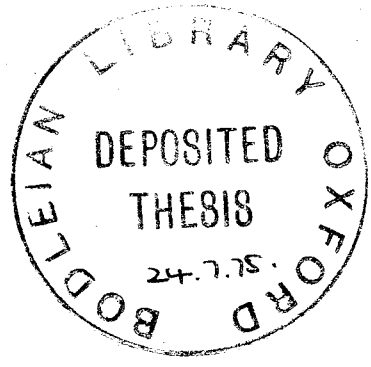
# G R E E K  W E I G H I N G

by

C.H. Grayson




Thesis
submitted for the Degree of Doctor of Philosophy
at Oxford University

1974 [i.e. 1975]

# A B S T R A C T

This thesis is not a direct contribution to Greek metrology in the traditional sense of the subject, though it is an attempt to move the subject in a different direction. The relatively straightforward search for Greek weight standards can only take place after it is known that such standards existed and that they were built into such evidence as might survive to be studied. This however is not necessarily the case, nor is it necessarily true that even if such standards existed they meant very much to the ancient Greeks. If little substantial progress has been made with the study of Greek metrology (and in this particular case with weighing) it is because these basic questions have not been resolved. In fact it will be shown that weight as a concept was not understood by the ancient Greeks; their balances distinguished or compared but did not measure weight. With this conclusion the strictly metrological aspect of the subject is largely irrelevant.

An attempt has been made to use every available source, and type of evidence, to illustrate Greek weighing. The evidence falls into two categories: first, the direct evidence of actual balances, of extant weights, of coins (being weights), and of recorded weighing in literature and on inscriptions; and second, the indirect evidence of weighing theory, of attitudes to the balance and its use in allegory, metaphor and simile. This range of evidence must be taken as a whole.

The first chapter is devoted to the collection of evidence about Greek balances. No complete balance has survived and only a very small number of even possible pans have been excavated. The main evidence for the balance is from representations on Greek vases; these are classified according to subject matter. A number of literary references can also be taken into account for discussion of the construction, use and performance of Greek balances. This discussion is supplemented

by Appendices A (on modern theory) and B (experiments with reconstructed balances). All types of weighing are considered, but especially comparative weighing with the unstable (overbalancing) two-pan balance. Minimum detectable difference in weight should be distinguished from minimum measurable weight; the former is a means of expressing the latter, but on the overbalancing balance it is the only relevant factor; it is also the lesser of the two weights. Even at this stage it is clear that Greek balances were of the overbalance type. The minimum weight difference they are likely to have been able to detect was over 0.2gm.

Weights are assembled in chapter two. In the first part on actual weights, the most significant series is the Attic. This is analysed in some detail: clearly the most significant changes (including that of standard) and the majority of weights belong to the post-classical period; overall a remarkable lack of precision can be observed (with Appendix F). Other weights are next classified, where identifiable, according to provenance. The second part of the chapter reviews the evidence of coinage: general questions are raised and the importance underlined for further detailed study of the fractional coinage of Greek mints. A preliminary survey of the sixth and fifth-century coins of the Sicilian mints is given in an Excursus; Appendix C collects some of the evidence for coin conversion.

Chapter three comprises epigraphic (and some literary) evidence for measured weights and weight systems; again subdivision by states results in greatest attention being paid to the Attic evidence. A great variety of systems clearly existed, and in some cases it is possible to relate this variety to differences in commodity, as well as in source.

In chapters four and five the more traditional questions of Greek metrology are discussed: standards, systems, and their origins. The more significant conclusions reached are that no marked weights precede the introduction of coinage, that weight units were tied to commodities, that standardisation of weight began with coinage and that other weights were only gradually systematised by their being incorporated into the coin systems. Manipulation of standards belongs to the Hellenistic

period at the earliest; and the first official decree about the absolute weight of a Greek coin is Roman (Appendix E). The controversial account by Aristotle in Ath.Pol.10 of Solon's legislation about coins, weights and measures is fully analysed (chapter five and Appendix D).

Chapter six imposes a new line of approach. Examination of mathematical and scientific theory of weighing fails to produce evidence of interest in measurement, even when the principle of the lever was fully understood by the time of Archimedes. This evidence might be suspected of being unduly selective, but the same picture results from a consideration of how the Greeks regarded weighing. Philosophers spoke repeatedly of light and heavy as different things, as opposites; allegory involved the use of the balance to distinguish (the scales of Zeus) not to measure or evaluate; and the same idea is reproduced in more general literary evidence: metaphor, vocabulary, and simile.

Two problems therefore emerge in reconciling this general evidence of lack of interest in, or even awareness of, weight measurement with the clear evidence of weights, coins and recorded measurement of weight collected earlier in chapters two and three. First, in chapter seven, it is shown that the contexts in which weighing occurred were extremely restricted. Only in inventories and some specialist processes was weight measurement necessarily involved; in other contexts (and the range is extensive) a comparative technique appears to have sufficed. For general buying and selling, for example, comparative weighing offered advantages of being psychologically suitable, rapid, efficient and also precise: with no sufficiently standard weights or systems, little value lay in measurement or pricing. Coins were counted and accepted at their face value; they were not weighed, although they could be used as weights.

The second problem arises from the apparently extravagant claims to accuracy and high precision made in the recording of certain weights and in the minting of many fractional coins. A careful analysis of the elements of this problem in chapter eight shows that it is artificial. Such cases where high accuracy in weight measurement appears to be implied by the evidence are areas where the point of weighing was in fact descriptive. Other cases can be regarded as careful comparative weighing.

This picture of Greek weighing is next compared with those that can be derived from other near-eastern cultures (Egypt, the Hittites, Mesopotamia, the Canaanites and Phoenicians, the Hebrews) and also from bronze-age Greece, chapter nine. It would appear that the Greek attitude was largely unique. Some elements of obscure Hittite ritual may be related, but rather than seek an indo-european origin for the Greek attitude to weighing, this probably lies in the social and political conditions of the early iron age. The role played by the Phoenicians at this point is difficult to estimate, but was probably negative.

Finally, the implications of this study of Greek weighing are briefly discussed in the General Conclusion. On the economic side, commerce was impeded, but no more than by state disinterest in trade which was itself one reason for the lack of standardised weights. In fact for practical buying and selling the Greek weighing technique was well suited. The effect on subsequent thought about weighing and the balance have led however to serious confusions. No theory of absolute weight was properly developed until the Middle Ages, and Christian iconography incorporated Greek balance allegory alongside the near-eastern. Weight metrology however was not a field to which the ancient Greeks contributed.

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# PREFACE

Although of considerable interest to late classical writers, the study of ancient metrology was reopened in the early sixteenth century by Budé, who chose to consider weighing in his major work *De asse et partibus eius* (Paris 1514). The subject has since attracted the attention of many scholars, noteably Hussey, Böckh, Hultsch, Viedebantt, and most recently Lang. Even though no argued general criticism has appeared, this traditional approach to Greek metrology has as such been treated with suspicion by most modern scholars. Nevertheless, despite this suspicion, the results and conclusions of nineteenth-century Greek metrology continue to be used in published research. The suspicion is, I believe, well founded and applies to all aspects of Greek metrology; it will however only be possible to consider here the question of weights and weighing.

That a distinction can exist between weights and weighing, but is ignored by the traditional approach (that is concerned almost exclusively with weights, their derivation, transmission, and manipulation), is possibly the main criticism of this approach. It is further based upon a number of unwarranted assumptions, of which I should select in particular: that Greeks were interested in the measurement of (absolute) weight; that systematisation existed in general (or even within a single Greek state); that (even if this were the case) every, and so any surviving, weight should belong to, and be assignable to, a system or standard; and, finally, that the evidence of any particular period or date can be applied to Greek metrology as a whole, at all dates. The traditional metrological approach can be characterised as operating from the measurement of ancient weights in the most precise terms possible from modern techniques of weighing and statistical analysis, from ancient literary evidence with no serious regard for its chronological context, and from the present-day conceptual framework of measurement. A good example is Lang's definition of the *kotyle* as 60 drachmae or 32 cubic

fingers (The Athenian Agora X (1964) 44): the correlation between weight and volume belongs to the Roman period whereas that between volume and length is American (or "metric") and entirely without ancient justification. Hultsch cited (GRM$^2$ 105 n.6 on p.106), but regarded as simply striking, the comment of the first-century writer Theon of Smyrna:

εἰσὶ σηκὸς πρὸς μναν ἡ χοινιξ πρὸς κοτυλην ἀσυγκριτα καὶ ἀσυμβλητα .

The traditional approach to ancient metrology is in need of reappraisal and revision. I have however tried to avoid polemic and detailed discussion of much of the straightforwardly metrological modern work. By adopting a different approach to the subject, here restricted to weighing, I hope to leave little content to the complex edifice of traditional metrology. While to a certain extent unavoidably involved in the absolute values of ancient weights, my main interest has been to consider how contemporary Greek society used them - how concerned the Greeks were in their precision, standardisation, and correlation; in other words the subject of this study is weighing rather than weights.

I am anxious to note here that metrology studied in this way can be a new and valid approach to general social and economic problems, and is far from the simple playing with figures and hypothetical origins that has rightly made many scholars suspicious of the subject. In so far as standardisation depends upon official control, the question of how far commerce made use of weights (and measures) is a direct reflection of the relationship between a Greek state and its trade. My research on weighing would show however that, contrary to the general assumption, commercial weight standards did not exist in the classical period, and that only coin standards were (indirectly and inaccurately) officially controlled. The variation in these weight standards, not to mention their non-existence in the pre-coinage period, obviously had an effect upon the mechanism of pricing, and must seriously have restricted the scale and planning of trade. Budgeting for small profit margins, for example, could have no obvious place in inter-state trading. It is possible to go further as there is abundant evidence that the Greeks did not use weights to weigh on most normal occasions. Suspicion of the excessively mathematical approach to Greek metrology is confirmed by the remarkable lack of references in Greek literature and art to the use of weights in weighing. The point can be extended in the light of the construction of Greek balances and of indirect (metaphorical or allegorical) applications of the idea of weighing. From both it can be shown that the weighing machine was used to distinguish, rather than to equate .

This Greek use is as far as I can tell unique in the ancient world (with the exception of some elements of Hittite ritual). It had repercussions on the development of scientific theory (so that Aristotle could assert that light and heavy were different things) and also raises the general question of whether the Greeks were restricted by, or in fact restricted their technological development. It clearly had a more practical effect on commerce. Naturally weights were used (as they survive, and measurements of weight are recorded), but the contexts of their use can be shown to be restricted to specialists and to an interest in the description of value rather than the measurement of weight.

Minor developments took place within the classical period, but changes become more marked after this (versions of the steelyard appear; commercial weight standards are attested; many more weights survive, and many more commodities are weighed). It is because of this late evidence that I believe the majority of the misconceptions about the earlier development of Greek metrology have arisen. The later period is not without its own interest however. The New Style coinage of Athens, for example, not only shows a new and developed interest in official accounting, but also formed the basis for the fixing of Greek commercial weight standards in the second century BC (IG.ii$^2$.1013 and its lost predecessor that I believe must also have been second-century). This coinage was furthermore probably the first Greek coinage ever to be defined, or delimited, in non-coin weights - significantly in Roman weights by the treaty of Apamea. The development towards general standardisation in the Hellenistic period raises the important question therefore of the influence of Rome on the Greek world, as also of the changed direction of Greek activity as a result of their loss of political freedom. These matters have their earlier parallels in the relations between the iron-age Greeks and their more advanced near-eastern neighbours.

The problem of what can properly be classed as Greek weighing involves not only separating Greek from non-Greek, but also the extrapolation of evidence from particular Greek states. The greatest part of the Greek evidence for both weights and weighing to be considered in this study is in fact Athenian. While such evidence as can be found from other states does not appear to conflict with inferences made primarily from the Athenian (and often have helped in drawing such inferences), this restriction imposed by the nature of the evidence should be recognised as a qualification of the general conclusions drawn here about Greece as a whole.

A further difficulty lies in the stratification of ancient Greek society. The evidence of literature, the product of a politically active but essentially leisured class, cannot without careful consideration be correlated with actual weights and actual weighing, the tools and chores of a lower, and silent, section of society. To a certain extent such social levels can be shown to vary in their use and understanding of weighing.

The evidence relevant to this study of weighing in Greece is vast. While I have attempted to cover the total breadth of types of evidence, in several areas such coverage has inevitably been incomplete: thus I have not examined every Greek pot, inscription, or written word; I have not been able to examine many Greek weights; nor have I attempted the necessary review (and reclassification) of the products of all Greek mints. I have however felt it important to examine possible (but negative) as well as actual contexts for weighing, because the identification and restriction of the contexts in which weighing occurred is an integral part of the study as a whole. Similarly it has been necessary to consider non-Greek cultures in order to contrast and isolate as an independent and internal development the weighing of classical Greece.

