Karl M. Petruso

MARKS ON SOME MINOAN BALANCE WEIGHTS AND THEIR INTERPRETATION*

I. Introduction

Our understanding of the system of weight in use in Minoan Crete has increased as a result of inquiries along several lines. E. L. Bennett, Jr.[1], in his investigation of fractional measures expressed in the Linear B tablets from Pylos and Knossos, and more recently D. Was (in this journal[2]), in his study of fractions in the Linear A tablets, have demonstrated convincingly through the use of frequency distributions and simple mathematical summations the relative values of the subdivisions of the Minoan talent. Their conclusions parallel each other in many ways. Most striking, perhaps, is that the primary subdivision of the Minoan talent in both Linear B and Linear A tallies was determined independently to have been $\frac{1}{30}$. These findings corroborated Evans' speculation, made some years earlier, that the Minoan talent was sexagesimal, made up of 60 light or 30 heavy or royal (i. e., double) minas[3]. Evans regarded the stone 'octopus weight' found in the West Magazines of the Palace of Minos as the Knossos standard talent weight against which oxhide ingots and other commodities were weighed. Its weight was determined by him to be almost exactly 29,000 grams, and thus by division he established the weight of the Minoan mina at ca. 483 g[4]. His identification of the octopus weight as the palace standard for the talent has gained general acceptance among Aegean prehistorians. Ventris and Chadwick applied Bennett's Linear

* I am grateful to the following persons for allowing me to examine, weigh and publish the balance-weights catalogued herein: Prof. J. L. Caskey (the Ayia Irini lead weights), Dr St. Alexiou (the weights in the Herakleion Museum), and Dr Chr. Doumas (the lead weights from Akrotiri). I am especially indebted to Professor Caskey, who has shown a keen interest in and support for this project from the beginning, and who has commented critically on my work in prehistoric metrology in several long and fruitful discussions.

1 Fractional Quantities in Minoan Bookkeeping AJA 54, 1950, 204–22.

2 Numerical Fractions in the Minoan Linear Script A, Kadmos 10, 1971, 33–51; 12, 1973, 134–48.

3 BSA 7, 1900–01, 43; Palace of Minos (hereafter PM) IV 651–2.

4 PM IV 652.

0022-7498/78/1701-0004$2.00

Kadmos XVII (1978), S. 26–42.

B fractional series to the talent weight and calculated the theoretical absolute values of the subdivisions smaller than the mina[5].

In 1906 Evans presented a metrological analysis of all the Minoan balance weights then known to him[6]. His study was a significant first attempt to make some sense of the scanty archaeological remains of the Minoan system of weight. Unfortunately, however, the total amount of data he possessed at that time was too small and too diverse to allow any useful conclusions to be drawn; his corpus included only seventeen Minoan weights from five sites in Crete. More than 200 more balance weights have been discovered and recorded since that time, from some twenty Minoan sites. Consequently we are now in a much better position to attempt a metrological analysis.

The purpose of the present report is to examine 21 selected balance weights of stone and lead found at several Minoan sites in Crete and the Cyclades, with a view to establishing through the archaeological evidence a framework for understanding the mechanics of the Minoan system of weight-measurement. The objects which will be presented here are especially useful toward this end in that each bears simple markings of some sort which, it will be demonstrated, can be interpreted as indicators of value on a common system. To be sure, relatively few Aegean weights are so inscribed, and, of all the marks known, many certainly denoted something other than value or denomination in a system or set (makers', owners', and sealers' marks are some other plausible interpretations). In most cases, however, the isolation of value marks is not at all difficult, as will be evident, if the symbols are approached with healthy measures of imagination and common sense.

II. Catalogue

Each of the following entries includes the following information: Provenience, material, shape, museum or site inventory number; dimensions, condition of preservation (unless otherwise noted, it can be assumed that the piece is complete and now scales a weight close to

[5] Documents in Mycenaean Greek (hereafter Docs) 57.

[6] Minoan Weights and Mediums of Currency, from Crete, Mycenae, and Cyprus, In Corolla Numismatica: Numismatic Essays in Honour of Barclay V. Head, Oxford 1906, 336–67 (hereafter CorNum).

that originally intended); a description of the marks; chronological information (if available and reliable); published references; and weight in grams in bold type at the far right. A minus sign (−) following the weight-value indicates that the piece is physically damaged and underweight. A plus sign (+) following the weight of a lead piece indicates that its surface is oxidized and hence that the piece might be slightly heavier than originally intended[7]. Weight-values in parentheses are restored and must be regarded as approximations. The initials KMP indicate that the piece was weighed and examined by me, in which case the weight-value recorded is that determined by me, whether or not it be at variance with earlier published values. Subsequent cleaning, especially of the unconserved lead discs, will change their weights to some extent. I have noted (after KMP) the dates on which I weighed the pieces, in order to obviate confusion if they should be conserved and re-weighed in the future.

All but nos. 3, 8, 14, 15 and 21 were weighed by me on an Ohaus triple beam laboratory balance with a capacity of 2610 g. and a sensitivity of 0.1 g. Occasionally estimates have been made to 0.05 g.

1. Palaikastro (Pl. I, Fig. 1). Lead disc. Herakleion Museum **7.8**
   Case 55, no. 34.
   Diam. 0.024 m.
   Eight round dots shallowly impressed in one face.
   Unpublished. KMP 5. iv. 76.
2. Mochlos (Pl. I, Fig. 1). Lead disc. Herakleion Museum **19.4**
   Case 55, no. 93.
   Diam. 0.026 m.
   Three dots in a row impressed in one face; cross incised in reverse.
   Unpublished. KMP 5. iv. 76.
3. Akrotiri (Fig. 1). Smooth gray disc-shaped stone. **20.2**
   Triangular piece carved out of one face.
   LMI or earlier.
   Marinatos, Thera II: 19, 49–50, pl. 14.2 *(in situ)* and pl. 41.2; Praktika 1968: 123, pl. 119.

