirrup jars are reported in the notebooks of Evans from areas

⁴⁷ S. Hiller, «Amnisos in den mykenischen Texten», *Kadmos* 21 (1982) 44-45, discusses the place of Amnisos in production of oil for the palace at Knossos.

⁴⁸ *Emergence*, 296. For oil storage facilities in the Minoan palaces and villas, see A.J. Graham, *The Palaces of Crete* (Princeton, 1962), 130-34.

⁴⁹ *Docs* 2, 60. A.J. Graham, *The Palaces of Crete*, 130-31, estimates the total at 60,000 l.

⁵⁰ *Emergence*, 296, suggests grain and wine as other probable stored commodities. Note that the medallion pithos Zb 35 from the tenth west magazine is inscribed in Linear A with the signs for oil (LA 89) and figs (LA 60). See J. Raison, M. Pope, *Corpus transnuméré du linéaire A* (Louvain, 1980) 240, and *Kadmos* 14 (1975) 102-106. *GORILA* 4, 80-81, puzzlingly transcribes the first sign as a reversed LA 71, a grain of some type. Graham, *Palaces of Crete*, 131, notes that the larger pithoi at Mallia contained wheat or lentils; the smaller, some liquid, probably oil.

⁵¹ Hiller-Panagl, 160-62.

such as the Queen's Megaron and the Area of the Fish Fresco ⁵². Two tablets do list large numbers of stirrup jars ⁵³:

K 700 * 210 ^{VAS} +KA 1800
K 778 ka-ra-re-we * 210 ^{VAS} 180.

Assuming that the standard large size of stirrup jar is being referred to here (capacity ca. 12-14 l.), we would have evidence of the production of vessels for a maximum quantity of 27,720 l. of olive oil. Even this high figure would be well within the limits of the storage capacities estimated above.

We have already asked how extensive a region would be required to produce such quantities of oil. Is Knossos's apparent lack of interest in the oil production of the western stirrup-jar locales consistent with the actual historical situation in Late Minoan Crete? Could Knossos have drawn mainly upon the center of the island for its oil, leaving the other sub-regions to function independently as they undoubtedly had during the period of the Minoan palaces? The answer I think is decidedly yes. The 1953 Marshall Plan study of Crete lists the yearly production of olive oil for the entire island as 21,690,750 okes (30,818,207 liters) per year ⁵⁴. Of course, this production depends on some modern techniques of cultivation, pruning and insect control, but not so far advanced over basic methods employed in the Bronze Age ⁵⁵. Linear A records confirm that oil was being produced in perhaps some sixteen different varieties in the MM III - LM I periods in all the main sub-regions of Crete. Chania, Hagia Triada, Phaistos, Knossos, Tylissos, Arkhanes and Zakro all have records of oil ⁵⁶. According to the Marshall Plan report:

⁵² Palmer, *On the Knossos Tablets* (Oxford, 1963) 142-43.

⁵³ Niemeier, *SMEA* 23 (1982) 259. For the identification of the ideogram and dating of the stirrup-jar as a pottery-type, see J.-P. Olivier, F. Vandenabeele, *Les idéogrammes archéologiques du linéaire B* (Paris, 1979) 266-67.

⁵⁴ L.G. Allbaugh, *Crete: A Case Study of an Underdeveloped Area* (Princeton, 1953) 328, table MS 1.

⁵⁵ Compare Allbaugh, *Crete*, 269-72, and *Emergence*, 285-91, 304-307.

⁵⁶ At least sixteen variations of the oil ideogram, differentiated by adjuncts, are registered on the tablets from these sites. This invites comparison with the similar designation of various types of processed oil on the Linear B tablets from Pylos, for a concise discussion of which see Hiller-Panagl, 163-69.

The references to oil by site, type and tablet numbers are:

<i>Arkhanes (AK)</i>	* 89: 3.b.3
<i>Hagia Triada (HT)</i>	* 89: 101.3, 114.2, 116b.2, 121.2, 131a.4, 137.3, 139.3
	* 89 + [: 23b.1, 125a.4, 129.4
	* 512: 2.2, 2.4
	* 513: 2.2, 21.3, 42.3, 50a.3, 58.3
	* 514: 2.1, 2.3, 44b.2
	* 515: 8a.1, 18.1, 28b.2, 42.1, 42.2, [+]59.3, 44b.2, 50a.2, 50b.2, 56b.1, 91.2, 101.2, 101.5, 116a.3, 116a.5, 125a.2, 129a.4, 140.2

The areas of heaviest olive production were located near Ierapetra and Khania. Other major olive producing areas along the northern coast were found near Kastelli-Kisamos, Kastelli-Pedhiadhos, and east of Rethimnon and Sitia. Palaiokhora and portions of the Mesara Plain also had large olive groves⁵⁷.