The chronological limits to this study are essentially from the Dark Ages to the late fourth century BC. These are also of course the limits of a phase in the political history of Greece. The correlation is not artificial, as the question of weighing and weight control directly reflects political development and interest. The lower chronological limit has however been considerably stretched in order to include the greater detail of many third-century inscriptions (especially of Delos), and to reach down to one or two significant pieces of evidence of even later dates (for example the Athenian decree IG.ii$^2$.1013). This is necessary, not simply because such evidence has tended to be assumed for the earlier period, but because contrasts can be brought out between the late and the earlier periods and the development of weighing in ancient Greece set out.

The chapters are roughly grouped around the central topics of this study: the balance and its operation (I), weights (II-V), and weighing (in VI-IX). This arrangement also suits for the most part the available evidence which has therefore been included within the main text: thus

representations of the balance (listed in I), actual weights (II), recorded weights (III), literary references to weighing (listed in I, but discussed in VI). For certain matters of more general, or less direct, relevance I have resorted to a small number of Appendices. An exhaustive bibliography either of all works on Greek metrology, or of those used in the many different areas covered by this study, has seemed unnecessary. No work has been done to my knowledge on the lines pursued here, and reference to no modern research would apply in general.

My interest in Greek weighing arose in the course of research into the trading patterns of Western Greeks in the archaic period. A provisional survey, based essentially on the evidence of pottery, indicated the existence of distinct patterns and, while technical difficulties were apparent in the quantification of such patterns, the real problem seemed to lie in their interpretation. This demanded an independent picture of commercial activity in the period and area in question. I set out this position in my B.Phil. thesis "The archaeological evidence for Greek trade in the archaic period (an evaluation of quantitative analysis)" (1968). A possible approach to the archaic period was at this point suggested to me by the work of Breglia and others on coin standards. While recognising that coinage appeared only late in the Western colonies, Breglia argued that the coin standards reflected earlier, pre-coinage weight standards which themselves indicated those areas in commercial contact with each other when such weight standards were adopted. As the coin standards of as small and as compact an area as the Western colonies were accepted by numismatists as varying considerably, it seemed possible to me that this variation could be correlated with the variation in pottery-import patterns that my earlier research had shown to exist. My study of Greek weights and weighing since has convinced me that no such approach is valid. The picture of weighing that I have now established is relevant to my initial problem, but in a different and more general way. Further study of other aspects of Greek metrology are called for; my research into these is not yet concluded but seems to confirm the general conclusions reached here for weighing (especially in capacity and linear measurement).

I should like finally to thank my supervisor, John Boardman, for his continued support and encouragement of what began as a somewhat lengthy digression into its present form.

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# A B B R E V I A T I O N S

Throughout standard abbreviations have been used (literary LSJ; graphic arts ABV and ARV$^2$; near-eastern ANET$^2$). Full bibliographic detail is given in the notes, where only references repeated within a single section are abbreviated. A small number of works are cited more generally; these are listed below. For convenience I add here a number of internal references.

| | |
|---|---|
| ANET$^2$ | J.B.Pritchard Ancient Near Eastern Texts relating to the Old Testament (Princeton, 2nd ed 1955) |
| AS | The Attic Stelai (W.K. Pritchett Hesperia 1953, 1958 ff) |
| B (-) | Epidauros inscriptions from A.Burford BSA 61 (1966) 254-334 |
| BB (-) | Weight from Babelon and Blanchet BN Catalogue de bronzes |
| BN (-) | Bronze weight from Lang Agora X |
| CAD | Chicago Assyrian Dictionary |
| Davidson (-) | Weight from G.R.Davidson Corinth XII: The Minor Objects (Princeton 1952) |
| DS | Daremberg, Saglio, et Pottier Dictionnaire des antiquités grecques et romains |
| Exp (-) | Experiments with reconstructions of Greek balances (see Appendix B) |
| HN$^2$ | B.V.Head Historia Nummorum (Oxford, 2nd ed 1911) |
| Hultsch GRM$^2$ | F.Hultsch Griechische und Römische Metrologie (Berlin, 2nd ed 1882) |
| Hultsch SM | F.Hultsch Scriptores Metrologici (Leipsig, 1864-6; reprinted 1971) |
| Kroll (-) | Weight from J.H.Kroll "Three inscribed Greek bronze weights" Studies for C.H.A.Hanfmann (1972) 87-93, pl.28 |
| Lang Agora X | M.Lang (and M.Crosby) The Athenian Agora X: Weights, measures and tokens (Princeton, 1964) |
| Lang ANSMN (-) | Weight from M.Lang "Five Hellenistic lead weights" Amer. Num.Soc.Mus.Notes 14 (1968) 1-3, pls.I-II. |

| | |
|---|---|
| LW (-) | Lead weight from Lang Agora X |
| M (-) | Weight from A.S.Murray "Greek weights in the British Museum" NC 8 (1868) 57-73 |
| Michon | E.Michon in DS sv.pondus |
| ML | R.Meiggs and D.M.Lewis A selection of Greek historical inscriptions (to the end of the fifth century) (Oxford,1969) |
| NC | Numismatic Chronicle |
| OCD/OCD$^2$ | The Oxford Classical Dictionary (Oxford, 1949; 2nd ed, greatly altered, 1970) |
| P (-) | Weight from Pernice GG. |
| Pernice GG | E.Pernice Griechische Gewichte (Berlin 1894) |
| Pleket | H.W.Pleket Epigraphica I: Texts on the economic history of the Greek world (Leiden, 1964) |
| Pnyx (-) | Weight from G.R.Davidson and D.B.Thompson Small objects from the Pnyx I (Hesperia Suppl.VII, 1943) |
| PP (-) | Passage listed by G.S.Kirk and J.E.Raven The Presocratic Philosophers (Cambridge, 1969) |
| P.Supp (-) | Weight from E.Pernice AA 1904 pp.45-6 |
| RE | Pauly-Wissowa-Kroll Real-encyclopädie der classischen Altertumswissenschaft (Stuttgart) |
| Rep (-) | Representations of the balance in Greek art (see lists ch.I.1.(2) pp.9ff) |
| Rob (-) | Weight from D.M.Robinson Excavations at Olynthus X: Metal and minor miscellaneous finds (Baltimore, 1941) |
| S (-) | Hebrew word number from J.Strong The exhaustive concordance of the Bible |
| SEHRE$^2$ | M.Rostovtzeff The social and economic history of the Hellenistic world (Oxford, revised by P.M.Fraser, 1957) |
| Seltman GC$^2$ | C.T.Seltman Greek coins (London, 2nd ed 1955) |
| SW (-) | Stone weight from Lang Agora X |
| Wallinga P (-) | Text from H.T.Wallinga "The unit of capacity for ancient ships" Mnemosyne 17 (1964) 1-40 |
| Walters (-) | Weight from H.B.Walters BM Catalogue of bronzes (1899) |

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# G R E E K  W E I G H I N G

Volume One

CHAPTERS I-V

chapter one

# GREEK BALANCES

Introductory

Although the word "balance" will be used in this chapter, and throughout, of Greek weighing devices, it implies a concept (of balance) that will be argued later to be foreign to the Greek attitude to weighing. Discussion of this attitude must be preceded by examination of the evidence for weighing, weights and (in this first chapter) the weighing devices used.

The evidence for Greek balances is minimal, and widely dispersed through archaeological remains, pictorial representations, and literary references. These sources are first listed before an attempt is made to reconstruct the types of Greek balances and their historical development. A later chapter (IX) places this development, and the Greek attitude to weighing, in the wider context of earlier and associated cultures. Because of the inadequacy of the direct evidence, the Greek balance has tended to be passed over in favour of the more impressive achievements of these other cultures (in particular the Egyptian and the Roman)[1]. This is certainly justifiable in terms of the historical development of the modern weighing machine to which the Greeks contributed little. However it is possible to reduce many of the uncertainties about what was the normal Greek balance by considering it in the largely negative light of other aspects of Greek weighing: in particular of ancient Greek theory (which never seems to have appreciated those factors that significantly affected the performance of a two-pan balance) and of the Greek preference for inclined (or even swinging) beams to the precisely levelled, properly balanced beam in their "balances". Conclusions on these last matters are here anticipated from later chapters (and especially from ch.VI).

Sufficient evidence exists to distinguish several Greek balance types (and other minor modifications). Their operation is discussed here, but their relation to context is again delayed to a later chapter (VII). An important aspect of balance design is naturally sensitivity; where this arises in the case of Greek balances it is considered in another later chapter (VIII). An Appendix (A) covers the developed theory and design of modern balances and of modern mathematical ways of expressing sensitivity on them. It seems possible that the Greeks were not too much to be blamed for apparently overestimating the sensitivity of their balances as they rarely were interested in precision: again see Chapter VIII which considers the evidence for the effectiveness with which Greek balances were used in practice, as opposed to their potential. Experiments, made with reconstructed models of Greek balances, give ~~some indication~~ some indication of this potential, and are also relevant for the discussion of design and operation in this chapter. These experiments are described in detail in Appendix B.

## 1. Evidence for Greek balances

### 1.(1) Extant remains of Greeks balances

It is not possible to identify with certainty any balance, or part of one, as used by and made by Greeks of the historical period (from Dark Ages to Hellenistic). Pictorial representations, weights, literary references and inscriptions show beyond doubt that the Greeks did weigh and did use balances, but the silence of the material evidence remains remarkable in comparison with the abundance of bronze-age balances that have survived, as also of Roman and Egyptian[2].

This lack of evidence calls for explanation, and certain considerations can be used to soften the more far-reaching implications. In the first place, Greeks did not invest the balance with a symbolical value for the after-life. Such a value accounts for the survival in undisturbed, tomb contexts, of many Mycenaean, Egyptian, and even Sicel balances. Secondly, for not all bronze-age balances come from religious contexts[3], it is likely that Greek balances were more vulnerable in design, were constructed out of more perishable materials. Certainly iron is more vulnerable to corrosion than the bronze of the earlier age; but equally a thin sheet of metal is more vulnerable than the solid beams and counterweights of Roman steel-yards. This consideration plays a part in the reconstruction of Greek balances below. It leads to a third explanation for the lack of apparent remains, namely the problem of identifying the relatively simple elements of a Greek balance. This did not have the counterweight, or the complex hooks and chains on a specially-shaped solid beam, that makes identification of Roman balances comparatively simple. Balance pans alone are not easy to identify.

Small metal disks as might be balance pans could equally serve as dress and furniture ornaments. Regularly-spaced rim holes, ideal for pan suspension, would also be needed for attachment to other materials; a dished-shape is appropriate to both pan and decorative boss; and while there is no reason for balance pans not to have been decorated, there is equally no reason for dress (especially female) ornaments not to have been made in matching pairs. Consideration of any likely means of manufacturing such pairs makes similarity in weight (essential for balance pans) an inadequate means of identification. Nevertheless, matching pairs of metal disks, of similar weight, and with suitably positioned rim holes, would appear to be the most identifiable part of a Greek balance. Yet even on this criterion only one pair has come to my notice.

This, no.1 in the following lists, is, perhaps surprisingly, made of lead. The possibility that lead was used here and generally for Greek balance pans points to two further explanations for the lack of material evidence: (fourthly) lead could be reused, and the lead disk Olynthus no.2535 (see notes following) was broken up to mend a bath: and further (fifth) archaeologists have not thought to consider lead disks as possible parts of balances, and may therefore have overlooked evidence that does exist. In fact I believe clay to have been also a likely material for many balance pans.[4] None such have been identified, but possibly for the same consideration.

1. Pair of lead discs from Lefkandi. Unpublished: for the following I am indebted to notes and comments by the excavator L.H.Sackett and by V.R. d'A. Desborough.

The discs were found close together in the fill over the largest and richest tomb of the ST cemetery (T.59). In the associated deposit above the tomb were also found several pots of local Sub-Protogeometric date (Attic EG II/MG I), apparently therefore contemporary with the tomb itself and all around the middle of the ninth century BC. The discs are described as follows:

"1. (ST/T.59a/SF 1). D. 5cms; Thickness 0.15cm; Weight 47.7gm. Good condition, but chipped at the edge and broken at one string [the excavators believe them to be balance pans] hole. Underside is rounded, the upper surface slightly concave. There are four tiny string holes (D. c.1mm) at the cardinal points; these are linked by two fine incised lines which form a cross on the upper surface.

"2. (ST/T.59a/SF 2). D. 5cms; Thickness 0.15cm; Weight 48.2gm. Complete except for break at one string hole. Identical with no.1; the difference in weight is accounted for by the large chip missing from the edge of no.1."

