

**Angelos Chaniotis (Ed.)**

# **From Minoan Farmers to Roman Traders**

**Sidelights on the  
Economy of Ancient Crete**



**Franz Steiner Verlag Stuttgart**

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Edited with the assistance of  
Louise Shaler, James Cowey and Oliver Hoover



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# Systems of Weight and Social Relations of 'Private' Production in the Late Bronze Aegean

Anna Michailidou

## PART I

### THE MAIN DISCUSSION<sup>1</sup>

#### 1 THE SIGNIFICANCE OF THE BALANCE WEIGHTS

The ideas developed in this article were occasioned by the study of the lead weights found in large numbers in the LC I settlement at Akrotiri (preliminary presentation of material: Michailidou 1990). The weight metrology of the Bronze Age Aegean has been studied by Petruso in his doctoral dissertation (1978c; cf. Part II no. 1) and various articles (see below). One system, which he dubbed the 'Minoan' system, dominated the south Aegean in the Late Bronze Age; it includes discoid balance weights, both stone and lead ones, from Crete and the Cyclades, with a number from the Mycenaean world (Petruso 1978a; 1978b; 1978c; cf. Part II no. 2). The unit of weight for this system was defined by Petruso as being about 61 gr. An earlier view asserts that the unit was 65.5 gr (Evans 1935, 650-655; Caskey 1969, 95-106; see also Parise 1986, 303-314; Michailidou 1990). In recent decades, there have been great advances in metrological analysis, with the aid of modern statistical methods (Hewson 1980, 363-370; Cherry 1983, 52-56), but despite the progress made in the methodological approach, there are still difficulties in the first stage — the selection of the data from which the sample is to be formed. In the case of weights in particular, it is necessary to attempt to define a tolerable margin of error in measurements of mass (Petruso 1978c, 15-18; Cherry 1983, 53; Michailidou 1990; cf. Part II no. 3).

Independently of metrological analysis, however, weights deserve particular attention from the point of view of their social and economic context, as well as the *cognitive abilities* of their inventors. As Renfrew (1983, 14) has commented in connection with the system of stone weights that was in use in the Indus Valley by the third millennium BC, the existence of a metrological system is an indication of the stage of human knowledge at the period in question: "we are learning, by reliable inference, about humanity's ability to

<sup>1</sup> Part I is the translation of an article written in Greek in 1989 and published in the volume *Ποικίλα (Μελετήματα, 10)*, edited by the Research Center for Greek and Roman Antiquity of the National Hellenic Research Foundation (Athens 1990, 65-94). I owe the translation of the original article to Dr David Hardy, to whom I would like to express my warm thanks. I have preferred to retain the original form of the article, updating its content and bibliography in an additional commentary (Part II). The bold numbers in Part I refer to the notes of the additional commentary in Part II. I would like to express my thanks to Professor J. Maran for the environment he kindly provided in the library of the Institut für Ur- und Frühgeschichte in Heidelberg, where Part II was written in December 1998.

map the world and about the development of concepts developed for this purpose..." The numerical system used by the Minoans and the Mycenaeans is known to us from the Linear A and Linear B clay tablets. It was a decimal system (Ventris and Chadwick 1973, 36, 53, 117-119; Dow 1958, 32-34) which was considered suitable for a range of mathematical operations (Anderson 1958, 363-368). A practical way of carrying out addition was to scratch vertical lines in groups of ten — as attested on the verso of a tablet from Pylos (Chadwick 1976, Fig. 20). For more complicated operations, unfortunately, no material evidence has survived comparable to the so-called 'school' tablets of the Sumerians, on which even correct and incorrect solutions to the same division problem are sometimes recorded (Høyrup 1982, 19-36). The existence of a duodecimal system, and possibly even a system to base 60, in the case of weights (Petrušo 1978c, 27), attests to advanced mathematical thought, since both systems have clear advantages over the decimal system, in which two and five are the only divisors.

The weights certainly testify to the ability to carry out mathematical calculations, an ability that is in any case also known to us from the mathematical proportions apparently expressed in the dimensions of architectural structures (Preziosi 1983, 319-500; Graham 1969, 222-229; Cherry 1983), and most probably also in volumes of vases (Lang 1964; Katsa-Tomara 1990); balance weights are of greater interest, however, for the information they may provide for the *economic system* of the society that created and used them. There is no doubt that Late Minoan society was a complex society (Cherry 1986, 20), and the invention of a metrological system is one of the manifestations of this (cf. Knapp 1986, Table III). Quite apart from the fact that the invention of a metrological system implies a complex society, it is interesting to see what is implied by the presence of the weights themselves in the specific geographical and social space. According to Petrušo, for example, weights are 'tools' of trade rather than objects of trade. Consequently, the discovery of the same system of weights in two geographically separate places is evidence of trade relations, since it answers the need to give the same valuation to equal quantities of goods (Petrušo 1979, 139). The lack of a coinage in Minoan/Mycenaean societies was the most serious of the reasons advanced by Alexiou for considering trade to be the exclusive monopoly of the palace authorities (Alexiou 1987, 251-253; 1953/54). However, "systems of weight exist in order to standardize quantities of goods and materials" (Petrušo 1979, 139), and they played an important role in pre-coinage societies. Can the existence of weight standards therefore cast light on the relations of production of their period? To approach this question, I shall examine: (i) sites and places in which weights have been found in the Late Bronze Age and (ii) commodities they were used to weigh.

## 2 SITES THAT HAVE YIELDED BALANCE WEIGHTS

The study of the catalogue in Petrušo's dissertation (1978c, 179-215) reveals that weights of the Late Bronze Age have been found in Crete, on three of the Cyclades islands (Kea, Thera, and Melos), and in some parts of mainland Greece (the Peloponnese and Central Greece). They come both from coastal sites (e.g., Mochlos) and from the interior (e.g., Praisos). In terms of social space, they have been found in palaces (e.g., Knossos), villas (e.g., Ayia Triada; cf. Part II no. 4), houses in settlements (e.g., Akrotiri), and tombs (e.g., Vapheio). In Table 1, the first column gives the site at which weights have been found (following Petrušo's catalogue, and a number of cases I have added, together with the bibliography; cf. Part II no. 5), the second column gives the specific social context of the find (cf. Part II no. 6), and the third column adds details that may prove useful. The

table does not include the stone weights (?) from Malthi, of Middle Helladic date. Also omitted are a number of stone examples from Phokis, Korinthos, Sparta, Tiryns, and Dendra (see, e.g., Petruso 1978c, 204-208, 214), which require further investigation and are undated.

Site	Context	Find
<b>Crete</b>		
<i>Knossos</i> Settlement with palace	Palace	Various balance weights: Lead discoid <b>Stone discoid</b> Stone sphendonoid Stone 'anchor' Bronze calf's head Stone discoid weight (House A at Gypsades)
	House	
Mallia Settlement with palace	House	Lead balance weight, discoid (Quartier E)
	House	Lead balance weights, discoid (House Zb: <i>Études Crétoises</i> XI, 75)
Zakros Settlement with palace and harbour	Palace	Stone 'oval' weights ( <i>Praktika</i> 1962, 162) Stone discoid balance weight (House H, north of the palace) Stone discoid balance weight
	House	
Mochlos Settlement with harbour		<b>Lead discoid</b> balance weights
Pseira Settlement with harbour		Stone discoid balance weight
Palaikastro Settlement with harbour		Various balance weights: Lead discoid Stone discoid Stone 'ducks'
Katsambas Harbour (Knossos)	Tomb	<b>Stone sphendonoid</b> balance weights
Kommos Harbour (Phaistos)		Lead discoid balance weight