[7] While buried in soil, objects of lead take on a crust as a result of chemical reaction with humic acids. In advanced stages of oxidation, the surface accretion can affect the weight of a small object to a surprising degree: increases of as much as 10% have been observed in lead weights from Ayia Irini.

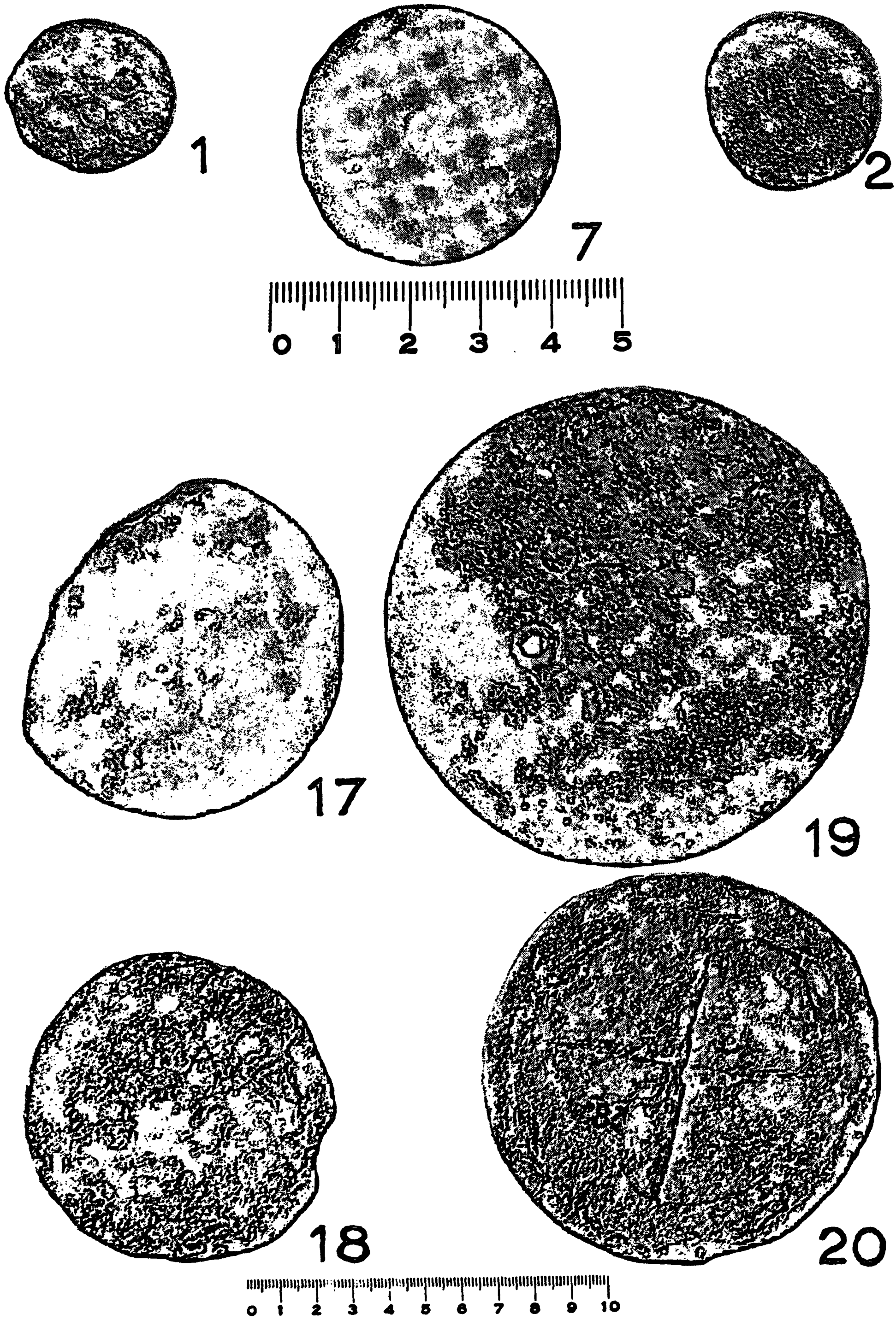

Plate I

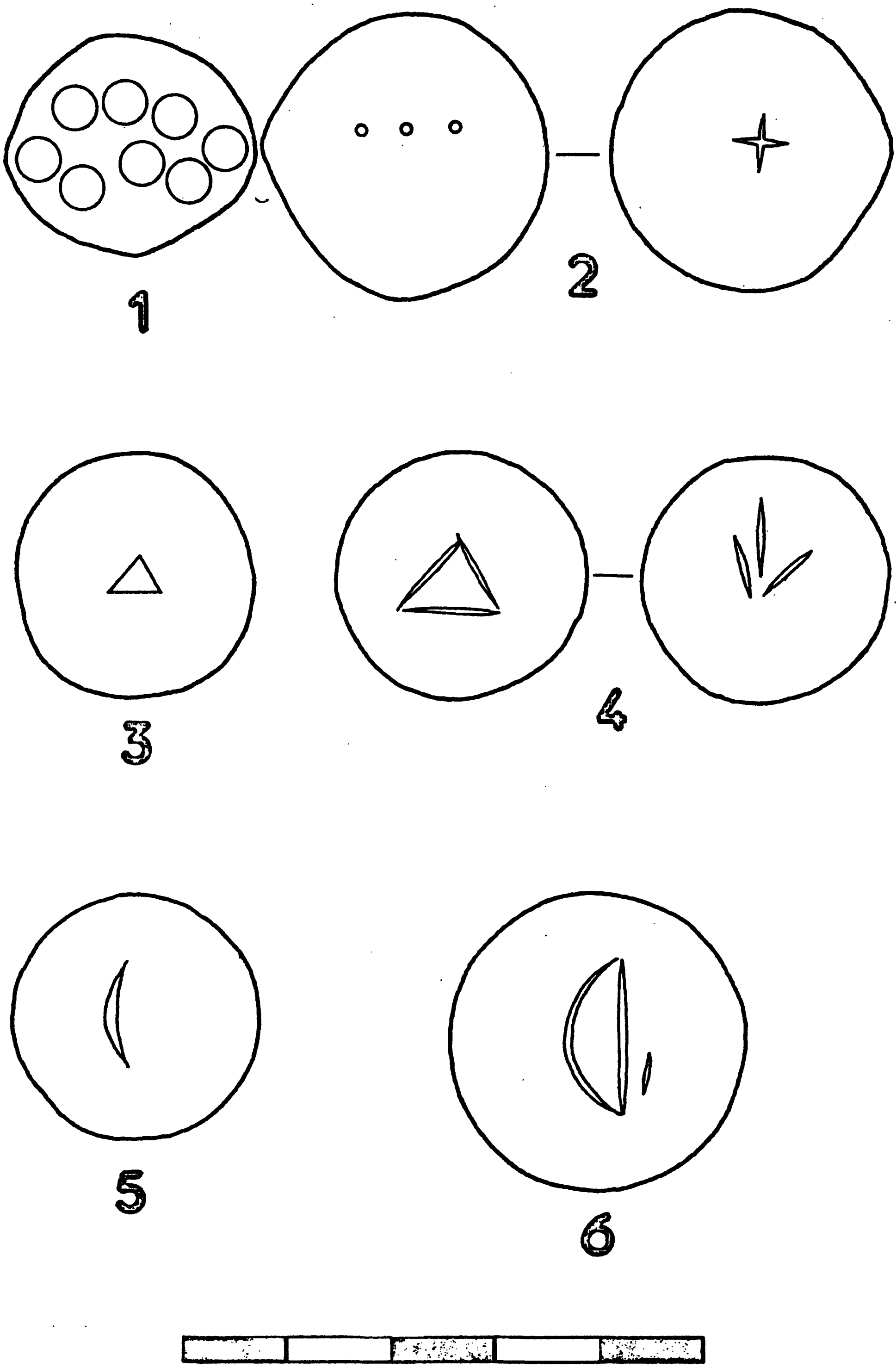

Fig. 1

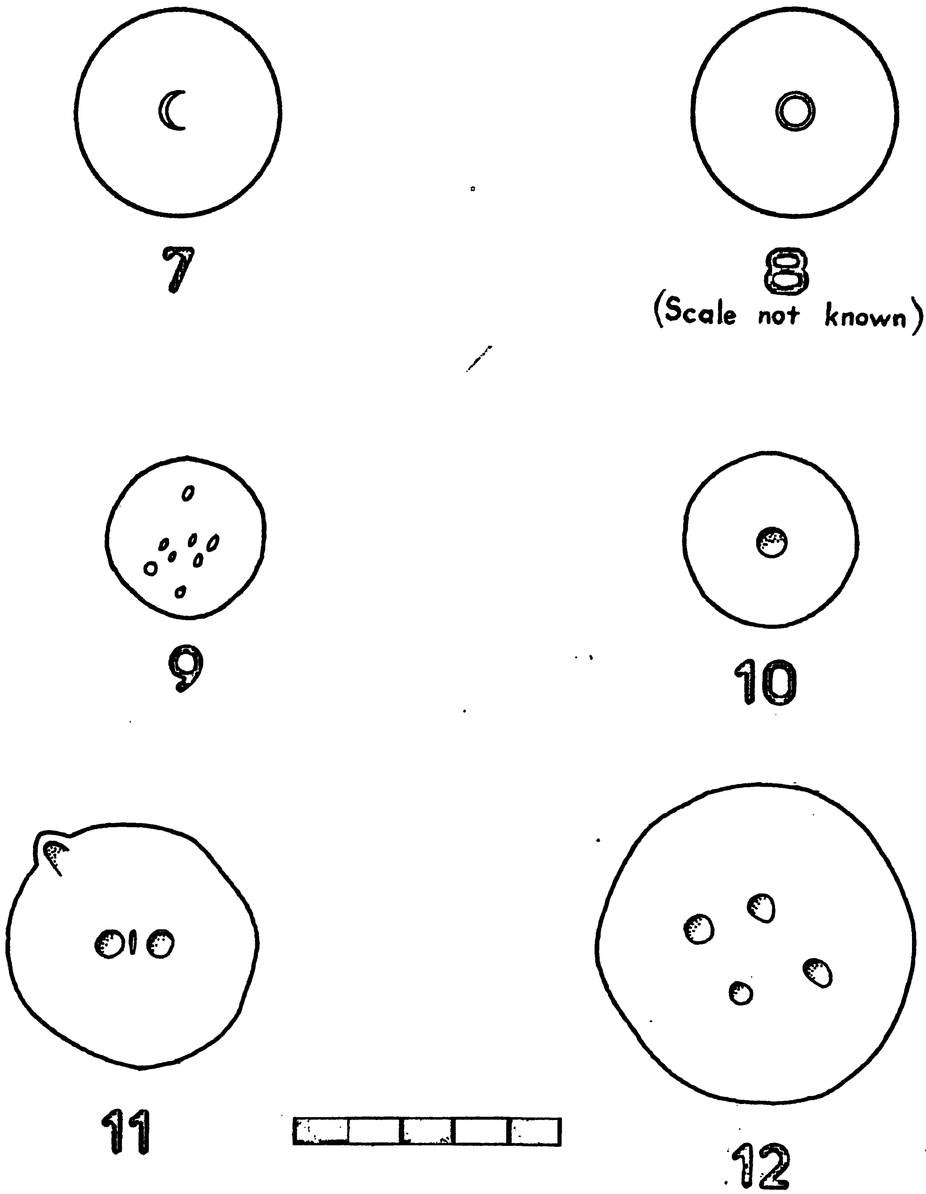

Fig. 2

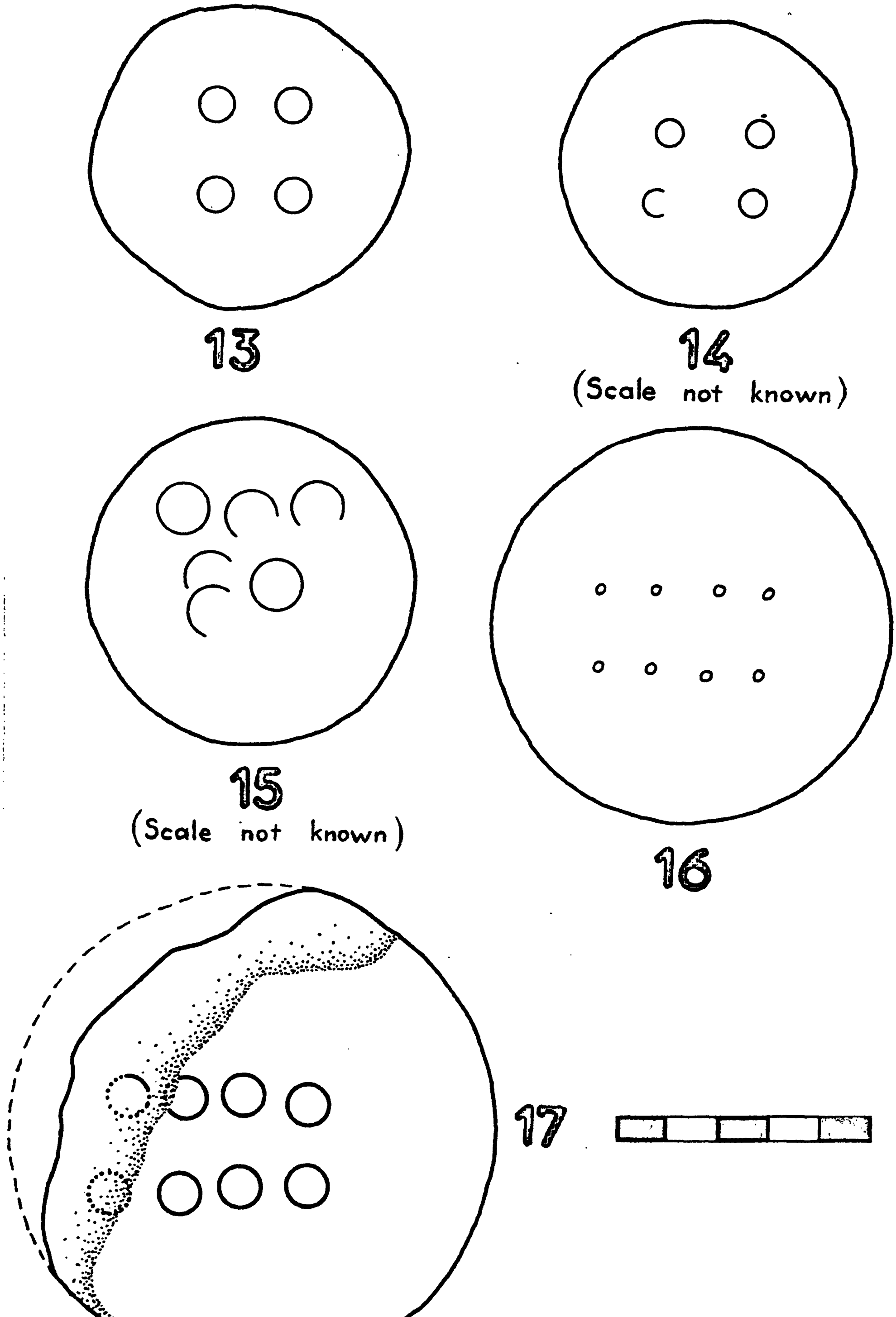

Fig. 3

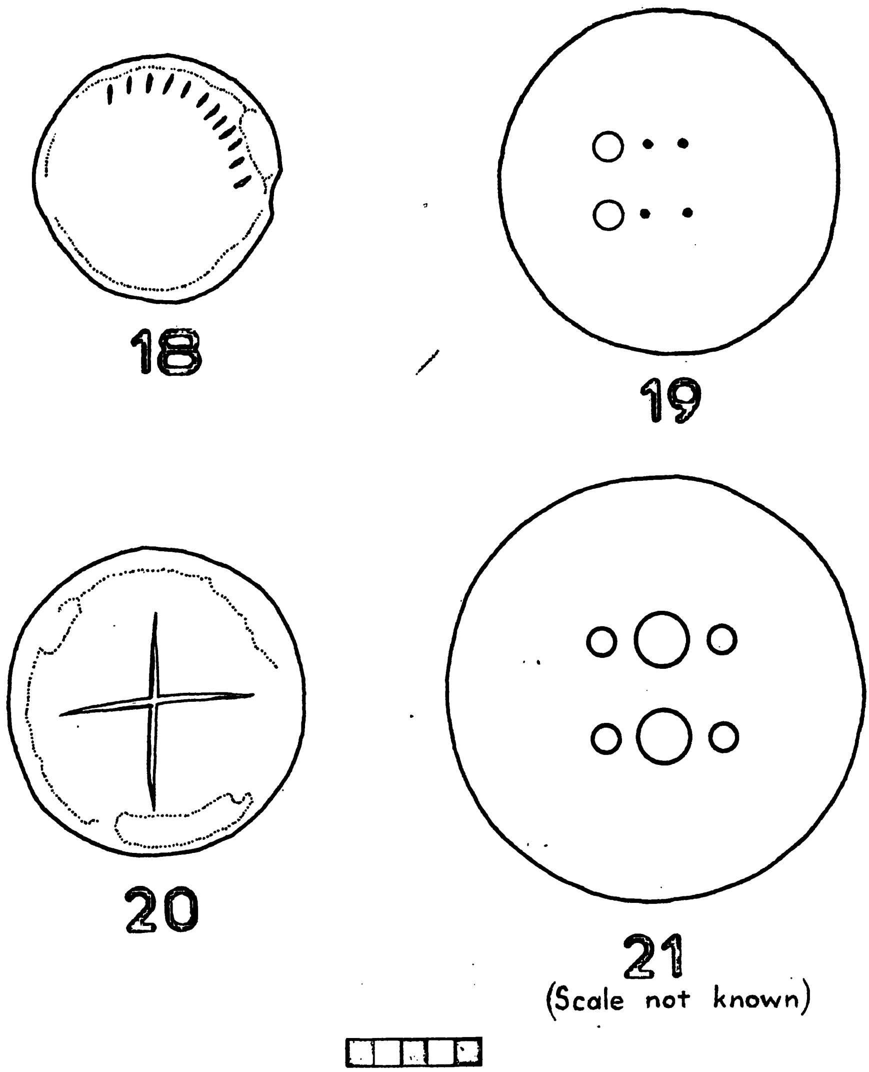

Fig. 4

4. Ayia Irini (Fig. 1). Lead disc. Inv. no. K8.32. 20.25
Diam. 0.024 m.
Triangle incised in one face; three converging lines incised in opposite face.
Ayia Irini Period F (MM II–III).
ArchDelt 1969: 96 (no. 7), fig. 1, pl. 53.