The problems in identifying these discs as balance pans are first their uniqueness (especially in being lead, but also the early date - on which see further below), second the incised decoration, and third the reason for their being left in the tomb fill. The first problem should clearly be discounted, not least because the identification of this pair might well lead to the noticing of others. The decoration also is not decisive; indeed being on the upper concave surface this decoration must have been viewed from above, and so dress and furniture convex bosses are improbable. Whether the decoration in fact performs some function is not impossible: marking the central point (objects placed at this point in a balance pan would cause the pan to swing less), or assisting the equal positioning of the four suspension holes around the circumference of each disc (as far as I can see such lines have to be imagined for the placing of four holes with a minimum of trial and error in any case). Finally, the abandonment of the pans in the tomb fill is no easier to explain than the abandonment of the other items to the same context. As the tomb contained some gold it could further be suggested that the balance had served some related purpose (? the division of their loot by subsequent treasure hunters). If the balance was broken (as the state of the pans now seems to indicate) it might possibly have been discarded at a much later time; this would help inferences about later Classical balances, but until more details of the composition and arrangement of the fill become available, such speculation cannot be pursued.

The provenance of the discs cannot be settled with certainty. If the identification as balance pans is correct, I should incline to regard them as Greek in that no other lead pans are known from non-Greek cultures (where examples of balance pans in other metals have survived). However the Lefkandi sites does show evidence of contact with the Near East even if much less striking than the degree to which the pottery types were exported overseas (see the preliminary report by M.R. Popham and L.H. Sackett Excavations at Lefkandi, Euboea 1964-66 (1968) esp.33).

2. Beam of balance Delos B.6727. See W.Deonna Delos XVII (1938) 139ff. and pl.398. This is the simplest of a number of bronze balance beams found in uncertain, or general "Graeco-Roman" contexts on the site; other steelyard types, with chains, are clearly Roman or later: there is no way of dating the present example however to any particular Greek period.

The beam is inadequately described by Deonna, and the following notes are provisional inferences only. The beam thickens in the middle with a small central hole (is this vertical for suspension, or horizontal for an axle pivot ?); at its ends are plates with holes for the strings that would support the pans, now missing (how many such string holes, and how arranged ?).

3. Pair of bronze pans from Lindos. See C.Blinkenberg Lindos I (1931) 158 (cat.no.474 but not illustrated).

Diameter 6.5cm.; three suspension holes; no decoration noted; date uncertain even though included in a chapter headed "objets des premières époques archaiques".

4. Silver pan from Taranto. M.Mayer La coppa tarantina di argento dorato del Museo Provinciale di Bari (1910); H.Nachod "Die Silberschale aus Tarent in Bari" RM 33(1918)103-24.

Dated stylistically to the end of the fourth century, but partly for the same reason a most improbable balance pan. It was itself weighed and bears the inscription ΔΔΓϟ (26drs), though this weighing can have related in no way to its function as a scale pan for, if a steelyard, its absolute weight was irrelevant, and, if one of two pans, equal balance between them was necessary no matter what each weighed.

I note in conclusion other sites considered but from which the evidence remains negative:

Corinth Davidson Corinth XII(1952)207 "In the case of scales and other weighing instruments, the absence of Greeks remains is even more marked than that of the weights. There is no fragment of a balance that can definitely be called Greek, and not many that are certainly Roman..."

Olympia The only balances found are of the Roman period or later from Therme Kladeos, and are associated with the bronze suspension weight of a steelyard: A.Furtwängler Olympia IV Die Bronzen (1890)190. Some iron chains and hooks, also two iron pans (not a pair), may belong to balances: H.Weber Olymp.Forsch.1(1944)166-71 and pl.74 a-b.

Olynthus Excavation has revealed a very large number of discs in bronze and also lead. No pairs have been found. It is difficult to identify any of the following possible pieces as certain balance pans even though most could have served as such if matched with a twin. Refs. to the catalogue numbers in Robinson Olynthus X (1941). Dates late 5th to 4th cent.

shallow bronze bowl [no.573] three rim holes (diam 0.5cm) but too large with a diameter of 53cms ?
undecorated bronze disc [no.1221] diameter 4.8cm with four regularly-spaced holes; broken.
idem [no.1229] diameter 8.6cm and again four regular rim holes; slightly dished; Robinson "It has been suggested that such a disk might have been used as a scale-pan. It is more likely however that the disk was a decorative reinforcement".
series of flat bronze discs, curving up slightly at the rim, decorated with incised concentric circles and a central point, four holes evenly spaced around the rim, diameters ranging between 4.3 and 5.3cm [several of nos. 1231-51 fall into this description]. Robinson suggests parts of mirrors or mirror covers, or decorative mouldings on wood or leather: on some the holes wander from the rim position yet still seem to have served their intended purpose; on at least one of the series [no.1251] nail heads are still in place in the holes.
lead cover or disc [no.2535] diameter c.15cm with holes around edge some of which still hold nail-heads (note that the fragmentary condition of this disc is due to part having been taken to repair a bath tub.. Of how many balance pans might this not also have been true ?).
Lead disc or plate [no.2536] but with no suspension holes.

## 1.(2) Greek representations of balances

In the following lists Greek representations of the balance are arranged by subject and date. References are made to convenient illustration and bibliography[5], and as straightforward a description of the various scenes as is possible is given without begging questions of balance construction, use, and symbolism that will be discussed in subsequent parts of this thesis[6].

To the Greek evidence I have added references to Roman (indicated by the suffix -R) and Etruscan (-E) representations. A final section (U) comprises the miscellany of uncertain scenes, or non-Greek groups of scenes, that involve the balance.

The subjects are arranged and labelled alphabetically:

C. Commercial

E. Erotostasia (with associated EE)

H. The weighing of Hector's corpse

K. Kairos

P. Psychostasia

U. Uncertain

## C. Commercial

Under this heading are grouped all representations of weighing in a direct or practical context. Most appear to be commercial, but this is not meant to exclude alternative interpretations (such as private or temple inventory). No non-commercial contexts can as yet however be definitely identified from the Greek representations.

C.1 The Arcesilas Cup. Laconian Bf 565-560 BC; now in the Bibliothèque Nationale, Paris. See best P.Arias and M.Hirmer History of Greek Vase Painting (Eng.ed. 1962) pl.XXIV (in colour, facing pl.74); and for discussion Arias op.cit. 309-10, Lane BSA 38(1936)182, Nichon DS sv.Libra 1223, Ibel (1908) 47-9.

Inside: a seated figure (named Arcesilas) supervises the weighing, packing into bales, and storage of some material (wool rather than silphium as the latter would be stored in jars: Lane). Part of, if not all, the operation takes place on board a ship, the sail and yard of which are clearly shown. From the latter is hung a balance, labelled, in an inscription by the left-hand pan suspension cords, [st]athmos. Several people occupy the space below and around the balance, but only the seated figure and a smaller attendant (partly behind the left-hand pan) seem immediately concerned with the weighing.

The beam is large - over 7x the forearm of the small attendant (or 6x that of Arcesilas); it is carefully drawn, with added details incised or in red paint. Around a central flat swelling the arms taper until widening to trumpet-shaped ends. The pan suspension cords do not depend directly from these beam ends, but from a flat disc or vertical hook (?? - depicted by a simple vertical line) fastened onto the beam end. There are four cords passing to rings on each of the two flat pans.

The manner in which the beam is suspended from the ship's yard is ambiguous, for it is not clear whether a vertical line drawn from the centre of the beam, and ending in a cross-piece that engages a ring suspended by cords from the yard, is rigidly attached to the beam or is in fact cord itself, and so pliable (see discussion below following ). There are incision marks that appear to divide this vertical line, and at its lower end, near the balance beam, there is a short cross-piece. Below this, and passing both in front of the beam and behind it, hang several (5 ?) loose cords.

No weights are shown, and both pans are piled high with the material being subsequently packed away into the bales (thus the bales themselves clearly do not serve as measures). The beam appears more or less horizontal, and both pans are off the ground. As the small attendant's left hand is hidden it is not possible to tell whether he is to be thought of as holding the pan (compare C.3): no-one else however is either loading or unloading the balance.

C.2 Attic lekythos. Bf by the Amasis Painter, c.550 BC; from Vari and now in the Metropolitan Museum of Art, New York. See best G.M.A. Richter Bull.Met.Mus.Art 26(1931)291-2 esp. fig.5 (drawing) but also Deonna Delos XVII (1938) 152 n.9 and Pl.430 (showing amount restored). ABV 154 no.57.

Main field shows eleven women engaged in activities connected with wool (spinning, weaving etc as well as weighing). One holds a balance just clear of the ground while another places lumps of material into one (the right-hand) pan.

The length of the beam is c.4x the forearm of the operator (holding it); it is drawn as a straight rod. 3 (or ?4) cords depend from each end to flat pans. It is not clear how the operator is holding the beam, though her hand is above the beam and some cord must be understood. Note a carefully added detail (picked out in white paint) of a loop (of string ?) between points on the beam either side of the operator's hand.

The beam is drawn as level, but more material is being put into one pan. The contents of the other pan are not preserved. Restoration of a weight has been suggested on the analogy of Homer Il.12.433ff (Richter) but see below ch.I.3.(2). The woman holding the balance is paying no attention to either pan, but this could be as much a comment on the tedium of assembly-line work as an indication of how Greeks weighed.

C.3 The Taleides Amphora. Attic Bf 550-525 BC; from Agrigento and now in the Metropolitan Museum of Art, New York. See best D. von Bothmer Bull.Met.Mus.Art ns.5(1946/7) photograph on p.223. ABV 174 no.1 qv. for further bibliography including Ibel (1908) 49-50, Tillyard Coll. Hope (1923) 25-9, Michon DS. sv.Libra, and von Bothmer loc.cit.221-8.

On what is referred to as the reverse of this amphora (see below) is a scene of weighing. Two figures are seated each side of the pans suspended from a large beam; below this a central operator bends slightly to introduce something to the right-hand pan.

The beam (its length more than 5x the central operator's forearm) is drawn with a pronounced bulge towards the middle. The ends taper to the point where the pans are suspended; this suspension is initially by a single cord down to a short cross-piece, after which four cords continue to each (slightly curved ?) pan. The ultimate suspension of the beam itself is lost above the upper frame of the scene, but before this it is possible to identify two stages in the suspension. First two lines show something (cord?) passing round (and possibly through) the beam itself; these lines come together under a short cross-piece. Second, above the cross-piece, two more lines (clearly not continuing the first two) pass out of the picture.

The beam is drawn as level but the operation has elicited controversy: in particular whether the central operator is adding another lump, or pouring something, into the right-hand pan. The latter (von Bothmer's) interpretation seems more likely in that the right-hand seated figure is parting the ropes of this pan. The left-hand seated figure meanwhile also holds the suspension cords (of the left-hand pan). The contents of both pans are drawn similarly, as amorphous lumps.

The scene on the other (main) side of this amphora is of Theseus wrestling with the Minotaur. That the weighing scene is a comment on the "equally balanced" struggle is, however, artistically improbable and can also be refuted on metaphorical grounds (see below ch.VI.4).

C.4 Vienna Oinochoe. Attic Bf of the Keyside Class, late sixth-century. See best D. von Bothmer Bull.Met.Mus.Art ns.5(1946/7) photograph from a drawing on p.227. ABV 426 no.4 qv. for further bibliography.

The field is framed by a large balance, and in the space beneath it, and between the two pans, two men in long, embroidered dresses are carrying 'bundles' towards each pan, itself filled already with several such 'bundles'.

The large beam (over 6x the forearms of the operators) swells at the middle. Above this point is drawn a sort of loop, and from the top of this two lines run out of the top of the picture. The pan suspension is by three cords (or wires ? as the left-hand pan lines return slightly on themselves, resembling hooks) attached to rings on composite, flat pans; the attachment to the beam is not represented consistently: that on the left is to a box-like object below a simply-tapered beam end, whereas the cords (wires ?) emerge on the right from what appears to be a version of the trumpet type beam end. It is possible however that the drawing (modern) is responsible for this variation.

The objects carried, and being weighed, are depicted as rectangular with several longitudinal divisions. Michon DS sv. Libra 1223 suggests metal objects; von Bothmer prefers bales. A heavy substance however seems indicated by the reinforced pans, and the fact that the men are carrying their bundles on their shoulders.

The beam is horizontal, with neither pan on the ground and no indication of anyone supporting them.

There are several inscriptions running vertically in this scene. They might elucidate some of the uncertainties of interpretation, but I cannot as yet make any sense of them.

CR.1 Eurysaces' sarcophagus. Pompeii, late first century BC or early AD. Eurysaces was a baker, and the representation shows round objects, identified as loaves, weighed in baskets on a standed balance (pivoting on an axle fixed into the stand). The length of the beam is c. 6x the forearms of the operators; of these, one parts the ropes for the insertion of the baskets, another steadies the other pan, and another makes notes in a book. In view of this it seems reasonable to identify the objects in this second (in fact left-hand) pan as weights, stacked on top of each other; they are patently different from the baskets of loaves on the other pan.