**Table 1. Sites that have yielded balance weights (cf. Part II no. 5)**

Site	Context	Find
<b>Crete</b>		
Tylissos Settlement with 'villa'	House type 1 (McEnroe 1982)	<b>Lead discoid</b> balance weights Lead spheres - balance weights
Ayia Triada Settlement with 'villa'	House type 1 (McEnroe 1982)	<b>Lead discoid</b> balance weights Stone discoid balance weights
Maroulas (Siteia)	chance find	Lead discoid ( <i>Praktika</i> 1977, 495)
Dictaeon Cave	Sanctuary	Bronze ox head filled with lead
Praisos Tombs	Tombs	Stone discoid balance weights
Mavrospilio Tombs	Tombs	Balance weights: Lead discoid Stone discoid
Pachyammos Tombs	chance find	Stone discoid balance weight
<b>Cyclades</b>		
Thera Settlement with harbour	Houses	Balance weights: <b>Lead discoid</b> Stone discoid Stone sphendonoid
Kea Settlement with harbour	Houses	Balance weights: <b>Lead discoid</b> Stone discoid
Melos Settlement with public building		Lead discoid balance weights
<b>Mainland Greece</b>		
Mycenae Acropolis with palace	Acropolis	Various balance weights: <b>Lead discoid</b> Stone discoid Stone sphendonoid
Athens Acropolis	Mycenaean spring	Various balance weights, e.g.: <b>Lead discoid</b> Stone discoid Stone sphendonoid

**Table 1: Sites that have yielded balance weights (cf. Part II no. 5)**

Site	Context	Find
<b>Mainland Greece</b>		
Pylos Palace	Houses	Lead discoid balance weights
Vapheio Tholos tomb	Tomb	Lead discoid balance weights
Thorikos Lead mine with harbour	Tomb	Lead discoid balance weight
Perati Tombs	Tomb	Balance weights: Stone dome Stone flatened sphere Stone sphendonoid

**Table 1. Sites that have yielded balance weights (cf. Part II no. 5)**

In Table 1 bold typeface emphasises the kinds of weights which make up the majority in the specific place in question. Quantitative conclusions are dangerous (except in the case of Akrotiri, where the volcanic material 'sealed' a large part of the household equipment), as, too, are conclusions drawn from comparisons between find places, since they may be based on an *argumentum ex silentio*. Accordingly, account is taken only of positive evidence: the presence of a *variety* of weights in the palace at Knossos is taken into consideration, for example, but not the absence of weights recorded from the palace at Phaistos. The large number of lead weights found in the Cyclades should be noted, however: about 50 from Ayia Irini on Kea (Caskey 1969, 95-105) and 102 from Akrotiri on Thera (Michailidou 1990), as opposed to 36 weights known to Petruso from the whole of Crete (cf. Part II no. 7). This perhaps underlines the important role played by the Cyclades in the Aegean transit trade (see, e.g., the West String review by Davis 1979, 146, and the reconsideration of the thalassocracy by Doumas 1982). Could it also imply that the use of lead to make weights was a Cycladic invention (Michailidou 1990; cf. Part II no. 8)? Stone weights are more reliable with regard to their weight, since they do not wear as easily as lead (for the advantages and disadvantages of lead as a raw material for weights, see Petruso 1978c, 4). It is possible, then, that the presence of several stone weights in the palace at Knossos indicates that standard weights (which I assume to have been of stone) were kept in the headquarters of the palace bureaucracy: the 'anchor' of porphyry with the octopus relief has been thought to be one such standard, for the value of one talent (Evans 1935, 651; contra: Davaras 1980, 61-67). The shape of some stone weights (e.g., sphendonoid) may attest to foreign contacts and influence (for sphendonoid weights see, indicatively, Petruso 1984, 293-304), and it is not surprising that such weights have been found at Katsambas — the harbour town of Knossos, where tombs with grave offerings of Egyptian style have also been found (Alexiou 1967) — or in the palace at Knossos — from which foreign trade is thought to have been directed (Wiener 1987 and 1990).

In Table 1, lead disc-shaped weights seem to be in the majority, and also the most widely disseminated, their great advantage being that a greater weight-value is achieved

using a smaller volume. They were accordingly very useful for weighing large quantities of goods; stone weights were more appropriate for weighing small quantities, since they were more reliable and gave a more accurate measurement. The view has accordingly been advanced that lead weights were “for everyday mercantile weighing of non-precious commodities such as foodstuffs, raw materials and manufactured items in ancient general stores,” while stone ones served for “small quantities of gold or rare spices, in fact the majority of haematite weights from the Aegean and Cyprus are under 100 gr. in weight” (Petrušo 1978c, 3). This leads on to our second question: what precisely was weighed by these weights, whatever their material?

### 3 COMMODITIES MEASURED BY WEIGHT

For this subject, I derive my information from the tablets. In the Linear A tablets (the Linear A script is contemporary with the lead weights of Thera), the items recorded are followed by numeral signs, without the intervention of any special metric symbol for weight or volume (Bennett 1950, 209; Ventris and Chadwick 1973, 36). It should be noted, however, that Linear A has a sign for weighing-scales (Ventris and Chadwick, *op. cit.*) as well as the monogram for wool, which may be the forerunner of the special unit of weight for wool (LANA), recorded in the Linear B tablets (Palaima 1988, 326 and n. 82).

In the Linear B tablets, the commodities listed are often followed by special metric symbols: symbols for volume and also for weight have been identified. In Linear B, then, commodities may be counted (e.g., so many vases or so many sheep), weighed (e.g., so many talents of bronze), or measured in units of volume (e.g., so many litres of oil). The interesting feature to emerge from the lists of products in Linear B is that farm produce is normally *not weighed*. Wheat, barley, flour, olives, oil, figs, wine, and also perfumes or spices are measured in units of volume, specifically designed for dry or liquid products (see Ventris and Chadwick 1973, Fig. 10, under the columns: *By dry measure*, *By liquid measure*). Consequently, if it is accepted that units of volume were in practise even during the period of Linear A (cf. Bennett 1950, 221; Katsa-Tomara 1990), both foodstuffs and rare spices should be excluded from Petrušo’s conclusion stated above (1978c, 3).

Attempts were made by Was (1972; 1973b) to identify measures of volume and weight in the Linear A symbols for fractions, and some of his conclusions were used by Petrušo. Is it likely, however, that alongside the units of volume for wheat, there was also the unit to which Was gives the name ‘heavy talent’? Was himself concedes that this was used “apart from the more usual measurement by dry capacity” (Was 1973b, 147). Was’ arguments have been considered with scepticism (see the criticism by Bennett 1983, 8-32), and it is preferable to turn to the evidence of the deciphered Linear B tablets, which list a wider variety of goods. The items weighed in the Linear B tablets appear to be: metals — such as copper/bronze, gold, silver (?), and lead —, wool, flax, saffron, wax (?), and possibly some fabrics (Ventris and Chadwick 1973, Fig. 10 in the columns: *By weight* and *By weight or in units*).

The following commodities were weighed, according to the Linear B tablets:

#### Metals

*Copper* or *bronze* is mentioned in quantities of 1, 1½, 2, 3, 4, 4½, 5, 6, 7, 8, and 12 kg, with regard to the bronze distributed by the palace (of Pylos) to each of the bronze-



smiths under the *talasia* system (Ventris and Chadwick 1973, 352-354).<sup>2</sup> The products resulting from the working of the bronze were probably weighed when they were returned to the palace (Chadwick 1976, 140). Total quantities of bronze (e.g., of the order of 1046 kg) are also mentioned (Ventris and Chadwick 1973, 356). There is the interesting tablet from Knossos with a list of 60 bronze ingots of a total weight of 1562 kg (Chadwick 1976, 142; cf. Part II no. 9).

*Gold* is mentioned in quantities ranging from 62 gr to 1 kg, the most common quantity being 250 gr, in a tablet recording tribute paid to the palace of Pylos. The total quantity is calculated to be about 6 kg (Chadwick 1976, 359).

There are very few references to *silver* (Chadwick 1976, 143), but it is interesting that if silver is rendered also by the ideogram \*143 (Ventris and Chadwick 1973, 351), this is a simpler form of the ideogram for weight \*115 (Ventris and Chadwick 1973, 57; but see Parise 1986, 308).

*Lead* is mentioned three times in only a single tablet (from Knossos), together with some unknown material (Ventris and Chadwick 1973, 359). On all three occasions, the quantity listed is three kg of lead (for a linguistic examination of *mo-ri-wo-do*, see Chantraine 1972, 205f).