KMP 12. v. 76.

5. Ayia Irini (Fig. 1). Lead disc. Inv. no. K7.284. **30.35**
Diam. 0.024 m.
Crescent-shaped incision in one face.
ArchDelt 1969 (no. 9), fig. 1, pl. 53.
KMP 12. v. 76.
6. Ayia Irini (Fig. 1). Lead disc. Inv. no. K6.323. **31.6**
Diam. 0.029 m.
Semicircle deeply incised in one face. Short line shallowly incised nearby (probably extraneous).
Ayia Irini Period H (LM I).
ArchDelt 1969: 98 (no. 12), fig. 1, pl. 53.
KMP 12. v. 76.
7. Pachyammos (Pl. I, Fig. 2). White marble disc. Herakleion Museum Case 55, no. 1094. **31.7**
Diam. 0.038 m.
Crescent inscribed in one face.
Unpublished. KMP 5. iv. 76.
8. Knossos (Fig. 2). Alabaster disc. **(59.92)**
Restored by Evans (weight as found 58.5 g.).
Small circle inscribed in one face.
CorNum: 345 (no. 5), fig. 2, second from left; PM IV 655 (wrongly recorded as 5.92 g.), fig. 638 d.
9. Ayia Irini (Fig. 2). Lead disc. Inv. no. K4.504. **60.3**
Diam. 0.029 m.
Eight dots punched into one face.
Ayia Irini Period G or H (LM I).
Unpublished. KMP 12. v. 76.
10. Ayia Irini (Fig. 2). Lead disc. Inv. no. K3.100. **64.0**
Diam. 0.032 m.
Large dot impressed deeply into one face.
Ayia Irini Period G or H (LM I).
ArchDelt 1969: 99 (no. 28), fig. 1, pl. 53.
KMP 12. v. 76.
11. Ayia Irini (Fig. 2). Lead disc. Inv. no. K1.23. **121.0**
Diam. 0.046 m. Struck by pick but complete.
Two dots impressed into one face. Shallow short line between the dots.
Ayia Irini Period H (LM I) or LH IIIA.
ArchDelt 1969: 99 (no. 40), fig. 1, pl. 53.
KMP 12. v. 76.

12. Akrotiri (Fig. 2). Lead disc. Inv. no. 1901. 224.4(−)
Diam. 0.059 m. Slightly damaged, a bit underweight.
Four circular impressions in one face.
LM I or earlier.
Unpublished. KMP 25. v. 76.

13. Akrotiri (Fig. 3). Lead disc. Inv. no. 1389. 252.5(+)
Diam. 0.061 m. Slightly encrusted, may be overweight.
Four circles incised in one face.
LM I or earlier.
Unpublished. KMP 25. v. 76.

14. Knossos (Fig. 3). Limestone disc. (273.47)
Restored by Evans (weight as found 232 g.).
Three small circles and one semicircle inscribed in one face. The arrangement is symmetrical and the value should be read 'four'.
CorNum: 345 (no. 4), fig. 2c; PM IV 654, fig. 638c.

15. Knossos (Fig. 3). Steatite disc. (327.02)
Restored by Evans (weight as found 272.75 g.).
Six circles or crescents inscribed in one face (Evans read five).
CorNum: 345 (no. 3), fig. 2b; PM IV 654, fig. 638b.