Michon 1224 fig.4470; Baumeister p.246 and Abb.224c; but best in Rostovtzeff SEHRE (2) p.32 and pl.IV.3; also Ibel (1908) 57 fig.14.

CR.2 Pola bas-relief. Standed two-pan balance; one object in left-hand pan but three in right (indicating the use of weights ?); the beam thickens considerably towards the middle where it passes through the supporting stand (so axle pivot ?); note that the right-hand arm of the beam is held close to horizontal position by means of a stay projecting from the main stand.

Michon DS sv. Libra 1224 and fig.4469.

CR.3 Naples relief 6575 from the Farnese Collection. A copper-smith's balance, consisting of two pans depending from a straight beam hung beneath another, larger, beam that is fixed above by two vertical chains. Interest lies in two vertical marks (from top beam overlapping the lower beam towards its ends) which may represent guides in which the lower beam moves and from which accurate note of balance position can be made. See Gummerus (1913) 73 Abb.4 (his no.5) and Nowotny (1913) 11-14 figs.7 and 8.

CR.4 Rome relief showing a storeroom with scales hung up empty; only one pan is visible, and a counterweight appears on the other arm; the machine may be a steelyard but see CR.5 and 6. Jahn (1861) 350 Taf.XIII.4.

CR.5 Vatican relief with inscription "aurifex brattiarius" (first century AD). Two-pan balance hung in background; no point of suspension indicated; a circular object appears attached to one part of the beam and could be a counterweight, though Nowotny argues it to be simply a flaw in the stone. See DS. sv. aurifex, brattea figs.659 and 876; Grummerus (1913) no.1; Jahn (1861) Taf.VII.2; Pernice JdA 26(1911)288-9 Abb.1 (photo).

CR.6 Fish balance. Two-pan balance of highly developed design showing axle suspension pivot and hook and ring pan suspension; also a counterweight on the left-hand side of the beam. A weight is visible in the left-hand pan, two fishes in the right. The whole balance is suspended from one of several hooks (? sawn-off branches) on a large columnar stand. See Jahn (1861) 351 and Taf.X.5.

CR.7 Bologna grave-stele from a goldsmith's workshop showing the same parallel beam arrangement as CR.3 above. Grummerus (1913) 70 Abb.1.

CR.8 Vatican gravestone of Hilarus (aurifex). Second century AD ? The various tools of the goldsmith's trade represented include an angularly drawn two-pan balance with simple (diamond shaped) central suspension handle. Grummerus (1913) no.2; DS sv.aurifex fig.660.

CR.9 Lateran terracotta relief. Second century AD (late). Simple standed two-pan balance in a workshop. No details emerge, the beam and stand forming a straight-forward "T". See Grummerus (1913) 72 Abb.3 (his no.4).

CR.10 Lateran grave plaque. Third century AD. Tools of a craftsman's trade include a two-pan balance with roughly drawn central suspension handle. Grummerus (1913) 71 Abb.2 (his no.3).

CR.11 Frieze of putti running a jewellery shop from the House of the Vetii "black room" (Pompeii). A range of three sizes of balances is illustrated (2 standed and 1 hand-held); all involve two-pan weighing. The interpretation of the context as inside a mint has now been abandoned in view of the female customer. See Rostovtzeff SEHRE (2) 96 pl.XV.3.

CR.12 Mosaic of a threshold from Sousse (Hadrumentum) now in the Bardo Museum, Tunis. People are shown wading ashore from a ship towards two others standing beside a two-pan balance suspended from a tripod. The waders are carrying rectangular objects (metal ingots: Rostovtzeff) but there is no indication of what the others are weighing. The beam is level and the pans held in position (mid-air) by these two operators. See esp. Rostovtzeff SEHRE (2) 328 pl.62.2.

CR.13 Verona Relief 1391. A man sitting at a bench weighs some round objects with a single-pan steelyard type balance. No counterweight is shown, or other details. Inscribed "C.Ficarius HMHNS". See Jahn (1861) Taf.X.3.

E. Erotostasia

An extension of the iconography of the psychostasia (qv) found on gems and vases of the late fifth and fourth centuries. To the main group I have added the "Boston Throne" (EE.1), which is clearly associated by subject matter and belongs here more naturally than anywhere else despite the doubts surrounding its precise interpretation.

E.1 Gold ring with engraved bezel. Middle to third quarter of the fifth century. Formerly Lewes House. See J.Boardman Greek gems and finger rings (1970) no.666 and text pp.216,296; J.D.Beazley Lewes House Gems (1920) 50 no.53 pl.3; Frel (1963) no.1.

Aphrodite weighing two Erotes, a third Eros at her feet. The beam of the balance is inclined at an angle of about 30°; it is of even thickness with three cords depending from each end to flat pans; the beam is held by hand above its centre but it is not clear how this suspension is achieved; its length is approx. 2½x Aphrodite's forearm.

E.2 Silver medallion. Last quarter fifth century. Athens. See Collignon Manuel d'Arch. Grecque 362 fig.3; Frel (1963) no.2.

Aphrodite weighs two Erotes, while a third flies to crown her.

E.3 Attic Rf crater c.330 BC by the Painter of the Erotostasia (!). Athens, Mus.Nat. See esp.K.Schefold Kertscher Vasen (1930) pl.23b; Frel (1963) no.3; ARV² 1456 no.1.

Aphrodite, assisted by Hermes, weighs two Erotes (clothed and winged), only one of which is fully visible. Hermes turns with one hand on hips, the other gesticulating; Aphrodite (top half restored) holds the scales in her left hand.

The beam is drawn with some care; it is of even thickness but with much wider cross pieces (rings ?) at each end; from the beam itself, and not from out of these ends, two cords depend to the pans (which are themselves not visible); several marks are drawn on the beam (across its width) at the centre and at the ends (cord binding ?); the hand of Aphrodite holding the balance comes right down on top of the centre but as it does not overlap some sort of suspension hook or cord can be inferred. The beam is approx. 2x Aphrodite's forearm. It is shown in a horizontal position.

E.4 Campanian hydria. C.350-325 related to the AV Group. From Apulia, now in the BM, London. See esp. Studniczka (1911) 140 Abb.58; CVA 2 IV Ea 8.10; Frel (1963) no.4.

Two small winged figures are held in a balance by a woman facing a man. The balance tilts over a stool on which are a cushion and an egg (?? or ball of wool).

The details of beam suspension and its thickness are unclear; it is 2½x the forearm of the operator in length; the three cords to the pans depend from the ends, but it is not clear whether from out of the ends or from under them; the two winged figures are using the pans rather like swings. Most significant however is the steep inclination of the beam (approaching 45°).

E.5 Grisolia ring. Tarentine, late fourth century. Reggio di Calabria. Frel (1963) no.5.

EE.1 The Boston Throne. Mid fifth century (towards 450 BC).
See Simon (1959) in general and esp. Abb.33 and notes pp.108-9 for bibliography, also one of the scales is illustrated on p.92; Studniczka (1911) 76 Abb.16 (attempting a reconstruction of the balance); J.Young and B.Ashmole "The Boston relief and the Ludovisi throne" Boston Mus. Bull.66(1968)124-68.

Main panel: central winged boy holds up a balance with one hand, the other is placed ostentatiously on his hip; the balance itself is lost, though fixing points show that it was of metal and inclined down on the left-hand side, but the pans and cord suspension are modelled in stone; the pans hold two similar, long-haired, naked youths hanging by their hands to a cord that continues upwards to join the other pan cords; the higher, right-hand youth faces out right (to me he seems to be trying to jump), whereas the left-hand youth faces front (and both feet are firmly on the pan - could he be pulling down ?); either side of these pans is a woman, flanked, on the sides of the "Throne" by a man; the woman by the left-hand (lower) pan is smiling, waves her hands in joy, is accompanied by a fish and, round the side, by an old [wo]man; the other woman, by the right-hand (higher) pan, seems unhappy; she is associated with a pomegranate, and round the side is a young man. The figures have been variously identified, thus (from left to right): Anchises, Aphrodite, Eros, Eos, Tithonos (with a representation of Tithonos in each pan also) - Simon; or Clotho, Aphrodite, Eros, Persephone, Hermes (with Adonis implied by the figures in the pans) - Ashmole. I shall not pursue these problems further. It is sufficient to note that the balance is being used to distinguish, that like is weighed against like, and that, on this occasion, the lower (heavier) side appears the winner (for better or for worse - and the uncertain context does very much undermine the significance of this conclusion).

The details of beam suspension and design are of course irretrievable. It was hand-held, a little way above its centre; and its length was 3x the forearm of the operator (2½x the larger women's); the pans are shallow dishes with probably three cords (taking the central cords that the youths are holding as parts of the pan suspension). The angle of the beam seems slight, though clear.

[This relief is discussed further below ch.VI.3 on the Afterlife].

H. The weighing of Hector's corpse

A relatively rare subject derived from Aeschylus' misrepresentation of Homer Il.22.351. The idea was later applied by Lycophron and others to the ransoming of Achilles himself after he had been killed by Paris. It is possible therefore that certain of the following scenes may represent the weighing of Achilles' corpse, but all clear identifications are of Hector's. The "correct" version of the scene, without a balance, is more common (for sixth-century shield bands from Olympia see E.Kunz Olymp.Forsch.2(1950)145-8 IVf, XVIId, XXXIIIδ and for Attic versions see KE Johansen Iliaden 72ff 162.20 a-g. See below ch.VII.2.(16).

H.1 The Toronto Relief. A clay, Melian plaque, c.440 BC, in Ontario Museum. Graham (1958) 313-9 and pl.82.1.

The corpse lies on the ground in front of a square frame balance; by its head, standing to the right of the balance and holding a rod towards the right-hand end of the balance beam, is a young attendant (not Hermes, pace Graham, as he plays no part in the Homeric meeting and is clearly not involved with the weighing itself on H.2). To the right is an old man (Priam ? or an old woman ?); to the left a warrior, holding a Thracian type helmet (or pot ?), rests one hand on the top frame of the balance. Towards him the attendant extends a bowl (?). Behind the balance (drawn between the cords) is a square open box.

The balance is suspended from a massive frame held rigid by brackets at the junctions of uprights with cross-piece; the suspension appears to be simply by a cord passing round the cross-piece, but it is not clear how it is fastened to the balance beam itself. The beam tapers towards its ends from which the pans (obscxured) are hung by three cords; it is approx. 3x forearm of the attendant and appears to be drawn level.

H.2 Volute crater. Italiote, early fourth century, from Ruvo now in the Ermitage. See Michon DS sv.Libra 1224 fig.4467; Baumeister (1885-8) Abb.792; Graham (1958) 315 and pl.83.5.

Two levels of the large composition are joined by a square frame balance drawn at an angle. Hector has been ransomed and is carried back to Priam (weeping on his throne). An attendant rests one hand on the corner of the balance frame and turns to face Achilles who is in conversation with several gods (including, clearly indicated, Hermes).

The lower part of the balance (pans and contents) is restored, and the drawing in general is not precise. It seems that some attempt at perspective has been made, and if so the balance beam is clearly in the same plane as the frame supporting it. This frame is again more massive than the balance beam, and there are traces of bracing and cord lashings at the joints in it. The manner of suspension of the beam is unclear; but the beam, 3x the operator's forearm, swells at its centre, has trumpet shaped ends, and is shown as parallel with the top frame (so level ?). From the beam ends (out of or from under ?) depend four cords towards each pan.

HR.1 Silver jug from Bernay. Priam and his retinue stand to the right, Achilles and others are to the left of a "two-pan" balance in which the actual body of Hector (to the left) is weighed against a metal vase (to the right). The balance is shown level. It is an elaborate type: supported by a tripod stand the beam terminates in two hooks from which cords (only two drawn) depend to a pan supporting Hector and another cord around the metal vase's belly; the beam pivots on an axle that is concealed by a large bearded mask with a decorative finial. See drawings in Baumeister (1885-8) Abb.793; Ibel (1908) 56 fig.13.

HR.2 Sarcophagus from Woburn Abbey. Fragmentary, but again the body of Hector is actually on one side of the simple standed balance. Towards the other side a sack and ? ingot are carried by two attendants with Phrygian headdresses. Priam follows with a cloak over his head. The Greek side is lost beyond the break. See Bulas Les illustrations antiques de l'Iliade (1929) fig.55; Graham (1958) 315 n.11.

K. Kairos

The following group can be established on the assumption that one of the two first Greek examples did represent Kairos and did include a balance. This can be disputed, in which case the later versions, which clearly show a balance, are probably derived from a late misinterpretation of the early statues and in particular of the phrase "epi xurou akmēs". See below ch.VI.4.(1).

K.1 Polyclitos' Kairos (?) Pliny NH 34.55 "nudum talo incessentem" but with no mention of the symbolical details (including the balance) that appear first with Lysippos' version (K.2).