### Wool

Sheep's wool was weighed by a special weight unit indicated by ideogram \*145 (LANA), which was equal to about 3 kg and normally corresponded with the amount of wool yielded by the shearing of four sheep (Killen 1962, 38-72; 1964, 9). This ideogram is to be found in the Knossos tablets listing numbers of sheep and the wool yielded by them (cf. Part II no. 10).<sup>3</sup> The quantities recorded are large: a tablet from Knossos, e.g., records the assembling of 456 units of wool from the area of Phaistos — that is, 1368 kg (Ventris and Chadwick 1973, 205).

The same ideogram also occurs in tablets listing textiles, thus making it possible to calculate the weight of the raw material required by the specific type of textile. For example, for the cloth named *tu-na-no*, three units of wool were required, while *te-pa* was a very heavy one, needing seven units of wool (Ventris and Chadwick 1973, 316). All cloths are counted, though one kind is possibly listed by weight (Ventris and Chadwick 1973, Fig. 10, columns: *By weight or in units*, and *Counted in units*).

### Flax

Flax is recorded only followed by numerals in the Pylos tablets, but in the Knossos tablets it is recorded by weight. It has been suggested that the numerals in the Pylos tablets refer to bundles of flax, and not to linen textiles (Ventris and Chadwick 1973, 468). There is also the possibility that the ideogram \*31 for flax indicates a special unit of weight in the Pylos tablets — like the ideogram for wool — resulting in quantities of one to three tons for each site in the region of Pylos (Chadwick 1976, 153f; Tzachili 1988, 500). Flax was used not only to make cloth, but also sailcloth, rope, and nets.

At Knossos, flax was recorded in quantities of one to three kg, and occasionally eight kg (Ventris and Chadwick 1973, 468; Chadwick 1976, 153; Killen 1985a, 29). Linen

<sup>2</sup> For the meaning of the term *talasia*, see especially Duhoux 1976, 69. According to the '*talasia*' mode of production, the palace provided a weighed quantity of wool or bronze to the craftsman, over whom it accordingly exercised control.

<sup>3</sup> For the entire process of assembling and working wool for the palace, see Killen 1962; 1964; 1984; Melena 1975; Tzachili 1988.

clothes are mentioned (Ventris and Chadwick 1973, 319f), and there is an interesting reference to a thin linen chiton, followed by the sign for bronze and the weight of 1 kg (*ibid.* 320).

### Aromatic substances

These include a variety of substances derived from plant sources which were used to make perfumes, spices, dyes, and medicines. Most of these were measured by units of dry volume, though there are the following specific examples that were weighed:

- The substance *phoinikion* (*po-ni-ki-jo*) occurs in quantities of the order of three or five kg (Ventris and Chadwick 1973, 222).
- Safflower (*ka-na-ko*) — the red kind (*e-ru-ta-ra*) — is weighed in quantities of 1-3 kg, in contrast with the white (*re-u-ka*) which is measured in units of volume (*ibid.* 226).
- Saffron (ideogram \*33) is weighed in very small quantities, by weight units used for gold (*ibid.* 130), with even smaller subdivisions (J. Driessen, personal communication; cf. Patr II no. 11).
- Celery (*se-ri-no*) is mentioned in quantities of 2 kg (*ibid.* 231).

*Phoinikion* was probably used to make red dye for cloth (Tzachili 1988, 175 and n. 154). Safflower (*knekos*) was also used for dye, though possibly additionally for medicinal purposes and cooking. The distinction between red and white *knekos* apparently corresponds to Hesychius' comment that *knekon* of a reddish colour come from the flower, but when it is from the seeds (?) it is white (Ventris and Chadwick 1973, 226). Saffron was probably used to make yellow dye, a colour characteristic of a special kind of garment (*krokoto*) (Tzachili 1988, 175 and n. 155; cf. Part II no. 12).

### Wax (?)

Two ideograms, \*142 and \*44, both of which are followed by metrical signs for weight (Ventris and Chadwick 1973, Fig. 10), have been interpreted as referring to wax. Of these, \*142 has recently received a different interpretation (Melena 1988, 213-217): the tendons of the wild goat, which were used for sewing together the hides needed to construct chariots. They are recorded along with other products of the wild goat (hide and horns) in quantities of 1 kg per animal (cf. Part II no. 13).

### Ivory

A tablet from Knossos records ivory (*e-re-pa-ta*) with a weight of one talent or 30 kg (Ventris and Chadwick 1973, 393).

All the above commodities share a common feature: they are connected with craft-industrial processes. They are mainly raw materials that were not fluid, and could not be measured in units of volume (metals, wool, flax, ivory), though they also included dyes and perfumes and possibly other similar items (see the ideograms and words associated with metrical symbols for weight: Sacconi 1971, 146f). It is also likely, of course, that the finished products were weighed to establish the quantity of raw material used in them (Chadwick 1976, 140). The full description of the weights is not simply 'tools of trade' (Petruoso 1979, 139) but 'tools of industry and trade' (Petruoso 1978c). Possibly their primary function was as 'tools of craft-industry', since they were useful for measuring the admixtures of metals: attention has properly been drawn to the contemporary emergence of systems of stone weights and gold jewellery at Tarsos, Troy, and Poliochni (Petruoso 1978c, 65; cf. Part II no. 14). Their second function, as 'tools of trade', rapidly followed upon the first.

#### 4 WORKING HYPOTHESIS I

On the basis of the evidence furnished by the tablets, one might state as a preliminary working hypothesis that the presence of the weights indicates a need to assess the quantity of raw material and the craft product, and implies that the area in which they are found was:

- A) A place where the raw-material/craft product was produced.
- B) A place for distributing the raw material/craft good.

The presence of weights is consequently connected with the investigation of two questions: 1) How were the raw materials and the craft goods produced and distributed (who were the producers, who the distributors, what was the transport network); and 2) what was produced or distributed (what is the source of wealth in each case)? On the basis of this working hypothesis, if the weights are considered indicators of workshop production and distribution of raw materials, then they can claim their place in the context of the relations of production of their era. By this I mean the 'social relations of production' (Knapp 1985, 1), that is, the social relations under which productive activity is developed (Chourmouziadis 1982, 45).

According to the foregoing, the presence of weights (see Table 1) at Phylakopi on Melos and Thorikos in Attica may be associated with the need to assess raw material — obsidian (cf. Part II no. 15) and lead respectively —, and it is no coincidence that large quantities of lead were found on the Athenian Acropolis (as Gale 1978, 176). Cyprus may be regarded as another example, with its copper mines (for the weight systems on Cyprus, see provisionally Petruso 1984). *The discovery of weights in ports, such as Mochlos, Pseira, Palaikastro, Katsambas, Kommos, Akrotiri on Thera, and Ayia Irini on Kea* may be associated with the distribution of raw materials and craft goods and with the sea routes followed by the trade of the period, and this is also true of Cyprus, on account of its strategic position (cf., e.g., Knapp and Portugali 1985, 66, Fig. 4-3 and Cypriote sites at which weights have been found: Petruso 1984, 297). The presence of weights at palace sites such as Knossos, Zakros, and Mallia is connected both with the manufacturing of craft goods (palace workshops) and with the distribution of raw materials and craft goods (the palaces were centres of trade and craft-industries: Alexiou 1987). I shall leave aside the tombs, in which the presence of weights (or weighing-scales) has been attributed either to religious beliefs or to the profession of the occupant (Petruso 1978c, 221f), or the sacred cave at Psychro, and shall discuss in detail the cases of the 'villas' at Tylissos and Ayia Triada where weights have been found.