16. Ayia Irini (Fig. 3). Lead disc. Inv. no. K6.11. 506.6
Diam. 0.079 m.
Eight small dots in two rows impressed into one face.
Ayia Irini Period G or H (LM I).
ArchDelt 1969: 100 (no. 43), fig. 1, pl. 53.
KMP 12. v. 76.

17. Praisos (Pl. I, Fig. 3). Stone disc. Herakleion Museum Case 55, unnumbered. (506.9)
Max. pres. diam. 0.095 m. Broken; estimated one-fifth missing. Restored by KMP (weight as found 405.5 g.).
Six circles in two rows inscribed in one face; part of a seventh faintly visible; an eighth may be restored for the sake of symmetry.
Unpublished. KMP 5. iv. 76.

18. Mochlos (Pl. I, Fig. 4). Lead disc. Herakleion Museum Case 55, no. 85. 720.3
Diam. 0.088 m.
Twelve short lines incised near edge of one face.
Unpublished. KMP 5. iv. 76.

19. Zakros (Pl. I, Fig. 4). Large stone disc. Herakleion Museum Case 55, no. 107. **1421.3**
Diam. 0.125 m., max. th. 0.055 m.
Two circles and four dots inscribed in one face; large square shallowly inscribed in opposite face.
Unpublished. KMP 5. iv. 76.

20. Mochlos (Pl. I, Fig. 4). Lead disc. Herakleion Museum Case 55, no. 83. **1458.1**
Diam. 0.112 m.
Large cross deeply incised in one face.
Unpublished. KMP 5. iv. 76.

Table 1 presents the data from this catalogue which will be pertinent to the following analysis.

Table 1

Cat. no.	Provenience	Weight (g)	Mark
1	Palaikastro	7.8	∘∘∘∘∘∘
2	Mochlos	19.4	··· +
3	Akrotiri	20.2	△
4	Ayia Irini	20.25	△ |/
5	Ayia Irini	30.35	(
6	Ayia Irini	31.6	(
7	Pachyammos	31.7	C
8	Knossos	(59.92)	∘
9	Ayia Irini	60.3	:∴:
10	Ayia Irini	64.0	•
11	Ayia Irini	121.0	••
12	Akrotiri	224.4(−)	·:·
13	Akrotiri	252.5(+)	∘∘ ∘∘
14	Knossos	(273.47)	•• ••
15	Knossos	(327.02)	occ cco
16	Ayia Irini	506.6	::::
17	Praisos	(506.9)	•••• ••••
18	Mochlos	720.3	\\\\\\\\\\\\//////
19	Zakros	1421.3	∘∘ ::
20	Mochlos	1458.1	+
21	Knossos	(1567.47)	:∘: ∘∘

21. Knossos (Fig. 4). Steatite disc. **(1567.47)**
Restored by Evans (weight as found 1507.5 g.).
Two large inscribed circles flanked symmetrically by four small circles on one face. Raised moulding runs around circumference (this might have served the same purpose as milling or rouletting on coins, a device to make it obvious if someone had tampered with its weight).
CorNum: 344–5 (no. 2), fig. 2a; PM IV 653–4, fig. 638a.

III. Analysis

Nos. 11–18 are the pieces which most plainly betray the values of their respective marks; this can be demonstrated most convincingly in the relationships of their weights. No. 11, bearing two dots, scales approximately one-half the weight of nos. 12–14, each of which bears four circles. These three in turn weigh very close to half the weights of nos. 16 and 17, which bear eight dots or circles. By dividing the weights of these six pieces by the number indicated on each and by averaging the six quotients, we arrive at a theoretical unit of ca. 62.5 g. per dot or circle. This can be used only as a rough approximation, however, since one of the weights (no. 12) is visibly damaged and somewhat underweight, hence yielding a low unit; the weight values listed for two others (nos. 14 and 17) are estimates of original weight, and so their derived units are liable to be either high or low to an unknowable degree. However, if we divide the weight of no. 18 by 12, as indicated by its twelve incised lines, a unit of ca. 60.0 g. is produced. This conforms rather well with the average values arrived at above, and certainly suggests the same absolute value for the standard unit. No. 15, with six circles, is approximately half the weight of the 12-unit piece. Division of its weight by 6 yields a unit in the vicinity of the others, though somewhat low (this piece, too, has been restored).

No. 19 is quite sound and weighs very close to double the weight of the 12-unit piece. Certainly this is indicated in its markings, which are paralleled almost on no. 21. Evans read the two large and four small circles on the latter piece as 'two tens, four ones', or '24', in accordance with the decimal system of numeration used in the Linear A and Linear B tablets[8]. Division of the weights of these two pieces by 24 yields an average theoretical unit of just over 60 g.

No. 20 is precisely twice the weight of the marked 12-unit piece (no. 18) with which it was found. For this reason, and since its weight is close to that of nos. 19 and 21, it can be attributed confidently in this system as a 24-weight. Its large engraved cross is a more abstract numerical indicator (if in fact this was its function) than the more conventional symbols of value on the other two 24-unit pieces, and its meaning is much less obvious than the multiples so simply indicated on nos. 11–18; nevertheless we may regard it as signifying 24 in 'shorthand' to its user.

The single marks on nos. 8 and 10 suggest that they are unit weights in the same system, and their weight values confirm this interpretation. The meaning of the marks on no. 9 (also a one-unit weight) will be discussed below.

Among the smaller pieces, nos. 5–7 scale one-half the unit weight. Certainly this was the intended meaning of their incised crescents or semicircles. Such symbols are most suitable for communicating the concept of 'half' since the mind's eye naturally endeavors to restore the symbols to a full circle signifying 'one' or 'whole', as on no. 8[9].