K.2 Lysippos' Kairos. Second-half of the fourth century, bronze; but, like all this prolific sculptor's work, now lost. Testimonia collected in Overbeck Ant.Schriftquellen nos.1463-7 and Johnson (1927) App.I.33-9, and 67 (with translations). Bibliog: Cook Zeus ii(2) App.A 859-68; Johnson (1927) 163-5; Lippold RE sv.Lysippos XIV(1930)50 n.11; Durbach DS sv.Kairos.

Kairos is described as a youth, with long hair in front but shorn behind, running on tip-toe with winged ankles. Both Himerius (Ecl.xiv.1) and Poseidippos (Anth.Pal.xvi.275) mention a razor carried in his right hand, but only Himerius adds that a balance was held by his left. Cook disputes the identification as Kairos, suggesting that Lysippos meant simply to idealise the athletes his other work shows he so much admired, and attributing the balance to a later version after Lysippos' intentions had been misinterpreted. Johnson is sceptical about detailed reconstruction of the statue, and makes no mention of the balance. Clearly, however, even if this statue did include a balance no details of it can be noted here; furthermore Himerius makes no reference to the razor's being used to support the balance beam though this can be seen on later versions (see K.6-7 and KR.1 below).

K.3-7 Various Helenistic gems. Furtwängler Die antike Gemmen i (1900) pl. 43, 49-51; Cook Zeus ii(2)860 figs.796-8; BM. Cat.Gems p.143 nn.1199-1200. Three types can be identified:

(a) K.3. A bearded figure with wings on both back and feet holds a butterfly in his right hand and with his left steadies (or depresses ?) the left-hand pan of a balance that is otherwise suspended in mid-air from a vertical cord at its centre. The beam is inclined at 45°, is 1½x the figure's forearm, and from it three cords hang down to each pan.

(b) K.4/5. A bearded figure with wings on both back and feet holds out a butterfly in his left hand and a lump (? razor) in his right towards an inclined balance (beam again 1½x his forearm).

(c) K.6/7. A bearded figure with wings on both back and feet supports a balance on a razor held in his right hand; with his left he steadies (?) the left-hand pan. The beam is shown level, balanced centrally on the razor, and is 1½x the figure's forearm. The suspension of the two flat pans is simplified to two cords from each end of the beam.

KR.1 Turin relief. If genuine, late Roman; possibly copied from the Greek, but questionably from K.1 as the figure has winged back as well as feet, and is holding the razor and balance in opposite hands. His feet lie on the ground line, not on a ball. See Ibel (1908) 58 fig.15 (photograph); Baumeister (1885-8) Abb.823; DS sv. Kairos fig.4251; Cook Zeus ii(2)861-2 fig.799.

The figure's left hand holds out a razor upon which is balanced the beam of a simple two-pan balance; his right hand is extended to the nearer (right-hand) pan; the beam (approx.2x the figure's forearm) is inclined down to this pan, but it is not clear if the figure is depressing the pan or simply steadying it. Clearly the artist meant to represent Kairos here.

KR.2 Torcello relief. C. 1100 AD. Baumeister (1885-8) Abb.824; DS. sv. Kairos fig.4252; Cook Zeus ii(2)866 fig.802.

Kairos, now running on winged wheels, holds a Roman two-pan balance (with shears and two-tier pan suspension) and brandishes a razor. Three other figures are shown, and I suggest that Kairos has left his companion Metanoia with someone who has not taken advantage of his presence and is now grasping in vain at the hair of Kairos (cut short with the razor); Kairos moves on to the next person. The levelness of the balance beam may possibly be significant. (The beam is small, equal in length to Kairos' forearm).

KR.3 Roman imperial gem. Furtwängler Geschnitt. Steine Berlin p.273 no.7358 pl.55; Cook Zeus ii(2)862 fig.800.

A clean-shaven Kairos with winged feet balances as he walks along a paddle. His left hand, fingers spread, is held out behind; his right hand holds a simple two-pan balance (beam 1½x Kairos' forearm and shown level).

KR.4 Vatican MS. Eleventh century AD, St.John Klimax, Cod.Vat.Gr.394. Cook Zeus ii(2)867 fig.803. Kairos now represented as a naked youth on wheels, labelled Bios. No balance is shown.

P. Psychostasia

Psychostasia (weighing of souls) and Kerostasia (weighing of fortunes) are grouped together here. An extension may be noted from Athena's involvement in these scenes to her appearing alone in the context of the balance (Athenē Stathmia Hesych. see below UI). Related are representations of Erotostasia (E) and, if the source must be detected within Classical art (and I doubt this), of Justice (Provisionally U. VII).

P.1 Hydria. Clazomenian Bf of the third quarter of the sixth century; Villa Giulia, Rome. See Ricci Annuario 24-6 (1946-8) 49 with pls.3-6; Caskey and Beazley ii.18 and iii note on 147 (in connection with P.6).

Achilles v Memnon and Psychostasia. Zeus holds the balance to the left with two goddesses imploring him. [Descr. from Beazley who also complains of the lack of adequate representations of the balance itself]

P.2 Dinos. Attic Bf by the Painter of the Vatican Mourner c.525BC; from Cervetri, now Vienna 3619. See Simon (1959) 74 Abb.45 (with bibliog. on p.110); Caskey and Beazley iii.147; ABV 140 no.3.

Achilles v Memnon. Psychostasia. Heracles and Kyknos. The actual psychostasia shows Zeus seated, behind him a woman, in front Hermes (caduceus just visible) holding a balance, and to the right another woman (unhappy with arms lowered and fists clenched).

The balance is held very close above its centre where it may also be slightly thicker. It inclines a little to the right. Apparently four cords depend from near the beam ends to flat pans. On these pans are two small winged figures, squatting and looking out to the two women.

P.3 Lekythos. Attic white ground Bf by the Sappho Painter c.500BC; now in the BM, London B.639. See Studniczka (1911) 132 Abb.54; C.H.E. Haspels Attic Black-figured Lekythoi (1936) 227 no.28 on pl.36.1; Caskey and Beazley ii.18, iii.147.

Psychostasia: Hermes weighs two small winged figures; two warriors frame the scene.

The beam appears to be held by a cord from its centre; it is of even thickness, approx. 2x the length of Hermes' forearm, and three cords depend from its ends to each flat pan; these pans are just clearing the ground and appear level (the beam horizontal).

P.4 Volute crater. Attic Rf by the Cleophrades Painter, early fifth century; from Tarquinia with fragments in Cab.Méd.385 and Bonn 143b. Beazley Der Kleophrades-Maler (1933) pls.2, 30.6; ARV$^2$ 186 no.50.

Psychostasia. Contest Achilles (?) v Hector or Memnon. In the former Zeus stands to the left of the scene holding his thunderbolt; a woman (Eos) intervenes as one pan (with the ker of Memnon) sinks of the balance held by Hermes.

P.5 Cup. Attic Rf by Epictetos, c.500BC; from Cervetri, now Villa Giulia 57912. Simon (1959) 75 Abb.46; Caskey and Beazley ii.18; ARV$^2$ 72 no.24.

Inside a naked woman on a phallos bird. Outside A: Psychostasia and B: Heracles and Busiris. In the psychostasia scene Hermes (central) holds a balance, in each pan of which is a tiny warrior reflecting the poses of the larger warriors (Achilles and Memnon ?) either side of him.

The beam is held by a string (drawn quite simply to the top centre); it is rather thicker in its middle and possibly again at each end whence four cords sprout to a flat pan; its length is approx. 3x Hermes' forearm; held at hip height, the beam inclines slightly down to the right.

P.6 Stamnos. Attic Rf by the Syracuse Painter, second quarter of the fifth century; from Cumae, now Boston 10.177. See Simon (1959) 76 Abb.47; Studniczka (1911) 133 Abb.55; Caskey and Beazley iii.147 with pls.82-83; ARV$^2$ 518 no.1.

A: Psychostasia B: Old man turning round to man and youth. In the former scene Hermes, central, holds a balance in his right hand, the caduceus in his left; two tiny armed warrior are in the pans, that on the left is slightly lower and identifies the woman to Hermes' left as Eos with Thetis on his right.

Hermes holds the balance by means of two cords, perfunctorily drawn to the top centre of the beam; this beam is of even thickness, a little more than 2x the forearm of Hermes, and appears in fact inclined down on the right hand side; the pans are suspended by two cords that come from a point slightly before the end of the beam. The artist clearly meant the left-hand pan to be lower (obvious from ground line and the reaction of the women).

P.7 Nolan amphora. Attic Rf by the Nikon Painter, early fifth century BC; now Louvre CA 2243. See Simon (1959) 77 Abb.48; Caskey and Beazley iii.147; ARV$^2$ 651 no.11 with 1663.

A: Psychostasia B: Woman holding out hand. On the former Hermes stands holding the balance away to his right, in the pans appear (in red) tiny figures (? armed).

The beam appears suspended by a string to its centre; at this point two bulges in the beam may be intentional, as also the slight thickening of the beam towards its ends. The beam is over 2x Hermes' forearm in length; it appears level. The two (or four ?) cords to each flat pan come down from under the beam ends (not out of them).

P.8 Cup. Attic Rf, second half of the fifth century BC; now Louvre G.399. See Simon (1959) 79 Abb.49; Caskey and Beazley iii.147; Studniczka (1911) 134 Abb.56.

Inside: Thetis tells Achilles he is to fight Memnon. Outside A: Psychostasia B: Combat Achilles v Memnon. In the psychostasia scene Hermes (despite beard, he has both hat and wand) holds a balance in his right hand; the pans contain two identical tiny warriors (somewhat oddly both facing to right); Hermes gives to right encouraging news to a happy (tripping) Thetis, whereas Eos looks dejected.

The beam is clearly depicted: it is held by a rigid handle forming part of a central thickened piece; each end thickens again to a sort of mouth whence sprout two cords to each flat pan; the beam is large (4x the length of Hermes' forearm and thicker than his wrist at all points); susprisingly both beam and pans are shown as level.

P.9 Amphora. Campanian Rf, 4th century BC; from Nola, now in Leyden (26f41) See Simon (1959) 81 Abb.50; Baumeister (1885-8) fig.994; Ibel (1908) fig.11 (facing page 50); Beazley JHS 63(1943 [45]) 95 no.11 attributes to the Ixion Painter; Caskey and Beazley iii.147.

A two tier scene showing Hermes (caduceus and petasos) seated in the background watching a balance pinned to a tree; in the pans are small winged figures; from the higher left-hand pan a woman (happy ?) turns pointing forward to the foreground where a warrior is on the point of overcoming his opponent; this latter (to the right) sinks to one knee with a spear in his neck while behind him another woman retreats tearing her hair (in grief).

The pivot suspension of the balance beam is shown by a dot; the beam is a thin reserved line (only marginally longer than Hermes' forearm), and three long cords depend from each end to dish-shaped pans; the winged figures clasp the innermost cords facing each other (cf. EB.1 ?); the angle of inclination is a pronounced 45°

PE.1 "The Jenkins patera". An engraved Etruscan mirror, now in Madrid. Beazley "The world of the Etruscan mirror" JHS 69(1949 [50])1-17 on p. 16f. also Caskey and Beazley iii.147.

PE.2 The Barberini sarcophagus. Etruscan, from Palestrina. Annali dell' Instit.di Corrisp.Arch.1861 p.150; Monumenti Inediti (by the same inst.) VI pl.54; DS sv.Libra p.1224

U. Uncertain (date or interpretation) and non-Greek

U.I Steelyard counterweights. These take several forms, of which a majority are plainly decorative solely; nevertheless I suspect a connection exists between those identifiable as Athena (by helmet and aegis) and the obscure note in Hesychius to the existence of Athēnē Stathmia. Whether this epithet derived from Athena's involvement in Psychostasiae (which is itself unclear) I do not see fit to speculate. As the weights are on a post-Greek type of balance, the matter is irrelevant to this enquiry. For examples see Michon DS sv. Libra figs.4479, 4481 (the former from Pompeii and dated 77 AD); compare also the later Byzantine example from the Yassi Ada wreck (pictured on p.88 of Horizon Spring 1968).

U.II Nemesis identified by Cook Zeus ii(2)863 n.1 on two reliefs from eastern contexts and of doubtful date. The iconography is possibly derived from that of Kairos (if it is not in fact a variant of that), and may be related to that later found for Justice.

(1) Limestone relief from Egyptian Thebes, now in Cairo Museum. The figure thought to be Nemesis is trampling Hybris, with Metanoia behind. A balance is shown in the top left field; two empty dish-shaped pans are suspended from the ends of a short, straight beam by three(?) central cords; an attachment rises from the centre of the beam to a diamond-shaped knob; the beam is level.

(2) Relief from Thebes, now in Istanbul. Two niches, one containing a youthful figure with a balance in his right hand and a wheel under his feet [surely, as Munoz L'Arte (1906) 212ff and despite Cook, this is Kairos ?], the other two women. Cook identifies the figure with the balance as Nemesis of Alexandreia.