The Minoan and Mycenaean palaces have been regarded as major redistributive centres (Renfrew 1972, 296, 461; see more specifically Halstead 1988). During the time of the Linear B script, in particular, the palace at Knossos exercised bureaucratic control over the economy of a large part of the island of Crete, though possibly only of selected sectors. The general picture emerging from the Linear B tablets is that they recorded the production of manufactured goods, the procurement of the raw material for this manufacture, and the supporting of the work force with basic foodstuffs (Bennet 1988, 26f). The craft-industries recorded are: cloth production; bronze-working; perfume-making; manufacture of chariots, wheels, weapons, and furniture; and the processing of hides. Occupations not listed but deduced from the names of the professions are: pottery-making, bow-making, goldsmithing, the working of lapis lazuli, shipbuilding, carpentry, net-making, and building (Killen 1985b, 272; also Lindgren 1973). Within this centralised system of economic organisation, there are thought to have been second-order

centres, such as Phaistos and Ayia Triada, and third-order centres, like Tylissos (Bennet 1988, 29-31, 34f). 'Mycenaean' Knossos seems to have taken over an already existing system: the centres that can be identified on the Linear B tablets (e.g., Amnisos) relate to sites at which 'villas' of the New Palace period have been discovered, which are thought to have functioned as local centres for the mobilization of goods the ultimate destination of which was the palace (Bennet 1988, 38f). The existence of the so-called villas and country houses in the New Palace period has been thought to be an indication of 'decentralisation' in the sphere of agricultural production, with the new palaces now concentrating on the production and storage not of foodstuffs, but of craft goods (see, e.g., Halstead and O'Shea 1982, 96f; cf. Part II no. 16). Within this framework, the presence of weights at Ayia Triada and Tylissos is associated with the assembling of raw material (wool or flax from the area) and the presence of workshops. The villas not only stored farm produce but also distributed raw material and produced craft goods. This picture appears to be confirmed by the presence of loom weights and copper ingots at the same sites. Moreover, the Linear A tablets (of which Ayia Triada has a large archive) attest to local registering of goods. Conclusions relating to the profession of those who worked in the villas or for the villas, and their payment (e.g., Watrous 1984, 130), are better set aside (see Palaima 1987, 301; Bennett 1983, 7-32) since they are based on a script that has not yet been deciphered.

What we have said so far constitutes a preliminary 'logical' explanation for the discovery of weights at the sites included in Table 1, and in some points perhaps offers an over-simplified picture. Thorikos, for example, was not only a source of raw material (lead) but also an excellent port through which it could be distributed. The discovery of weights at the settlement of Akrotiri on Thera is associated not only with the role played by the island in the transit trade of the Aegean (Doumas 1982), but also with the assembling of wool and the craft production of fabrics (Michailidou 1990; Tzachili 1990). The majority of the sites are not either A or B (see the above working hypothesis), but A + B. It certainly becomes apparent that during the period of the new palaces, there was some kind of decentralisation not only in the sphere of farm produce but, as the presence of weights, loom weights and bronze talents shows, also in the sphere of workshop production. A survival of this decentralisation of workshops is attested in the Linear B tablets from Knossos, where, in contrast with Pylos, the wool was processed — and the cloth woven — in the places where it was produced, despite the fact that the entire process is then recorded in the palace at Knossos (Ventriss and Chadwick 1973, 486; Chadwick 1976, 151).

Was the 'villa' (cf. Part II no. 17), however, the seat of an official who assembled the produce of the area at the behest of the palace? According to Watrous, the famous villa of Ayia Triada is not one, but three houses, and although he attributes an administrative-economic role to villa A (and other Minoan villas), he describes Ayia Triada as "a fairly typical Neopalatial town" which, like Kommos, served as a harbour for Phaistos, on the pattern of Poros-Amnisos for Knossos (Watrous 1984, 132f). Reservations have also been expressed as to the storage potential of the villas (Kanta 1983, 160). It has been observed that the term 'villa' or 'country house' has been mistakenly applied in some cases, as at Nirou Chani or Pyrgos (Zois 1987, 46), and, of course, there are three houses at Tylissos. In most cases, what we have are imposing houses in settlements that have not been fully excavated (e.g., Amnisos; cf. Part II no. 18). Even in the case of

country-houses, there was usually at least one more installation in the same area (Watrous 1984, 133).

The movement of raw materials and craft products, then, seems to have been between the palace (the redistributive centre) and *its peripheral settlements (the production units)*; in contrast with the period of the Linear B script (for differences in the Cretan economy as deduced from the Linear A and the Linear B tablets, see Palaima 1987, 301-303), the bureaucracy was also to be found on the periphery (in Crete, outside the palaces, Linear A tablets have been found at Ayia Triada, Chania, Archanes, Tylissos, Palaikastro, Papouira, Pyrgos: cf. Palaima 1988, 326; cf. Part II no. 19). This is further confirmation of the decentralised economic system in the New Palace period, based on 'systems of settlements' which Zois identified as systems of cooperating settlements with their organisational institutions concentrated in the palace (Zois 1982, 209); the additional element is that these settlements specialised not only in farming but also, as is evident from the finds, in craft-industries.

*In the period of the new palaces there were, alongside the 'palace workshops' housed in the palace itself or in houses in the surrounding area, a large number of workshops that functioned in the settlements on the periphery*; this furnishes the answer to the question posed by M. van Effenterre relating to the large number of preserved craft goods and the paucity of archaeological evidence for palace workshops — an answer at which she herself hints (M. van Effenterre 1983, 72f). The suggestion has already been advanced that *weaving flourished in the harbours* (Tzachili 1987), and weaving workshops are indeed to be identified in some houses of the settlements: the picture of specialised cloth production to emerge from Akrotiri on Thera is an interesting one, with weights and loom weights concentrated in the same house: more than 400 loom weights were found in the West House, along with an apparently complete set of weights, amongst which the material evidence for the unit for wool (LANA) is also found in situ (p. 103, Table 2, A/A 16; Tzachili 1990; Michailidou 1990). From this point of view it is also interesting that two weights out of the three reported from Mallia were found in House Zb, in which loom weights were again found (*Études Crétoises*, XI, Pl. XXII) Even in the case of Kamares pottery (a preeminently 'palace' ware, albeit of the previous period), it does not seem certain that this was produced under direct palace supervision (MacGillivray 1987, 278). The possibility of a distinction between palace workshops producing luxury goods and household industries for primary goods (for Zakros, e.g., see Chryssoulaki and Platon 1987, 82f) is an obvious answer to a question requiring thorough investigation. What is of interest here is that our preliminary working hypothesis I — that weights are indicators of workshop production and movement of raw materials and craft goods — points to a picture of decentralisation of workshops, at least in certain sectors, precisely in the period at which the new palaces were taking an interest in gathering in the craft output of their area. A large proportion of the craft goods was produced in the settlements. Perhaps the palace had not yet succeeded (as it definitely did in the following, Mycenaean period) in intervening in productive forces that operated in a traditional manner (?) (see, e.g., the views of Tzachili 1987 on the production of cloth; cf. Part II no. 20).

This raises the question of the relations between the palace and the settlements in the New Palace period (see also Evely 1988, 411). The palaces are thought to be centres of redistribution because "without the existence of such a redistributive centre, there would have been no means in a world which lacked markets for a highly specialised worker to obtain his livelihood" (Killen 1985b, 252). What was it, however, that the palace re-

distributed? The total output, or the surplus (Halstead and O'Shea 1982, 97; Tzachili 1987)? And how did the palace acquire it from the producers in the settlements? The discovery of sealings made by the same seal at Knossos and various sites in east Crete (Tylissos, Ayia Triada, Sklavokambos, Gournia, and Kato Zakros) has been regarded as evidence of the control of production exercised by peripatetic officials from Knossos (Betts 1967, 24-26; cf. Part II no. 21); as has been noted, however, at Ayia Triada, these sealings represent only a small proportion of the total number of 1,200 (Watrous 1984, 134). The fact that the majority of the Linear A tablets were found in villas has been used as an argument for attributing an administrative role to their occupants — the role of administrative supervisor, that is to say, is transferred from the peripatetic official to the owner of the villa (Watrous 1984, 134). 'The majority' is a hazardous argument, however, when it does not refer to a closed group. Only two weights from Zakros are included in Petruso's catalogue, e.g., and one of them was found in a house in the settlement (see Table 1). It is inconceivable, however, that there were no weights in a palace in which the existence of workshops is attested, and which had a harbour nearby; and indeed, one of the excavation reports mentions seven stone weights in the palace, fallen from the upper storey (*Praktika* 1962, 162). The argument applies even more strongly in the case of tablets, whose fragile material is only preserved under special conditions. The fact that tablets have been found in the less imposing houses of settlements (e.g., Watrous 1984, 134 n. 96) is enough to demonstrate the widespread dissemination of Linear A (cf. Part II no. 22).