Just as 'halfness' is indicated in these crescents, 'threeness' is signified by the triangles borne by nos. 3 and 4, and by the three dots impressed in no. 2. These pieces all weigh one-third of the unit of ca. 60 g. Finally, the smallest fractional piece (no. 1) bears eight impressed dots which, in like manner, indicate 'eightness'. The piece weighs one-eighth of the same unit.

The results of this analysis are summarized graphically in Table 2.

---

8 q. v. G. Sarton, Minoan Mathematics, Isis 24, 1935–36, 371–81, and S. Dow, Minoan Writing, AJA 58, 1954, 123–5.

9 The circle signifying 'one' is a diagrammatic logogram, a number-designation freely created from geometric forms (cf. I. Gelb, A Study of Writing, Chicago 1952, 99). The crescent or semicircle signifying half the Minoan unit is closely paralleled in classical Attic and Argolic inscriptions, in which C was the symbol for the half obol (cf. W. Larfeld, Handbuch der griechischen Epigraphik I 417f.). I thank Prof. Mabel Lang for suggesting this analogy to me.

Table 2

Cat. no.	Provenience	Weight (g)	Mark	Reading	Resultant Unit (g)
1	Palaikastro	7.8	°°⁘°	1/8	62.4
2	Mochlos	19.4	··· +		58.2
3	Akrotiri	20.2	△	1/3	60.6
4	Ayia Irini	20.25	△ ψ		60.8
5	Ayia Irini	30.35	(		60.7
6	Ayia Irini	31.6	ɑ	1/2	63.2
7	Pachyammos	31.7	C		63.4
8	Knossos	(59.92)	o		(59.9)
9	Ayia Irini	60.3	::·	1	60.3
10	Ayia Irini	64.0	•		64.0
11	Ayia Irini	121.0	••·	2	60.5
12	Akrotiri	224.4(−)	·:·		56.1(−)
13	Akrotiri	252.5(+)	oo oo	4	63.1(+)
14	Knossos	(273.47)	::		(68.4)
15	Knossos	(327.02)	occ cco	6	(54.5)
16	Ayia Irini	506.6	::::	8	63.3
17	Praisos	(506.9)	oooo oooo		(63.4)
18	Mochlos	720.3	ıııııı//////	12	60.0
19	Zakros	1421.3	o:: o··		59.2
20	Mochlos	1458.1	+	24	60.8
21	Knossos	(1567.47)	·o· ·o·		(65.3)

Mean resultant unit 61.3 g.
Median resultant unit 61.5 g.

IV. Discussion and Conclusions

The marks on these objects demonstrate that the system units proposed by Evans to have been in use at Knossos[10] and by Caskey at Ayia Irini[11] received recognition over a wide geographical area. The better preserved pieces among them allow us to fix the unit a bit more precisely than was previously possible, at a gram value in the low sixties. This unit was clearly quite popular throughout the Minoan world, and probably found its most common application in assaying and commercial trafficking in relatively dear commodities such as precious metals, oils and spices. No doubt the weights of less than unit value were also used by Bronze Age chemists, doctors and metalsmiths in their various procedures that required precise proportional mixing of ingredients. Transactions involving bulk foodstuffs such as grain and olives and non-precious raw materials of the sort one would purchase in a παντοπωλεῖον today might have been carried out by using the larger weights.

For various reasons it is difficult to pin down precisely the chronological and geographical limits of this system. The most reliable stratigraphic information comes from Ayia Irini, where the system is solidly attested by Period F (MM II–III), to which no. 4 belonged. At that site the system might have continued in use as late as LH III A, the period following the major destruction of the site by earthquake. Most of the weights (nearly 70%), however, belong to Periods G and H (LM II), the main phases of occupation of the site. Recently N. Parise[12], in a synthesis based upon the relatively few published balance weights, has argued that a system with a unit of between 59.92 and 68.37 g. was in use in the Mediterranean at least as late as the date of the sinking of the merchantman off Cape Gelidonya, which the excavator sets at the very end of the thirteenth century[13]. If this was in fact the same system, it was in use for at least five centuries.

---

[10] CorNum 345–6. Evans argued unconvincingly that this unit, in the vicinity of 65 grams, was a 5-multiple of the gold unit of Egypt.

[11] Lead Weights from Ayia Irina in Keos, ArchDelt 24, 1969, 102. Prof. Caskey provisionally set the absolute value of this unit in the vicinity of 65.5 grams, on the basis of his mathematical analysis of the weight values of the pieces before they were properly cleaned.

[12] Un'unita ponderale egea a Capo Gelidonya, SMEA 14, 1971, 163–70. I thank Prof. J. Muhly for bringing this reference to my attention.

[13] G. Bass, Cape Gelidonya: A Bronze Age Shipwreck, TAPS 57, Part 8, 1967, 164.

These few marked weights, all of which are paralleled by many unmarked weights at these and other sites, offer useful clues about the design of the Minoan system of weighing. The 2-, 4-, and 8-unit pieces suggest that the unit was doubled consecutively to form higher increments; the presence of $\frac{1}{2}$- and $\frac{1}{8}$-unit pieces indicates consecutive halving of the unit to produce smaller weights. This is not at all surprising, for the double and the half are binary denominations which are not only practical factors in any system of weight measurement, but also the factors most easily and accurately manufacturable on the double-pan balance. The binary series is not the only one in evidence, however. A duodecimal principle may be seen in the 12- and 24-unit weights, as well as in their aliquot subdivisions of 4 and 6 units; these also are useful denominations in a weight system. Finally the $\frac{1}{3}$-unit pieces indicate that tertiary division on the double-pan balance, which may be slightly time-consuming but yields accurate results, was also carried out.