U.III Mēn. This god is accompanied by a collection of symbols arranged to form a balance on a second/third-century AD votive stele from Asia Minor: see Rostovtzeff SEHRE (2) 256 pl.46.1. The pans consist of a cornucopia and snake balanced against a club and bow (Fortune and Heracles ?).

U.IV Phallos weighing. Roman only: see Cook Zeus ii(2)734 n.3 for bibliography, and Studniczka (1911) 139 Abb.57 for a convenient illustration. The subject was more likely comic than symbolic.

U.V Symbolic hands with representations of balances are labelled Graeco-Roman and appear in the BM Cat.Bronzes no.875 and the BN (Babelon-Blanchet) Cat.Bronzes no.1064 ("main panthée"). Is this related to the astronomical (? astrological) Libra (see ch.VI.3.(3)) ?

U.VI Venus Verticordia. Again Roman: see Cook Zeus ii(1)99 n.1 for both evidence and discussion of this version of Venus with the attribute of a balance. Cook notes that on later coinage Venus may in fact have her balance simply by association with Justitia and Moneta (thus this variant overlaps with Justice [Roman] U.VII).

(1) Gens Cordia denarii. Venus, with a sceptre in her left hand, holds a balance in her right. BM Cat.Coins (Rom.Rep) I.523f. pl.51.11f.

(2) Mayence Column. First century AD. Inter alia appears a female figure with a balance (only one side of which is preserved) held languidly at her side. Cook ibid. pl.IV (the identification is his).

U.VII Justice. As far as I know there is no association of Justice (Dike or Dikaiosyne) with the balance represented in a straight-forwardly Greek context. The origins of the association, which is now standard in modern symbolism, I believe to be Egyptian iconography and Roman representation of the accuracy (so justness ?) of their coins. See ch.VI.3.(2); IX; Conc. The earliest example I have found is late Seleucid and so its context is somewhat ambiguous.

(1) Seleucid weight. Dated to "year 86" and not clear whether Gaza or Ascalon chronology; probably first century AD. Relief figure of Justice with cornucopia in left hand and a balance in her right; the weight bears the name of the agoranomos and identifies the figure as Dikaiosyne. Michon DS sv.Pondus 556 and n.12.

(2) Various Roman coins depict a figure with a balance to indicate the accuracy and fairness of their production: see Cook Zeus ii(1) 99 n.1; Jahn (1861) Taf.VIII.7; Babelon-Cohen Monum.de la Rep. 20,22,83,147. On some late imperial coins three female figures appear, each with a balance in their hands; these are interpreted as Venus, Moneta, and Justitia: see Ibel (1908) 59 figs.16-17

## 1.(3) Greek (literary) references to weighing and the balance

These passages are relevant to the discussion of several aspects of Greek weighing: see especially Greek attitudes to weighing (ch.VI), the types of balances used and the manner of their operation (following immediately in this chapter), and the contexts in which weighing took place (ch.VII).

As the lists are of passages concerned with the manner of weighing, references to actual weights are not included. These form a separate aspect of the whole subject and are collected in chapters II and III (with analysis also in IV and V).

References follow the system of abbreviation used by LSJ, as also editions unless otherwise indicated.

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Aeschines. Schol.1.39.

Aeschylos. Supp. 403, 405, 822, 823; Pers. 346, 435-7; Agam. 251,(438), 439; Cho. 61f; Eum. 780, 888; Phrygians (Hesych.sv. ἀντιρρεκτον ); Psychostasia.

Alcaeus. 25B (31D).

Alcman. 37A.

Andocides. 1.83 (Teisamenos Decree).

Antiphanes. 26.24; 168.

Antiphon. Loeb. fr.B.1.

Antipho Sophist (5c). 42.

Aristophanes. Ach. 1005; Equit. 558; Nub. 745, 1155; Vesp. 39, 40f; Pax. 1240-9; Aves. 1041; Ran. 797-8, 803, 1365-7, 1378-1413; Frs. 488.4-5, 799; Schol. Ran. 798, 1378 (Rutherford 1376), 1386; Schol.Pax. 343, 1242, 1247; Schol.Vesp. 39; Tzetzes Ran. 795a, 797, 1369.

Aristotle. Ath.Pol. 10.1-2, 29.1, 51.2, 51.3; De Caelo passim esp. 308.a - 313.b; Mund. 395.b.23; HA. 607.b.32; PA. 666.a.27; [Arist] Mir. 833.b.10; [Arist] Mech. passim esp.848.a.12f, 849.b. 23-38, 850.a - b.init, 853.b.25 - 54.a.15; [Arist] Prob.915.b.3, 927.a.35 - b.5; NE. 1094.a.23, 1101.a.29, 1142.a.22, 1172.a.23; Pol. 1257.a.39, 1258.b.2, 1295.b.38; [Arist] Rhet. 1375.b.5 (?); Fr. 510.

Athenaeus. 1.11A; 2.43B.

Bacchylides. 9.47; 16.25.

Cercidas. 4.33.

Demosthenes. 1.10; 2.22; 5.12; 11.8; 18.298; 24.129; 25.46; 49.52; Prooim.55.

Diogenianus. 4.28.

Diotimos (mid 3c). ap.Anth.Pal. 6.267.

Eupolis. K 116.

Euripides. Alc. 462; Heracl. 690; Hipp. 1163; Hec. 57; Hel. 1090; Ph. 541; Ba. 812; Supp. 706; Frs. 631, 684.

Gorgias. Palam.30.

Herodas (3c). 1.16; 2.90; 7.33.

Herodotus. 1.14.2, 50.2 - 51.2, 65, 92.2; 2.65.4, 73.4, 168.2; 3.89.2; 4.50.4; 7.36.3.

Hesiod. Thgn. 711.

Hesychius. sv. ἀντίρροπος, ἀντίστάθμος, σηκωτήρ.

Hippocrates. Fract. 8 (v.1); Aër. 1, 8; Acut. 29 (cf. Art.6); Mul.1.48.

Homer. Iliad 8.69-74; 12.433-36; 13.745; 14.510; 16.658; 18.561; 19.223, 247; 22.209-13 (=8.69-72), 349-50, 351; Od. 24.232; Hymn.Merc. 324; Schol. Il. 22.351.

Hyperides. Frs. 154, 271.

Isocrates. 4.139; 12.50; 14.33.

Kallixenos (3c ?). ap.Athen. 204A.

Lykophron (3c). 270-2; Schol. 269-70.

Lysias. 10.18; Fr. 60.

Menander. Mon. 465; Fr. 383 K.

Naussiphanes (4-3c). 2.

Philo (3-2c). 2.170; Bel. 69.21.

Pindar. N. 8.18.

Plato. Euthyphr. 7c; Phlb. 14d; Tim. 52e, 63b-e, 65e; Phaedo 81c, 109a; Tht. 152d; Symp. 196c; Soph. 229c; Polit. 270a; [Plato] Minos 316a; Protag. 356b; [Plato] Just. 373e; [Plato] Virt. 378e; [Plato] Def. 412a; Rep. 438c, 550e, 556e; Leg. 625d, 733b-c, 746d, 757b, 794e, 920b; Alc. 126d. Rep. 602c-603a.

Plutarch. Artax. 30; Lysand. 17; Crassus 17; Aemil. 18; Marc. 15; Cam. 28; CG. 17. Moralia 16f-17a, 723c, 928b, 928d, 1026e.

Pollux. 4.130, 171-172; 6.91; 8.14; 10.26, 108.

Polybius. 1.11.1, 20.5, 20.7, 51.9; 6.10.7, 52; 8.5.9; 9.41.8; 16.14.6; 18.24.5, 29.3; 30.25.16.

Pythagoras. ap.Diog.Laert. 8.18.

Rhianus (3c). 1.2.

Sophocles. Ajax 558; Electra 120, 571; OT. 961; Ant. 264; Trach.82; OC. 1508; Frs. 256, 432, 555, 576, 697, 757, 945.

Strabo. 4.4.5; 15.1.11.

Theognis. 77 (Plato Leg. 630a), 157.

Theophrastus. Char. 18.7; HP. 5.3.1; 9.16.8.

Thucydides. 1.105; 2.13.5; 5.103.2; 7.62.2.

Xenophon. Hell. 5.1.36; Cyrop. 3.1.33; 8.2.21; Oikon. 3.15; Symp. 2.20; 4.45; Mem. 3.10.10-13.

Zenobius (2c AD). 3.16, 18.

## 2. The design and construction of Greek balances

### 2(1) General types

It is possible to distinguish at the outset two groups of Greek balances - I. the equal-arm, two-pan balances, and II. the single-pan balances. Within these groups can be identified several types. Modifications will be considered in the following section on details of balance construction relevant to accuracy, theory and use.

#### I. Equal-arm, two-pan balances

This is the only sort of balance represented in Greek art. Apart from the passages used to support the single-pan group below, it is also invariably the sort implied by other literary and epigraphic references to weighing. This arises for example from references to weighing as "A πρὸς B", or the idea of contrasting "up" and "down"; the words for pans, and also for the balance itself, frequently are plural; and further many words and metaphors related to the balance continue the idea of comparison.[7] Several types of equal-arm balance can be distinguished.[8]

1. Hand-held This is the most frequently illustrated type. Its beam varies from 2 x to 4 x the operator's forearm. If this unit be taken as 30 cms or 1',[6] the beams therefore vary from 60-120 cms or 2' - 4', the larger appearing on C2 and P.8. The beam is usually supported by a cord tied around its centre.[9] Pan suspension varies. The beam, though often shown as a straight line, does at times thicken appreciably at the centre.

1a. The Hellenistic gems showing mid-air balances (K.3-5) are clearly of types meant to be hand-held as the vertical central cord is also included. They are slightly smaller than others of type I.1.

2. No central support. K.6-7 show a straight beam balanced on an object held by the operator. Again the beam is short (1½').[10]

3. Pivot support. On P.9, some attempt at perspective may account for the beam being the smallest illustrated (approx. 1'). It is Campanian, and late fourth-century.

4. Large portable balance. The large, 6' or 7' beam on C.1 is suspended from a ship's yard-arm. The suspension is carefully drawn and forms the basis of much of the discussion of such beam suspension below. The beam itself is shaped and decorated.

5. Square-frame balances. The balances of H.1 and H.2 are remarkably similar. They are the only Greek representations of the scene, the weighing of Hector's body, and also the only illustrations of the distinctive frame suspension. This lends suspicion to the implication that the type was in fact as widely known as the fabric (fifth-century Melian and fourth-century Italiote) might have suggested.
The frame appears to have been constructed of wood; it is much heavier than the balance beam, and, at the join of cross-piece with uprights, it is strengthened by braces. The movement of the beam itself has been disputed. In view of the perspective on H.2, I feel it should lie within the same plane as the frame. The frame could be interpreted as also a convenient over-tilt device.[11] The beam in both cases is in any case drawn to fit inside the uprights (approx. 3' length); it is shaped to a thickened centre.

Three further general observations apply to this group as a whole:-

(a) None of these balances are shown to have either pointer or plumb line or any built-in feature to indicate level position (such as could be expected on the side uprights of type I.5. No one's attention is shown as concentrated on the levelling of the beam either in art or in literature - where ὀρθος for example implies "just" not "level".[12] Nor are there any Greek words for such indicators of levelness. No attempt was made apparently to shield the balance from air-currents that might disturb a carefully balanced position.

(b) Sizes. The smallest balance illustrated in a commercial context (C.2), is, with the beam 4 x the operator's forearm, in fact the largest hand-held example. The smallest balance appears on P.9, 1 x his forearm, though the separation of the balance from any particular figure operating it makes clear inferences impossible. However the use of πηχυς to denote the balance beam would seem to support the assumption that some balances were as small as one forearm. According to the rough principles I have

been using to describe balances,[6] the forearm measurement appears close to 1', and such a size is also probably indicated by the two surviving Lefkandi pans.

Further indications of the sizes of balances can be derived from references to their use. Thus Aristotle claimed to be able to measure the weight of air in a blown up askos: for any appreciable difference, the askos, and therefore the balance to weigh it, must have been enormous.[13] More seriously, it seems that wood at least was weighed normally in units of no less than one talant: as on two-pan balances the weight borne by the beam is twice any amount weighed, the beam in this case will have been extremely strong (its large size anyway must be implied by the bulk of such an amount of wood).[14]

A more controlled argument derives from references to "the smaller balance" being used in mid third- and early second-century Delos. IG XI (2) 287B 142 ff. lists 76 broken vases that weighed in toto 5329 drs on the"smaller balance". If all were weighed together a fairly substantial beam must be assumed (over 20 kg, assuming 4.2 gm drs); and, even if weighed separately (a laborious and surely unnecessary process), a not much smaller than 3' beam would seem likely (averaging at 70 drs each or c.300 gm). Later, in ID.442 B.27, a single other rhyton was weighed, at 5 minai 9 drs (509 drs, just over 2 kg). A small, 1'beam, balance is clearly out of the question. The balance in the former inscription is said to be the smaller in the Agoranomeion. As these items are larger rather than smaller, it may be possible to associate the two larger sizes (3' and the larger 6') with commercial use, while supposing a smaller and more accurate balance to have been normally available for those making the temple inventories in question.[15]

No large balances are in fact shown on pictorial representations after the 6th century. This is clearly unlikely to have obtained in fact as large weights continue to be recorded. It is impossible to say whether these later balances were a development of the frame-type or the large roof-hung sorts (but see next observation).