It is probable that the distribution of weights is even more indicative in this direction: Table 1 shows that weights have been found in the palace at Knossos, and also in a house on the hill at Gypsades, in two houses at Mallia, in a house at Zakros, in houses at Palaikastro, in houses of type I (McEnroe 1982) at Ayia Triada and Tylissos, in houses at Mochlos and Pseira, and in houses at Pylos, Akrotiri, Phylakopi, and Ayia Irini. Their wide distribution demonstrates that the quantity of goods could be assessed by all, and not just by special officials. It is no coincidence that weights have been found in both prehistoric wrecks of trading ships — albeit slightly later — at Cape Gelidonya and Ulu Burun (Bass 1967, 142; Pulak 1988, 30-33; cf. Part II no. 23); in the former, indeed, they may well have been the property of travelling bronzesmiths. I move on, therefore, to a second working hypothesis: weights were means of assessing certain exchange goods in the pre-coinage societies of the Late Bronze Age.

## 5 WORKING HYPOTHESIS II

This hypothesis regards weights as tools of the mechanism of exchange (in a context of intracommunity and intercommunity relations), and therefore raises the familiar problem of what the mechanism of exchange was in a society that was not profit-oriented, and which functioned without a coinage (or a market?). However, "in every society that has preceded those in which gold, bronze, and silver have been minted as money, there have been other things, stones, shells, and precious metals in particular, that have been used and have served as a means of exchange and payment... They have purchasing power, and this power has a figure set on it. For such and such an American copper object, a payment of so many blankets is due, to such and such *vaygu'a* correspond so many baskets of yams. The idea of number is present, even if that number is fixed in a different

way from the authority of the state..." (Mauss 1990, 100f n. 29).<sup>4</sup> In pre-coinage societies, metals and the surplus of craft goods might function as exchange goods. "Metal, however scarce and expensive to produce, required imported raw materials (especially tin for bronze) and capital investments (mines, technology, refining and 'human capital', i.e., technical knowledge held by specialists). Once in circulation, metal was a new, even unique, form of wealth: it was storable, liquid and could easily be transferred or accumulated. Potentially it had the properties economists recognise as essential for use as a medium of exchange or unit of account in any trade within a developing economic system directed toward accumulating wealth" (Runnels 1985, 43). This is the reason that metal objects were assembled in hoards, since, even with a slight loss of material, they could be melted down and recycled (Knapp 1985, 5). A similar product of accumulated work that endures for several generations and whose luxury lends social prestige to its user is cloth, a commodity listed in Homer as third in value after gold and silver (Tzachili 1987). There are possibly some indications of definition of value in the Linear B tablets that are worth noting at this point.

As Killen has noted (1988, 181f), there is a suspicion that, in contrast with the woollen cloths that were produced during the period of the Linear B script under the 'talasia' system, the palace exercised less control over the production of linen fabrics: two tablets preserve evidence for a possible 'purchase' of finished linen products by the palace in exchange for other goods. One of these tablets (Un 1322 from Pylos) records the provision of a quantity of wheat as payment (*o-no*) to a net-maker and a weaver, and also gives the value (?) of the garment \*146 — probably of linen — expressed in units of capacity of wheat. The other tablet (L 693) is from Knossos and gives the value (?) of a linen chiton in units of weight of bronze: *a chiton of fine linen: 1 kg of bronze*. In both cases there are counter-arguments (Killen 1988, 182f; cf. Part II no. 24). There may also be evidence of 'commercial' exchanges by barter in some of the Pylos tablets, in which a quantity of alum (an imported material used as a mordant in dyeing) is exchanged with goods such as 30 kg of wool and 10 cloths in one case, 6 kg of wool, 4 sheep, 3 cloths, 288 litres of wine, and 384 litres of figs in another. It is interesting that someone with the (ethnic?) name Kuprios (*ku-pi-ri-jo*) is mentioned in the course of these exchanges (Chadwick 1976, 158f; cf. Part II no. 25).

It has already been noted that the same manner of measuring quantities of wool is used in the Knossos tablets and those from Nuzi (Petrucci 1986; Melena 1987). It is therefore of interest to see how the value of farmland is calculated in the Nuzi tablets: in one case, for example, the value is fixed at 30 minas of tin (1 mina = about 500 gr), four minas of bronze, and one blanket; in another, it is fixed at 5 minas of bronze and 18 minas of tin, and there are cases in which the value is calculated in quantities of wool, cereals, and even in numbers of animals (Muhly 1981, 257). For this reason, Muhly (1981, 252) asserts that the concept of 'profit' exists even in the pre-monetary societies of the Orient (cf. Part II no. 26); citing the view of Godelier on the use of salt as a primitive form of money in New Guinea, he wonders whether bronze did not play the same role (cf. Part II no. 27).

It is in this context of a commercial economy that we should see the Halstead and O'Shea model of the 'social storage' — in the new palaces — of the 'valuable' craft

<sup>4</sup> There is an extensive bibliography on this issue; see, e.g., the foreword of M. Douglas in the English edition of the book (Mauss, 1990, vii-xviii), and the articles in Knapp and Stech 1985.

products that could be used occasionally as exchange goods to acquire foodstuffs, raw materials, and manpower (Halstead and O'Shea 1982, 98; Halstead 1988), and the accumulation of which additionally brought their owners social prestige (in itself a form of profit). If, as we have seen, only part of these goods were produced in the palace workshops, we come back to the question of how the rest were acquired (see, e.g., Evelyn 1988, 413). If there are suspicions that even in the period of the Linear B script some goods were also acquired by barter, alongside the '*talasia*' mode of production (see above n. 2), then, in the period prior to that, the period of the Linear A script, one would expect greater freedom in the commercial exchanges between the producers who worked in the settlements and the central authority that was based in the palace, since, as we have stated several times, the structure of the economy was less centralised. In other words, one would expect the palace to manage not the total output, but merely the surplus, and probably not all the surplus; this raises the familiar question of whether or not there were *merchants* in the palace period.

It is true that in the tablets there is no reference to merchants amongst the professions (Chadwick 1976, 157). However, since specialisation in craft production requires mechanisms for the distribution of its products (Trigger 1972, 585), there will assuredly have been people who specialised in exchanges. The question is whether or not these were attached to the palace, and whether, alongside the palace-controlled export trade (which mainly took the form of gifts to other rulers), there were also freelance middlemen.<sup>5</sup> If the concept of 'profit' may be defined for this period as the accumulation of exchange goods, it would not be unreasonable to expect personal attempts to accumulate wealth and acquire social prestige, which are in any event reflected in the hierarchy observable in settlement architecture (McEnroe 1982; Michailidou 1984, 44). It has been suggested that of the two ports of Knossos, Poros/Katsambas was the base for free merchants and shipbuilders, while Amnisos dealt with trade controlled by the palace (Zois 1982, 209); the discovery of sphendonoid weights (foreign to the 'Minoan' system) in a tomb at Katsambas is of interest from this point of view.

After the question of the concept of profit in a non-monetary society, the second objection raised to the operation of free trade is the lack of a 'market'. The concept of the market is not unknown, however, in the Sumerian and Akkadian texts, in which there are references to market prices, just prices, and to the deity Šamaš, patron of honourable exchanges (Muhly 1981, 252). The possible operation of peripheral markets has been investigated in the kingdom of Pylos (Morris 1987, 295f). It has even been asserted that in the Eastern Mediterranean, the general picture of trade is that of a "complex network of trade comprised of state as well as private traders," and that surplus goods function as valuables that can move as exchange goods in all directions (Knapp and Portugali 1985, 65); also that parameters such as local specialisation, internal market exchange, and export-oriented production are linked in a system of mutual influences with factors such as the value of labour, population density, external trade, transport technology, etc. (Earle 1985, 109, Fig. 8.2).