It remains to consider how the results of the above analysis compare with the model of Minoan weighing as deciphered from the tablets. Bennett[14] read the following series of fractional quantities expressed in association with weighed commodities:

$$1 \text{ (talent)} : \frac{1}{30} : \frac{1}{120} : \frac{1}{1440}$$

In addition, there are indications that an even smaller unit was used, estimated at $\frac{1}{6}$ of the weight of the last, or $\frac{1}{8640}$ talent[15].

Was read the following fractional series in the Linear A tablets from Haghia Triada:

$$1 : \frac{1}{30} : \frac{1}{120}$$

and a smaller, apparently rare unit to which he assigned the value of $\frac{1}{144}$ talent[16]. The parallels with the Linear B series are quite obvious and lead one to conclude that Bennett was correct in his early speculation that "... the originators of Linear B adopted without change the fundamental principles of ... accounting used in the Linear A script"[17]. The parallels may be seen in Table 3 (absolute values computed by Ventris and Chadwick[18]).

14 op. cit. 211.
15 Docs 57.
16 op. cit. 1971, 49–50.
17 op. cit. 220.
18 Docs 57.

Table 3
Denominations of the Minoan System of Weight
as indicated in the Linear A and B Tablets

Linear A Symbol	Linear B Symbol	Denomination	Weight (g)	Fraction of Talent	Fraction of Preceding Denomination
[illegible]		Heavy Talent*	58 000	$\frac{2}{1}$	–
[illegible]	𐄷	Talent	29 000	$\frac{1}{1}$	$\frac{1}{2}$
[illegible]	𐄸	Heavy Mina	966	$\frac{1}{30}$	$\frac{1}{30}$
		Mina	483	$\frac{1}{60}$	$\frac{1}{2}$
[illegible]	𐄹	Half Mina	242	$\frac{1}{120}$	$\frac{1}{2}$
	𐄺	$\frac{1}{24}$ Mina	20.2	$\frac{1}{1440}$	$\frac{1}{12}$
	𐄻	$\frac{1}{144}$ Mina	(3.36)	$(\frac{1}{8640})$	$\frac{1}{6}$

* Found only in association with the ideogram for wheat (𐂎). This reading suggested by Was (Kadmos 12 [1973] 142–3).

Nowhere in Table 3 is a unit of ca. 60 g. directly evident. However, the calculated theoretical weights of the mina, half-mina, and $\frac{1}{24}$-mina are very close in absolute value to the weights of nos. 16–17, 12–14, and 2–4 respectively. The correspondences between the theoretical and actual absolute values that occur simultaneously in the same ratios both on the tablets and in the balance weights are certainly not fortuitous. The relationship between our unit and the mina is thus precisely 1:8. Although the series of absolute values calculated from the tablets is identical with that indicated by the balance weights, it may seem somewhat peculiar that the system of denoting the various values is not identical both in the accounts and in the balance weights; in other words, one may ask why the mina is marked '8 units' instead of the unit being marked '$\frac{1}{8}$ mina' (in fact this could be the case with no. 9, whose eight dots might be read '$\frac{1}{8}$' by analogy with the interpretation of the eight dots in no. 1). The reason for this is that, if the mina were marked '1', the binary denominations below $\frac{1}{8}$ mina would be $\frac{1}{16}$, $\frac{1}{32}$, and $\frac{1}{64}$ mina. These fractional denominations, all of which are in fact represented by dozens of marked and unmarked Minoan balance weights, would have been very difficult to represent at all in symbols in this manner, let alone on progressively smaller discs of lead and stone. A symbol of eight dots representing $\frac{1}{8}$ seems to be a limit of sorts; to incise sixteen dots or a circle and six dots (to signify $\frac{1}{16}$) on a small disc of the prescribed weight would have been most tedious. There is, perhaps, an exception. Earlier it was suggested that the large cross incised in no. 20 from Mochlos indicated in shorthand manner the number 24. We may be justified, then, in reading the cross on its companion piece (no. 2, with which it was found) analogously – as $\frac{1}{24}$ – since the piece weighs $\frac{1}{24}$ of the mina. This weight bears markings which suggest that it was doubly useful, as a fractional measure of the unit ($\frac{1}{3}$) and of the mina.

The fractional measurements to be read on the tablets (especially the smaller denominations) may at first glance seem to us both complex and awkward, but they must be viewed in their proper perspective. It would be anachronistic of us to claim that the Minoan accountants visualized such fractions as $\frac{1}{1440}$ and $\frac{1}{8640}$; rather, they saw each small measure as a function of, and as the nearest relative to, the next higher measure (as presented in the last column of Table 3). If a Minoan merchant knew that 12 [sign] were equal to one ⧺, and that there were 4 ⧺ per [sign], he would have mastered the mechanics of the system and could, using a sanctioned prototype unit balance weight, make accurately his own set of balance-weights using no more complex a factor than 12. Any other denomination he needed could be simply and quickly derived from these.

We may regard the unit of just over 60 g., which is indicated in the series of Minoan balance-weights, as a popular sub-unit of the mina, regulated with remarkable precision. That this denomination has not been identified on the tablets is not disturbing. The tablets existed to serve the palace bureaucracies, and were therefore concerned with foodstuffs and raw materials in great quantities – talents and fractions thereof. The craftsmen, merchants and consumers who used these little stone and lead weights, on the other hand, were concerned with everyday matters more simply and more immediately grasped, that is, minas and fractions of the mina.

It may be noted in conclusion that the Minoan mina is very close to the weight of our English pound, and the unit stands in binary relationship to the mina, just as does our ounce to our pound. Binary multiplication and fractionalization were popular in the Aegean in the Bronze Age for the same reason that they are popular today: the resultant denominations are simple, logical and, above all, practical.