These areas match up well with the definable sub-regions centered around Minoan palaces and with the concentration of stirrup-jar toponyms in

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- * 516: 12.2, 14.2, 14.4, 28a.2, 28a.[4], .5, 28b.3, .6 (bis), 50b.4, 90.2, 116a.2, 129.3
 - * 517: 14.1, .4, 28b.2, [+] 59.2, 50a.2, 58.2, 90.4, 91.3, .5, 100.5, 101.2, .6, 116a.3, .5, 125a.3, 137.2
 - * 518: 21.2, 42.1, .2, 58.2, [+]59.4, 96b.3, 100.5, 101.2, [.3], 101.4, 125a.2, 140.4 (bis), .5, .6
 - * 521: 23a.1, 32.1, .4, 100.5, 112a.1
 - * 522: 23a.2, 28b.2
 - * 523: 28b.2, 91.2
 - * 524: 30.3, .5, 35.3
 - * 525: 44b.3
 - * 528: 121.1
 - Chania (KH)* * 89 + [: 80, 85.3
 - * 524: 19.2, 39.2, 55.2, 61.3, 85.1
 - Knossos (KN)* * 89: Zb 35
 - Phaistos (PH)* * 89: 32.1, .2
 - Tylissos (TY)* * 89 + [: 3a.5, .6
 - * 515: 3a.1, .3, .7, b.2
 - * 517: 3a.2, .5, b.1, .2
 - * 521: 3b.3
 - * 522: 3a.7
 - * 583a: 3a.4
 - * 583b: 3a.3
 - * 584: 3a.2, .4
 - Zakro (ZA)* * 515: 18.2, 21b.1
- The types of oil are documented at the following sites:
- * 89: AK, HT, KN, PH
 - * 89 + [: HT, KH, TY
 - * 515: HT, TY, ZA
 - * 517: HT, TY
 - * 521: HT, TY
 - * 522: HT, TY
 - * 524: HT, KH
 - * 512, * 513, * 514, * 518, * 523, * 528: HT
 - * 583a, * 583b, * 584: TY.

This indicates widespread production of specific types of oil, making the logical assumption that during this period major sites are drawing upon the resources in their own regions for production of special types of oil rather than importing different kinds from a central manufacturing site. A convenient survey of evidence for oil production in Middle and Late Minoan Crete is given by W. Richter, *Die Landwirtschaft im homerischen Zeitalter*, *Archaeologia Homerica*, II, H (Göttingen, 1968) 136, who concludes that «in der mittel- und spätminoischen Kultur das Olivenöl eines der wichtigsten Verbrauchs- und Handelsprodukte war».

⁵⁷ Allbaugh, *Crete*, 280, and the land use map at the end of Allbaugh's report. See also *Greece Volume II Economic Geography, Ports and Communications*, *Geographical Handbook*

the western and west central regions of the island, near the highly olive-productive areas around Chania, Rethymnon and the southern half of the route from Rethymnon to Phaistos. Is it likely that the levels of olive-oil production for each of the districts that supplied the LM IB Minoan palaces fell off drastically after their disappearance? As we have seen from the Linear B tablets, the minor settlements in these regions were still active in the production of other agricultural commodities. Also we should remember that Knossos in the pre-LM II period was already being completely supplied with olives from its own established sphere of influence. Could its needs and production capabilities have increased so drastically as to have assumed the whole olive production of the other sub-regions of the islands? In 1962 the Herakleion nome, which encompasses the entire Mesara plain, alone produced 6,666,666 liters of oil⁵⁸.

The most sensible conclusion is to accept the fact that as far as oil production is concerned communities in the various olive-rich areas of the island kept producing oil locally. Knossos could satisfy its own needs at the time of the Linear B tablets from sites in the surrounding central area of the island. Knossos was also chiefly concerned with the intensive production of wool and cloth noted in the Linear B archives. There is nothing in the Linear B tablets or the archaeological circumstances of the stirrup-jar finds to make Knossian control of the entire olive-oil industry of Crete necessary. There is, however, strong evidence for regionalism in the western cluster of stirrup-jar sites. Here *ku-do-ni-ja*, which is itself in the middle of a rich olive-growing district and has a tradition as a Linear A administrative center, is a likely candidate to have continued into the LM III period the oil production attested for the LM I B period on its Linear A tablets. The considerable number of stirrup jars from the site also mark it out as a special center for exportation. Yet we must not assume that it was the only such center. The distribution of toponyms on the mainland ISJ's and the existence of another identifiable coastal site (*a-pa-ta-wa*) closer to the equally fertile olive district near Rethymnon make the existence of many regional centers for this industry far from the improbable hypothesis it has heretofore been made to appear. An active palatial complex with a Linear B administration at Knossos is no *sine qua non existunt ka-ra-re-we et OLEUM*.

Series Naval Intelligence Division, October 1944, pp. 66-68 and fig. 18, for the production of olive oil in Crete in 1937, a very good year for olive production. This indicates that the four nomes of Crete produced oil in the following descending order: Herakleion (central), Chania (far west), Rethymnon (west central), Lassithi (far east).

⁵⁸ *Emergence*, 294.