(c) It may be significant that all the more interesting types of balances are rather peripheral, occurring on vases other than those of mainland (esp. Attic) manufacture. This applies to both frame types, though the similarity within and restriction to a single iconographical tradition would make suspect the inference that Italiote and Melian artists

and no others had seen such balances. The pivot-type appears only on a late Campanian vase. The extent to which the Greek artist is borrowing for C.1 from Egyptian iconography cannot be gauged, though the possibility is as great as the striking parallel.

II. Single-pan balances

Clear indication of the existence of this sort of balance in ancient Greece is confined to three widely separated references, each of which indicates a different type. A major difficulty raised by this group is therefore that in two cases the balances appear to be used in a general commercial context: see further below. The third single-pan type is known from its name only

1. Fixed counterweight, fixed suspension point. Ar. Pax. 1240-9. Trygaeus makes two helpful suggestions for what the Trumpet-maker (Σαλπιγγοποιος ) should do with his military trumpet now that peace has been secured. Both involve fitting the curved part (το κοῖλον ) with lead. The first is to make a kottabos stand: on this see below VII.2.(13). The stand is not related, at least by Trygaeus, to his second suggestion: a balance. The σάλπιγξ is to be filled with lead (not necessarily again just το κοιλον ); cords ( σπαρτια ) are to be attached, and a single pan hung from them; it then becomes something to go about the country weighing figs with: καὐτό σοι γενήσεται | τὰ σῦκ' ἐν ἀγορᾷ τοῖς οἰκέταισιν ἱστάναι.
The inference that this is indeed a single-pan balance, indicated by the singular and unique πλαστιγγα προσθες 1248, is confirmed by the usual shape of the σαλπιγξ (a long thin tube of iron or bronze with a tea-cup-like swelling at one end.[16]
The date when the play was produced (in 421 B.C.) and the context (general local commerce) should be noted. The lead-filled bulb acting as a fixed counterweight, also obviates the use of any separate weights.

It is perhaps significant that no instructions are given for how (and where) the balance beam is to be suspended - thus we must distinguish this balance from the rest.

2. Fixed counterweight, but several alternative suspension points

[Arist.] Mech.§ 20.853b25-54a15. The machine, designated for weighing large weights of meat, is described in some detail and it is the only Greek balance so treated.

The description is interwoven with mechanical explanations and references to the simpler principles both of the lever and of the two-pan balance. These pose greater difficulties than the machine itself: this consists of a single beam (called φαλαγξ ) from one end of which is suspended a scale-pan (πλαστιγξ ). The other end is apparently bulbous ( το σφαιρωμα taking the place of the πλαστιγξ : 853b31-2 and 37; that the σφαιρωμα was situated at the extremity is implied in 854a14 προς σφαιρωμα, as "towards") and so seems to be similar to Aristophanes' trumpet.

Between these extremities are fastened to the beam a series of suspension cords ( σπαρτια ) and the weighing of meat in the pan is done by seeing which suspension cord results in a level beam; the cords are equally spaced, the weight read off by (linear?) measurement (853b38-54a3). No mechanism is incorporated to indicate the level position ὅταν ὀρθη ἡ φαλαγξ ἡ (854a1-2): though there can be no doubt that this is a clear reference to levelling.

The means of attachment of the suspension cords seems fairly clearly to be above the beam's centre of gravity. At 853b36 they are said to lie in the balancing beam ( ἐγκειται ἐν τουτῳ ζυγῳ ) which may be ambiguous, but the theoretical explanation, in terms of an inverted lever (μοχλον ἀνεστραμμενον) upon which the cords act each in turn as pivot ( ὑπομοχλιον ) but from above ( ἀνωθεν ὂν 854a9-11) should, in view of the discussion of the difference in similar terms ( ἀνωθεν and κατωθεν ) at 856a3-29, indicate that the cords were not supporting the beam from underneath. Some uncertainty, however, must remain as there is no reason for reference here (beyond terminology) to the earlier situation described in 850a3-29; indeed the more likely sense of ἀνωθεν ὂν in 854a11 is simply a reminder of the fact that the beam is suspended ultimately from above. I leave this question open also in the following discussion of suspension variations.

The name of the machine, " αἱ φαλαγγες ", is obscure; probably it refers to the ranks of cords; the use of the singular φαλαγξ

for the beam is unfortunate: but cf Hdt III.97.3 δηκοσιας φαλαγγας ἑβενου in what appears to be a list of measured materials.

The context should however be noted: apparently the machine was normally used for meat-weighing to judge from the non-specified subject of ἱστασιν in 853b25, introducing it. The date however is certainly late, as the treatise has been attributed by most scholars to Straton or some other 3rd-century Alexandrian writer.[18]

3. The Charistion. Simplicius In Aristotelis Physicorum libros commentaria ed H. Diels (Berlin 1895) p.1110; Tzetzes Chiliades II.Hist.35,130; [? author] Liber de Chorastionis in E.A. Moody and M. Clagett The Medieval Science of Weights (1952) IV.76-117.[19]

Simplicius notes the Charistion as a weighing instrument that Archimedes made and then was inspired to remark "give me a place to stand and I shall move the earth". Tzetzes, though reproducing the remark in convincing local Syracusan Doric, πᾶ βῶ καὶ χαριστιόνι τὰν γᾶν κίνησω πᾶσαν, does not offer any comment on what it was.

The association, and the romantic notion of Archimedes' conceiving to weigh the world, is, like many stories of Archimedes, open to suspicion. The remark is associated by Tzetzes elsewhere and by Plutarch[20] with the launching of the great ship Syracosia: this was achieved by means of block-and-tackle machines that pulled (not lifted) the great ship to sea. Nevertheless the impression remains that the Charistion was a powerful weighing machine. In this case it is reasonable to relate it to the later charasto (var. carasto, canisto, baracto) or Roman statera, steelyard.[21] The principle of leverage involved was well-known to Archimedes and appears in his extant works.[22] However the name itself creates a second difficulty: Dijksterhuis rightly resists derivation from χαρις and prefers to treat Charistion as the name of its inventor or of the first person to describe it.[23] If we now follow Duhem in identifying this individual with Heriston (the son of Ptolemaios),[24] it is impossible for Archimedes in the 3rd century B.C. to have seen the machine or

made one like it. The identification is not of course certain; and the fact that Archimedes and others in the 3rd century B.C. were acquainted with the principle of single-pan balances is all that is really important for this study. The Charistion was certainly a large machine, hence the connection with the idea of weighing the earth, but the date of this connection (whether by Archimedes or a later writer) is best left open.

## 2.(2) Materials

Some general comments on the materials used in constructing Greek balances can now be made. No single type is satisfactorily described for any individual conclusions on these materials, and though variations are likely (and will be noted if probable) the general construction materials are in the main apparently uniform. That little (if any) evidence has survived of actual balances has already been used to suggest their construction of perishable or corrodible substances, and applies to all types of balance.

Wood is an obvious material for the supporting stands of balances (thus the frames of Rep.H.1 and H.2.[25] It can also be suggested for most balance beams. (a) The symmetrical shaping about the longer axis is suggestive of turning and applies to all representations of shaped beams except perhaps H.1, P.5 and 7, which are flatter underneath, and P.8, which appears to have a rigid handle. (b) The use of wood is attested for one falsely-weighted beam used by purple-dye sellers who make capital out of the heavier root- or knot-wood used in one side of their beams ([Arist.] Mech.§1.849b 38ff). The same passage also points to an alternative hollow (metal?) beam weighted with lead. (c) Parallels can easily be cited for wood beams from other cultures: especially Egyptian and Mycenaean.[26] (d) Finally the practical advantages of wood for adjusting (by shaving) or drilling (for suspension) beams can be noted in addition to their ability to take paint, clearly indicated on C.1.

The use of wood for balance pans must remain a possibility even if it might seem to us undesirable. The Greeks may well have preferred the ease of weight-equalisation, and the relative lightness (and so lack of beam

strain) possible with wooden pans to their instability (both movement in air and vulnerability to atmospheric variation).[27] I am, however, more impressed by the term the Greeks used for balance-pan(s) πλαστιγξ (πλαστιγγες ) which should indicate derivation from something moulded out of a soft material. Words of the same root are used of handling clay, wax, bread, plaster, earth.[28] Were Greek balances then originally (and why not subsequently) made of clay, a fairly light but strong material the Greeks knew well how to handle and which would be readily available? The obvious alternative would be some sort of metal, but metal, at least iron, cannot properly be said to be "moulded": Plato Lg.679.A (of primitive society) αἱ πλαστικαὶ γὰρ καὶ ὅσαι πλεκτικαὶ τῶν τεχνῶν οὐδὲ ἓν προσδέονται σιδήρου.

Turning to metals used in balance construction, we can note that no substantial parts can generally have been made of metal, to judge from the virtually complete lack of surviving remains.[29] Iron- and bronze-sheeting may have been used for pans, but no evidence exists to support this beyond individual disks with suitable rim holes.[30] That beams were occasionally made of metal tubes is more likely: the tubing is indicated by references to weighting beams: Ar. Pax 1240-9 and [Arist.] Mech§1.849b. 38ff already noted above; in the former passage the beam itself is a metal trumpet, but whether this must indicate general balance beam construction is clearly doubtful; any of the straight balance-beams illustrated could be tubes, but none show this as clearly as the non-Greek CR.1, with suspension cords passing out of the ends of a tubular beam. It is interesting that the sculptor of the Boston Relief EE.1 made his beam out of metal but whether this has any relevance to normal balance beam construction seems unlikely. The practice was general for sculptural details that could not easily be done in the stone. Other minor parts of the Greek balance were of metal - certainly the rings for large balance suspension (see Reps. C.1 top and pans; C.3 right-hand pan suspension; C.4 pans) and the frame bracket of H.1 (and also H.2?). Chains and hooks are indicated for Roman balances and do not appear on Greek. All such pieces would be of iron or bronze.

Of other metals, silver is suggested by the identification of the Taranto bowl as a balance pan (Bal.4), but the identification is doubtful; and gold is an epithet applied to Zeus' balance (Hom.Il.8.69; 22.209 χρυσεια ). If this is taken as more than romance, it could be a reference

to such luxury items as the gold scales in Mycenaean graves,[31] or it could refer to the function to which such scales would be put, viz. the weighing of gold. This interpretation is supported by the fact that only gold is weighed in Homer and by comparison with τῷ ξυλήρῳ σταθμῷ (if different from τοῖς σταθμοῖς τοῖς ξυλήροις ) on Delos ID 509 (Pleket.10) 33f, 2.[32]

Lead however was certainly used in some Greek balances and may have been more general than our present evidence indicates. Certainly the metal was in common use for weights in classical, and later, times. Lead was used for the only identifiable pair of balance pans in a Greek context (Lefkandi, Bal.1); its softness may be compatible with the idea of plasticity in the term πλαστιγξ (although I have found no reference to support or deny this); further the re-usability of lead has already been noted as a possible explanation for the lack of surviving pans made in this metal. It is further attested as used to weight balance beams, being poured (so molten) in both cases into tubular beams: Ar Pax 1240-9; [Arist.] Mech.§1. 849b38ff.

Suspension of all moving parts appears to have been done by rope or leather thong. There is no way of distinguishing the two in most illustrations, and both were commonly used in ship-rigging.[33] The descriptive term σπαρτιον is used both of the cord suspending the beam (Schol. Ar. Pax 1247; [Arist.] Mech 849b35, 853b30 etc; Pollux.X.108) and for the pan suspension cords (Ar.Pax 1247).

The most common balance construction would therefore appear to be with a wooden beam, clay (or less likely lead) pans, string suspension all round, but possibly with some metal rings in larger examples. Certain balances had tubular metal beams rather than wooden ones. Evidence of such constructions would be unlikely to survive recognisably to the present day.

2 (3) Details of Design

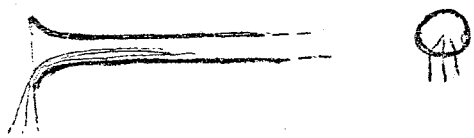
I shall concentrate here on features relevant to the three fundamental issues of balance-design: (1) equality of arms in two-pan balances and suspension (2) of pans, (3) of beam. See further Appendix A for discussion of theory and modern design.