In the light of all this, and if we have agreed that the socioeconomic organisation of Crete in the New Palace period was based on systems of cooperating settlements centred around each palace (Zois 1982, 209) — systems essentially similar to Cherry's 'peer

<sup>5</sup> On this subject there is again an extensive bibliography; see, e.g., Muhly 1981; cf. the articles on trade in Knapp and Stech 1985 and Hägg and Marinatos 1987.



polities' (1986, 20, Fig. 2.2) — we must assign to the palace within each system the management of a large part of the surplus of its periphery, though the control exercised by the palace over the production of this surplus must be regarded as indirect: the palace influenced production by supplying the larger part of the 'exotic' raw materials and acting as the recipient of the surplus of the craft output of the settlements. The exotic materials were acquired by the palace in the form of gifts from foreign rulers, to whom it sent exchange goods that it accumulated from its district. Some of these goods were acquired by occasional or regularly repeated offerings to the gods worshipped there (Boulotis 1987). A large part, however, seem to have been acquired by barter, a mechanism that made it possible to accumulate wealth in the settlements and thus accounts for their growth and the adoption of palace features in the settlement architecture of the New Palace period (see, e.g., Driessen 1982; Michailidou 1984, 44 and 1987, 525). In this exchange system, based on barter, weights played an important role from the beginning, because they determine the size (weight) of exchange goods such as metals (and the other commodities mentioned above), which, for reasons stated above (Runnels 1985, 43), occupied a prominent place on the scale of values. Consequently, the discovery of weights in different social areas (see above) appears to be consistent with a certain freedom, at least in internal exchanges, though the palace must have acted as the 'market mechanism' that determined the prices (cf. Part II no. 28).

## 6 PERSPECTIVES

It is clear that in the future, there is a need to investigate not only the problem of assigning weights to a specific metrological system, but also of their precise find-spot (cf. Part II no. 29) and date. What is the significance, for example, of the discovery of weights in the Mycenaean spring on the Acropolis (see Table 1)? Is it fortuitous that the weights of Pylos come from houses earlier than the palace (Blegen 1973, 29)? Is there any change in the distribution of weights during the Mycenaean period, when the palace intervened more decisively in the structure of the economy? Answers to such questions must be sought. From this point of view it is very fortunate for scholars that such a large number of lead weights has been discovered at Akrotiri, where the circumstances were, of course, very favourable to their preservation. As we saw above, 102 weights have been found to date in the excavated part of the settlement, supplying a benchmark for a number very close to the original for a settlement of this size. They all belong to the same period (LM IA) and their distribution is known (Michailidou 1990): it has been noted that they are concentrated in houses in which weaving workshops were housed, though at the same time, weights have been found in almost all the buildings. The picture that emerges is that the inhabitants of the house themselves weighed the raw material and the craft product, and arranged their own commercial exchanges. There is a pressing need, however, for study of the groups of weights from each house. It is highly important that for the first time we have groups of weights preserved from the same dwelling, and in many cases from the same room. Comparison of the groups will show whether there was a particular range of weights that were necessary for every household, or whether the presence of certain weights is associated with particular functions in the place they were found (see Table 2; cf. Part II no. 29). Weights were undoubtedly useful in the Cyclades as a means of assessing exchange goods which, by virtue of being transit goods, travelled in all directions. At first sight, the picture is consistent with theories about Cycladic merchants (Doumas 1982); after what has been said, the large number of weights found in the

Cyclades acquires particular importance. What of the history of metrology in the Aegean (cf. Part II no. 30)? Weights are reported on Kea from the Middle Bronze Age (Petrušo 1978c, 106), but many of the weights on Crete are not dated. A weight from Zakros has been assigned to the MM III period (Petrušo 1978c, 83). And undoubtedly the 'earliest' is a hazardous argument: in an article by Poursat (1984, 86), I discovered two more weights (stone, disc-shaped) from Mallia, which come from a workshop (!) in *Quartier Mu*, and therefore belong to the MM II period. With regard to the view that the weights served as tools of exchange, I cite the example from Ugarit, in which a free-trade system was based on values of goods measured in weight units of silver (Alexiou 1987, 251 no. 3; cf. also Wiener 1987, 263f; cf. Part II no. 31).

The matters dealt with in this article naturally remain open to discussion; the information in the Table 1, in particular, may be exploited in different ways, and it is certain that Petrušo's catalogue of find-spots of weights will be added to (there are already indications of the discovery or identification of new weights). Further examination and analysis of the data, however, would go beyond the scope of a short article, the aim of which has been mainly to consider the weights in the context of the social relations of production in their era.

## PART II

### ADDITIONAL COMMENTARY

Since this article (Part I) was written in Greek (1989, see n. 1), more work has been done on the subject of Mediterranean trade, starting with the conference on Bronze Age trade held in Oxford (Gale 1991) and continuing with Cline's book (1994). Conferences on trade and production in pre-monetary societies are now being organised every year in the Swedish Institute at Athens, while for the more broad subject of Aegean societies, crafts and commerce, the valuable volumes edited by Laffineur — especially *Aegaeum* 7 (*Thalassa*), 12 (*Politeia*) and 16 (*Tέχνη*) — have contributed greatly to our knowledge. For a general picture of the state of art of trade and interconnections in Neopalatial and Final Palatial Crete, cf. the relevant part in Rehak and Younger 1998.

One could say that after the above publications, the starting points of the discussion in Part I (Working hypothesis I and Working hypothesis II) may be now considered less hypothetical than they seemed to be in 1989. Nevertheless, this was the first attempt to put the humble objects of balance weights in the socioeconomic frame they deserved. In the following pages, I will try to update the critical points made in Part I (nos 1-30) and to summarise current views (especially no. 31).

1. The major and most satisfying portion (in Petrušo's own words) of his doctoral dissertation was published in 1992 in the series *Keos*, vol. VIII, under the title: *Ayia Irini: The Balance Weights*.

2. Select comparanda from the Greek mainland (Vapheio and Mycenae) are being examined, again, in Petrušo 1992 (Chapter V). More recently, Aravantinos has presented new material from Thebes, which he ascribed to Petrušo's unit (Aravantinos 1995).

3. The first attempt to reconstruct their original weight was carried out by A. Evans (1935, 653 n. 3) and the latest attempt was made by C.M. Pulak in his doctoral dissertation (1996, 319-321). A theoretical calculation of the mass through an estimation of the volume has been advanced by the author of this article (Michailidou 1990 and

Michailidou, forthcoming, see Table 2 below), with the scope of incorporating even badly preserved specimens, thus enlarging the sample under metrological investigation.

4. A conference held at the Swedish Institute at Athens (published in 1996) is devoted to the term 'villa' and its social implications. More details below (no. 17).

5. Table 1 is based only on Petruso's dissertation as of 1978 (1978c). Since then, new samples are being recognized in Museums (e.g., from Phaistos ?); new excavations have yielded balance weights — e.g., at the settlement of Poros-Katsambas (Dimopoulou 1997, pl. CLXXIVb) — and more samples have been added to those already published — e.g., from Kommos (Shaw and Shaw 1997, 270) and Pseira (Betancourt 1995, 165). This means that in Katsambas we have evidence also from a settlement with industrial activities, and of course both Kommos and Pseira were important ports (cf. also below, on Mochlos). Thus, new finds seem to confirm our comments on ports (above, pp. 95 and 97, *italics*) in Part I. To the new sites outside Crete, we must add Samothrace in the Northern Aegean, where one lead weight has been reported (Matsas 1995, 242), and Miletos (W.-D. Niemeier, personal communication).

6. For a study of the distribution of weights in an archaeological site, see Alberti 1995 (for Ayia Irini on Kea). The investigation of the archaeological context within the specific architectural environment may prove very useful for the location or the scope of the weighing activity; however, what we need mostly to proceed in this direction is a set of weights rather than one or two specimens (cf. Michailidou 1990). So, I quote here Table 2 for the set of the heavier weights among 26 weights found in the West House at Akrotiri on Thera (from Michailidou, forthcoming).

A/A	Theoretical weight (in grams)	Multiples of unit M	Possibly recorded in tablets as	Multiples of unit LANA	Possibly recorded in tablets as	Probable function of balance weights
10	262	1/4 M	N1			
11	327 (?)	1/3 M (?)	N1 P4 or P16			
12	393			1/8 LANA	N1 P6 or P18	1/2 the quantity of wool from 1 sheep
13	786			1/4 LANA	N3	the wool from one sheep
14	1048	1 M	M1	1/3 LANA		1 unit (M)
15	1572	1 1/2 M	M1 N2	1/2 LANA		1/2 a wool unit
16	3144	3 M	M3	1 LANA	LANA 1	1 wool unit
17	4192	4 M	M4	1 1/3 LANA	LANA 1 M1	4 units (M)
18	6288	6 M	M6	2 LANA	LANA 2	2 units of wool or 6 units (M)

**Table 2. The heavier weights from the West House of Akrotiri**

It is interesting that almost all the balance weights in Table 2 are either multiples (or subdivisions) of the wool unit.

7. Of course, this number is now surpassed by the new excavations and more publications. In Mochlos, the recent discovery of 12 lead weights has been reported (Brogan 1998, 391). It can now be added to the old group of 11 found by Seager in 1908. More samples may be detected in new excavation reports (e.g., Davaras and Soles

1992; Soles and Davaras 1996, 197) or even identified among other objects in storage drawers; the latter possibility applies in particular to stone discs that are sometimes mistakenly taken for lids (cf. the stone weight from Akrotiri with Petruso's mark for one unit: Michailidou 1990, 413, Fig. 20 right). Sites with weights that are not mentioned in Petruso's dissertation (as unpublished), are Archanes (Sakellarakis and Sapouna-Sakellarakis 1997, 604), the cave of Inatos, possibly Phaistos, etc.

8. There is an interesting parallelism with some lead discs of an earlier date in Alissar II and Kültepe Ib (Özgüç 1986, 77f for the lead weights); according to Buchholz (1987, 174), "einige sind bedeutend älter als die aus dem Schiffswrack vom Kap Gelidonya, ja sogar älter als die aus Thera."

9. There is a vast bibliography on metals in Linear B tablets, from A. Evans (1935, 661) and Ventriss and Chadwick (1973, 351-361), to — more recently — the articles by Smith (1992/93, with earlier bibliography) or Gillis (1997); more interesting comments are incorporated in works on broader subjects (e.g., Stavrianopoulou 1989, 95-110; Palaima 1989, 93f).

10. Tzachili's dissertation is now published: Tzachili 1997.

11. Even today, in Crete, saffron is sold in very small quantities and is expensive.

12. It may be useful to quote here more recent articles on crocus, such as Tzachili 1994 and Sarpaki 1997.

13. More recently, Perna (1996) has interpreted the ideogram \*142 as 'pelo di capra' and I agree that this product was useful enough to be regularly recorded in Near Eastern sources.

14. In Egypt, as well, the earliest balance weights known so far, made from stone, have been found in the area of Naqada, whose ancient name (*Nubt*) means 'the town of gold'.

15. Obsidian is mentioned here for the sake of argument, since, naturally, Phylakopi was a flourishing town, and wool industry would require weights as well. We do not know if obsidian was measured by weight, but nothing seems to exclude this possibility. According to Oriental sources, other stones were measured by weight.

16. See also the more recent article on the Mycenaean economy by Halstead (1992).

17. For the crucial subject of the Minoan 'villa', we now have the publication of the conference in Hägg 1997 (and a good summary in *AJA* 1998, 104-106). See especially the final general discussion in Hägg 1997, 229-231.

18. For Amnisos as a harbour town of Minos, see also Schäfer (1991, 111-116) and the new publication (Schäfer et al. 1992).

However, with regard to Ayia Triada, since the publication of Watrous's article, the Italian excavators have supported the view that, in fact, the administrative centre had moved from Phaistos to Ayia Triada (cf. Carinci 1989, 79f; La Rosa 1989, 81-92). About the type and the scale of economic activities recorded in the tablets of Ayia Triada, one must now consult Palaima (1994). Based on the evidence provided by the tablets, Palmer (1995) maintained that "the scale of resource management at Haghia Triada is not that of a 'second order' centre, but comparable to Knossos or Pylos." In light of the evidence from sealings, Weingarten (1990, 110) supports the view that in LM IB, "except for Ayia Triada (which has replaced Phaistos), all the villas and towns were administratively inactive at this time" and, therefore, LM IB Crete was divided into four administrative

regions (Weingarten 1990, 112, but see the response of Pini, *ibid.* 115 and the discussion that followed). Hallager does not see why Pyrgos, for instance, with its two LM IB tablets, should be excluded from having an administrative role in the region (1996, 239, and no. 21 below), and Driessen and MacDonald have expressed their doubts as well (1997, 77), although they rather favour the idea that a weakening of the central administration system had taken place.

19. To the find-spots of Linear A tablets we must add Petras; in the case of Petras, it is not clear whether it is a palace or an important administrative centre for its region; the latter view is found in Rehak and Younger 1998, 103 (*ibid.* n. 42 for the bibliography on the site by the excavator, M. Tsipopoulou). For the distribution of the Linear A tablets, one can now consult the map, the house-plans, and the texts in Hallager's recent book (1996). To the tablets from outside Crete (Kea and Melos), one must add the more recent finds from Thera: the tablets (Boulotis, forthcoming) and the unique 'ostrakon' with a Linear A text (Michailidou 1992/93). Driessen and Schoep (1995, 662) comment that as one can infer from the tablets of Linear A, "there is no evidence for regional control, only of a firm grip on local affairs. Recording did take place at different levels of Neopalatial society." But they continue that this "implies a strong central control but only by a regionally-based administration with local power."

20. This forthcoming article will be published in *Manufacture and Measurement. Counting and Recording Craft Items in Early Aegean Societies* (ed. A. Michailidou).

21. For this subject, see also Weingarten (1990, 111; 1991, 308-310) who — based on the evidence provided by the foreign clay of sealings — suggests, instead, a movement of sealed correspondence and goods. E. Hallager's view is that "both documents and rings/officials travelled on Crete" (1996, 210-213), but Hallager concludes at the very end of his book (1996, 239: 'Historical implications'): "Although sealing administration does offer some important evidence for the debate about political relations, and although one may speculate at length, it is not sufficient to provide a definite answer to even some of the more simple questions concerning the political structures of Neopalatial Crete." And we may keep in mind Weingarten's comment (1991, 310) that "intra-Minoan trade seems rather to have been conducted on a number of social levels." The great advantage of the evidence from the balance weights — as opposed to the evidence from the seals — is that *the weights are indispensable to activities at all levels of society.*

22. And outside Crete as well: cf., more recently, Hallager 1996, and add more specimens found in Akrotiri (Michailidou 1992/93; Boulotis, forthcoming), Samothrace (Matsas 1995), and Miletos (Niemeier 1996). Owens (1997, 172f) lists 11 sites outside Crete.

23. See also Pulak's doctoral dissertation (1996).

24. Of course, an interesting debate is continuing on the meaning of the term *o-no*. One interpretation, supported in the main by Gallagher (1988), is that it means the 'ass-load'; Gallagher assigned to it a value equal, in absolute terms, to the Mycenaean large liquid measure. Killen has strongly opposed this interpretation, and after long discussion of a 'benefit' or 'payment' interpretation of the term *o-no* in the tablets An 35, Un 443, and Un 1322, he concludes (1995, 219): "In sum, then, I should like to suggest that *o-no* does contain the same root as ὀνίμητι (and Myc. *o-na-to*, *o-na-te-re*, etc.); that its basic sense is 'benefit'; and that it is used of 'benefits' of various kinds, including 'benefits'

given to 'collectors' by virtue of their position and 'benefits' (or 'payments') given in return for commodities or service."

25. As summarised by Cline (1994, 60), the term *ku-pi-ri-jo* appears both in the Knossos tablets and in the Pylos tablets; it is an adjective for individuals associated with shepherding, bronze-working, and mixed commodities, but in some cases it was considered by Melena and Palaima (see Palaima 1991, 292-295) as rather being used to denote Minoan goods destined for Cyprus. More recently, Killen (1995, 215-221) interpreted *ku-pi-ri-jo* as being a 'collector' (a view shared by Olivier), while keeping the use of the adjective to denote wool of Cypriot type. Whether *ku-pi-ri-jo* in Pylos may be the Mycenaean equivalent of a Near Eastern *tamkar* or not (Killen 1995, 221), what interests us more in this article is its frequent association with the term *o-no* (= 'payment') both at Knossos and Pylos. Van Effentere's comment that the equivalent for *o-no* in French would be *monnaie de change* (*ibid.* 226) is especially interesting.

26. There is now an accumulated bibliography on this subject, and it will probably continue to increase! See, for instance, no. 31. For the nature of Bronze Age trade, see also Sherratt and Sherratt 1991 — especially p. 376 for the concept of the 'market'. For a more theoretical discussion on the creation of the value of an object, see Voutsaki 1997.

27. And it did, especially in small-scale economic transactions between ordinary people, where values were also expressed in weights of copper (see, for Egypt, Kemp 1991, 248-250). For the role of silver, see below and no. 31. Of course one must keep in mind the distinction between standards of accounting and means of payment.

28. This proposed level of freedom in internal exchanges suits the far more radical view by Driessen and MacGillivray (1989, 107) that the coastal towns (in East Crete) may have been independent and functioned rather along the lines of the Greek city-states! But what parameters or what institutions determined the 'prices', if any? For prices, see below, no. 31. If the means for international trade were mostly possessed by the palaces (cf. Alexiou 1953/54; 1987; Kopcke 1987; 1991; Wiener 1987; 1991), the situation might not be so different from the Near Eastern societies, where the king boasts that he has kept the prices low during his reign, — as, e.g., in Old Babylonian texts giving the amounts of products equivalent to one sickle of silver (Liverani 1995, 335) —, but again, the level of palatial control could be such as to permit the parallel existence of at least a semi-independent merchant class (cf. Warren 1989, 7f; 1991, 298). Free-lance trading has been proposed by Branigan (1989) for the Proto-Palatial period. Since "the mechanisms for Minoan economic exchange could not have remained the same from the time of the first palaces to the end of the Bronze Age" (Walberg 1995, 161; see also Tournavitou 1996 for an attempt to define social levels in architecture at Mycenae), in future research on balance weights, more precise dating of these finds and their context could contribute to our knowledge of differences between MM II and MMIII-LM IA or LM IB, and of course LM II and LM III. If we are right to presume that the Late Bronze Age economy was based on a wealth finance system (see also Walberg 1995, 161), then the investigation of the distribution of well-dated balance weights will be helpful, because the weights were the means of calculating the value of quantities of special products assigned with an established value.

29. There is also the problem that we seldom find the balance weights together with the balance scales. The bronze scale-pans are a less frequent find, possibly due to their fragility — as they were made of thin plate of bronze — or the value of their material

(which led to its recycling). For this reason, most known specimens come from tombs, as is evident from the relevant catalogues in Petruso (1992, 75) and Olivier and Vandenaebelle (1979, 156-160). In the Mavrospelio tomb, the scales and three lead weights were assigned to a gem-cutter (Renfrew 1972, 341f; Forsdyke 1926/27, 243; Beck 1928, 327). To the non-funerary contexts of Gournia and Akrotiri, we must now add Mochlos (Davaras and Soles 1992, 610; 1996, 194), where we have had the good luck to find both lead weights and bronze pans in a domestic context (as reported by Brogan 1998, 391).

Mochlos has recently provided us with valuable information on specialized production in settlements (cf. our comments in italics in Part I, pp. 95 and 97). Soles (1997, 428f), using a distinction between (i) the palace workshop and (ii) the part-time specialist who works out of his own home, places the artisans at Mochlos between the two extremes and — what interests us here — describes them as “independent, nucleated, kin-based, full-time specialists” who work not for local consumption but for a market belonging to the Gournia polity. We also have the evidence for flourishing workshops at Poros-Katsambas, for which Dimopoulou suggests: “However, the process of acquiring and remelting waste metal objects in considerable quantities, or reworking broken and waste valuable items, also the presence of the urban clientele, as well as the direct accessibility to the imported raw materials and to the export trade system via the port, all are arguments favouring a *partial autonomy of these craftsmen* against the palatial bureaucratic centralisation, at least during the Neopalatial period. In any case, it is reasonable to surmise that the spacious and rich, two-storeyed, in some cases ashlar houses with frescoes, in which the workshops were incorporated, belonged to *wealthy owners, not other than the craftsmen themselves*” (1997, 437, the emphasis is mine; cf. my comment in Part I, p. 100, for the concept of profit). Kopcke mentioned the possibility that besides the palace dwellers, there were other people who controlled wealth, based on the evidence of balances (1987, 257).

30. Parise (1986) named the system not Minoan but Aegean. Geographically he is right, especially after the discovery of lead weights in Samothrace; was this system invented by a central authority and if so, of what type? This is another interesting subject for future research, especially if one contrasts the evidence of weights from EBA Troy to that from EBA Poliochni. The subject seems — I dare say — a little like the subject concerning systems of coinage in later times: who imposed the system on whom?

31. To scholars dealing with Near Eastern sources, the usage of silver for the estimation of the value of the goods is common knowledge (see, e.g., *Alt-Orientalische Forschungen* 15, 1988, with articles devoted to the subject of prices). The most recent article on ‘Money in Mesopotamia’ is written by Powell (1996), while at the 99th annual meeting of the Archaeological Institute of America, Session 5A was devoted to a Colloquium for *New Insights into the Transition from Hack-Silber to Coinage* (*AJA* 102.2, 1998, 402f). I quote a summary by Shaps (1998, 403): “In Mesopotamia we find commodities, particularly silver, serving as standards of value and as real media of exchange, but usually not circulating throughout the population as true money.” What would be given back in exchange is well documented in the ‘ostraka’ of Deir-el-Medina in Egypt. Since it was not often silver, it could have been copper or bronze, and I will end this discussion, on the prominent role of the balance weights in the frame of the social relations of production, with the words of B. Kemp: “Metals were themselves used in exchanges but not as coinage. The nearest step on the road to money is to be found in the stone weights which, when used in the pans of scale balances, checked the weights and thus the values of

metals, precious and otherwise. One group of thieves of Thebes scrupulously kept in a house a stone weight they had used in dividing up the spoil from one tomb" (Kemp 1991, 248).

Therefore, weights are tools of industry (see Table 2 for the possible function of the set of weights coming from the West House in Akrotiri on Thera, where a weaving workshop was located), but surely not many people in the Aegean were manufacturers. Weights are tools of trade, and of course the prevailing view now is that the merchants had their own balance weights, carrying them on their business trips; this is what Pulak (1996, 281) maintains for the cargo in Kaš, and this is Özgüç's view on the weights found at Kaniš (1986, 78). Again, however, were so many Cretans (or Therans) tradesmen? I think that the variety of the social contexts already noticed in the distribution of weights (cf. Table 1 and relevant comments in Part I) has now been verified by the new publications that point to the vast use of the balance weights; the archaeological record from Mochlos is most promising in confirming this: "At Mochlos weights are found in many LM IB houses on the island — a pattern that complements that found at other sites. Weights have also been recovered at contemporary sites on the Mochlos coastal plain — the nearby artisan quarters and the small farmstead at Chalino Mouri. Both the variability in this distribution pattern and the different nature of these sites raise important questions about the existence of specialized household industries at Mochlos and the nature of internal and external exchange networks at this Minoan harbour town and across the wider Mirabello region" (Brogan 1998, 391). I think that there is more than that. It is the type of internal exchange system — at all social levels (see above, nos 19 and 21 for recording and trading at different social levels) — that requires the broad usage of balances and weights; as Tsountas commented, earlier than anybody (1893, 121): "καὶ ἀληθῶς, ἀφοῦ νομίσματα δὲν ὑπῆρχαν τότε, ἡ χρῆσις τῶν (sc. ζυγῶν) ἐν τισὶ θὰ ἦτο κοινότερα ἢ σήμερον."

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