1. The general principle of central-suspension with equal arms appears from such references as Il.8.72, 22.212 ἔλκε δὲ μέσσα λαβών from recognition of the deception of the purple-dye sellers [Arist.] Mech. 849b36 τὸ δὲ σπαρτὸν οὐκ ἐν μέσῳ τιθέντες and it is implied in the same writer's description of the bismar (see type II.2 above). All pictorial representations succeed in approximating to central suspension. It is not clear however that the Greeks fully appreciated that suspension should be both at the linear centre of the beam and above or below its centre of gravity.[34] This is certainly not implied by vague terms as ἴσος and compounds; these, apart from ἄνισα in [Arist.] Mech. 850a35, refer in weight contexts to the performance of the loaded balance, or to its loads, rather than to its construction.[35] The strongest reassurances available on this point are (1) the symmetry of such balances as are carefully drawn and (2) the implication that the purple-dye sellers' practices for deception were more the exception than the rule. On the other hand there is no evidence of Greeks' checking weighings by transposing from one pan to another: standard procedure in modern practice.

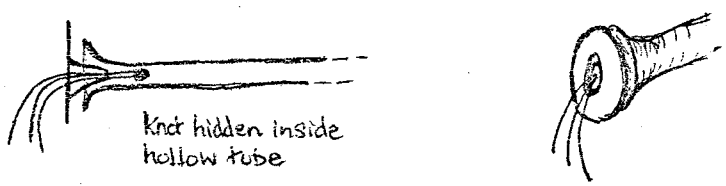
2. Pan suspension. The centre of a balance beam, for proper weighing purposes, is not simply its own centre of gravity, but is also determined by the distances between this and the points at which the pans (and their loads) depend from the beam.[36] Representations of two-pan balances do not always show the suspension cords from the ends of beams, and on certain examples the two sides vary (e.g. Rep.C.4). This begins to raise doubts over how far such representations can be trusted: not simply on this latter point (for which we might be inclined to give Greek technology and

common sense the benefit of the doubt) but also upon the further one of whether arrangements were normally made to ensure that pan-suspension cords continued to depend from the same point of the beam as the balance tilted. The representations are I believe sufficiently precise to distinguish several different versions of this suspension:

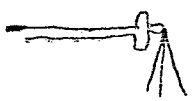
(a) Most obvious are the bulbous-ended beams showing the suspension-cords coming out from the ends of the beam: Reps. H.2(?); P.8; C.1. (but serious misrepresentation of this feature on C.4, E.3). This suggests a modification found on earlier Egyptian balances with hollow trumpet ends, and is a relatively accurate way of ensuring that all suspension-cords act at a constant and even distance from the central beam pivot-point:

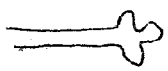


Disquieting however is the clearest version of a trumpet-ended beam: C.1 - the Arcesilas Cup: for this quite noticeably interposes a disk at the end of the trumpet opening, and the suspension cords come from the centre of this. The cords bulge or sprout out of the disk which is therefore unlikely to be a cleat, as it were, or hook, to which they are fastened. One possible explanation for this arrangement is that the beam in question was not as hollow as Egyptian beams were, and so the suspension cords could not pass inside. It is obscure, in this case, why the artist chose to give the beam the traditional Egyptian shape. Perhaps more likely is that the end-piece jams cords <u>into</u> the beam-end as a sort of wedge; there is no indication of cord knots at the end of the beam, or emerging at a point along the beam (as on certain Egyptian hollow-tube balances); if the thongs hanging at the centre of the beam are the ends of the pan cords this explanation is ruled out, however I do not feel the thongs belong to pan suspension at all (as will emerge in discussion of beam pivot and suspension following). The most likely explanation of the pan suspension on C.1, I suggest, is therefore as follows:



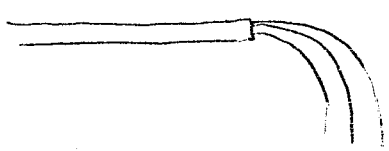
The other versions seem to encourage the impression of some central point within the bulbous end from which Greek suspension cords depended, rather than the edge of a circular trumpet end itself. Compare the right-hand side of C.4 and the almost trefoil-shaped right end of P.8



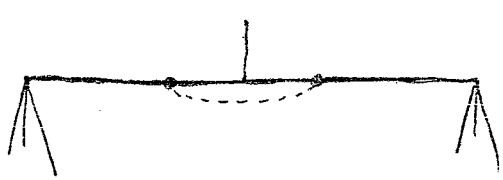


If this impression is correct the central point serves simply as a hook on what might be a simple beam. Accuracy of weighing would diminish as suspension cords tangled on top of each other, and would vary as the balance tilted. Nevertheless the sprouting of cords from the beam-ends remains a readily identifiable type of pan suspension, even if not the equivalent of the Egyptian.

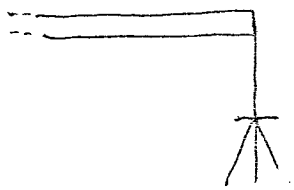
(b) Sprouting cords are not associated only with bulbous-ended beams on these representations; P.5 indicates the use by Greeks of simple tubular beams, whose ends could serve (for thin cords) as the trumpet ends of larger balances.



I have already cited Ar. Pax.1240-9 and [Arist] Mech § 1.849b38ff for hollow beams presumably of metal; the latter type, before filled with lead, is relevant here. Compare the simple Egyptian tubular beam[37] and, for a clear representation, Eurysaces' tomb monument CR.1. The thin straight beams of many other Greek representations could possibly be concealing the feature we are here concerned to identify; and one Greek representation probably shows the pan-cords emerging knotted at 2 points along the beam: C.2[38].

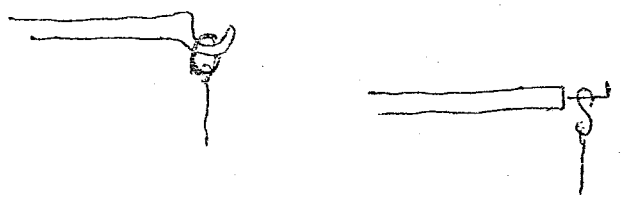


(c) The problem of varying positions of pan-suspension cords that these two modifications attempt to resolve, receives a different solution on C.3. A single cord attached to the beam divides subsequently before reaching the pans.



Variations on this ingenious solution are found on Roman balances[39]; it was in the sixteenth century incorporated by Agricola into his balances.[40]

Alternatives, with the same effect, are loose hooks and rings from which pan-suspension cords depend. Both features appear on Roman balances but surprisingly not on Greek as so far noted.



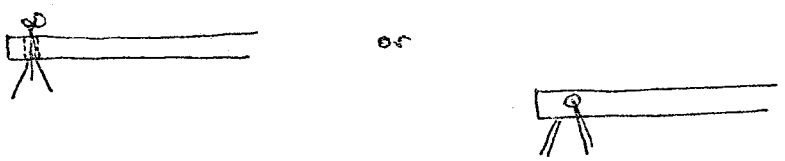
A ring on C.3 joins the four cords (from the pans) to the single cord depending from the beam (right-hand side visible only), but no ring is drawn at this top point. The left-hand side of C.4, different from the right-hand side, is extraordinary, and cannot be safely used here.

Tightly-knotted suspension cords, with the knot fastened close under the beam, might approach this form of suspension. This and other forms of simple cord attachment I have collected in the following final group.

(d) The majority of Greek representations simply show pan suspension cords meeting at or near the ends of beams. This is perhaps clearest on E.3, where the beam also has wide cross-pieces at its ends and beyond the points from which the pan cords hang. Either the artist has muddled two forms of pan suspension, or perhaps the cross-pieces act as stops? Several interpretations can be advanced: (1) the cords meet at a hook below the beam, but this is never drawn or mentioned; (2) the cords are

knotted simply to the beam either individually or first united in a knot below the beam which is then pulled up tight against the beam. Though no knots are shown some such arrangement seems likely. The ambiguity subsequently arises, however, of whether the pans hang as a result from points on the top of the beam or under the beam; this depends on whether the cords round the beam are (respectively) slack or tight. The former arrangement, if a notch keeps the cords in place, is more sensitive (raising the centre of gravity of the beam).

The same problem arises in connection with the beam suspension itself and its effect will be discussed further below. To note finally on pan suspension, is that there is no indication of drilling through the beam, with cords held simply by a knot above, or passing through it as loops from side to side



This seems to be comparable to the treatment of beam suspension prior to the introduction of axle pivots.

There appears to be no set pattern in the number of pan-suspension cords, nor in the design of the pans themselves. The only evidence is pictorial, and two, three and four cords are shown. Four was most popular early (including Lefkandi). Clearly the arrangement of 4 holes on pans is easier (see again Lefkandi for how it could be done!); it may also assist top suspension looping. Some doubled cording may represent looping from pairs of holes set close together on pans (avoiding a lower knot: See C.2; P.2); but the upper knots are never drawn.



Pans appear flat, though dish-shaping occurs on the later representation P.9. The deep pans of C.4 should be noted, as also the rings by which the cords are attached to the pans. Such rings are also shown on C.1, and may

simply relate to the larger balance loading (but do not appear on C.3). The Greeks did not apparently use the rigid pan suspension rod that is shown for example by HR.2 and greatly facilitated putting objects into the pans: instead Greek artists noted this inconvenience, on e.g. C.3.

There is no evidence of moveable counterweights on Greek balances (whether double- or single-pan types). The single-pan balances incorporated the counterweight in a weighted, or elongated beam: ὁ ἑτέρων δὴ ἡ φάλαγξ ἐστι μονον [Arist] Mech. 853b27f.

3. I have left to last the most crucial element in the design of Greek balances, the method of beam suspension. The evidence for this (at point of pivot, that is, rather than above) is tantalisingly ambiguous. Yet it makes a great difference not only to the performance of the balance, but also to its general use and so also to the weighing operation itself, whether the beam was suspended from above (and so was basically stable), or from below (and so unstable). The usual construction of two-pan balances is of the stable form, with weighing conducted by levelling the beam; however in subsequent chapters I shall develop arguments from balance use and general attitudes to weighing to show that for the Greeks it was basically an instrument of instability, its levelness not a cause for interest. Here I wish to show that there are indications that the balance was designed equally as an unstable instrument. The ambiguities may indicate that the stable type did exist but it is not likely to be so early, nor so basic, as the unstable.

The pictorial evidence is the obvious place to start as no other detailed descriptions of two-pan balances exist. Most representations are either too casually drawn or, if hand held, show the hand too near the beam, apparently obscuring the means of suspension (as on E.3). Nevertheless four different methods of suspension seem indicated very generally by these pictures: (a) some sort of cord wound round (?) the centre of the beam (most common); (b) rigid handle, if rightly interpreted from P.8 (c) underneath support on Kairos' razor, K.6-7 (possibly, if not certainly, special cases!) (d) axle-pivot: another single example, P.9. Of the three last methods, Kairos' clearly is unstable, and P.8 if correct, extremely stable; the drawing of P.9 shows the pivot central in the thin beam, and therefore is uncertain. As the commonest type of suspension is the first, it clearly must be examined in detail on this question. But

even the clearest, C.1, is obscure.

Outside help may perhaps be enlisted. The bismar of [Arist.] Mech §20 although described in detail, offers a further (different) method of suspension (multiple strings) and is also rather late: 3rd century B.C. I have already argued that, if the author is consistent, the strings must be attached above the beam's centre of gravity. There is no compelling reason however to suppose consistency in this. Nevertheless this same author provides clear evidence for the unstable (so suspended from underneath) balance in use in Greece, and at the risk of anticipating later conclusions this and other evidence can be summarised here.

At § 2 (850a3-29) [Arist.] Mech. discusses the different performance of two sorts of balance, suspended from above and from below. He is writing from experience as he takes the movement of a restricted unstable balance beam and applies it wrongly to an unattached lever.[41] Balances of both types can therefore be assumed at least for this date (3rd century B.C.).

Again [Arist.] Mech. §1.848b1ff seems to be envisaging the unstable balance. He describes large balances as more accurate because the movement of the beam end is quicker and so more noticeable. Speed of movement points to unstable balance operation, for in weighing with stable balances attention is paid to inclination only after oscillation has ceased, whereas the danger of overtilting (and the acceleration of the beam) is very real with unstable ones.

Though there is no helpful word for beam suspension ( ἄρτημα , ἀρτάνη, σπάρτιον or σπάρτια for the bismar), there is also no word for pointer or level or scale or plumb-line. This reflects the similar silence of representations where no one is shown looking at the point of pivot as on Egyptian balance scenes. Yet all these are features basic to a balance designed to be used to equate by levelling.

A similar point can be made from the vocabulary of weighing which insists above all on distinguishing "up" and "down";[42] even to weigh is to stand up ( ἱστάναι ) or pull up ( ἕλκειν ); a ῥοπή is a small weight added to one pan to cause it not to balance, but to overbalance and sink; ἰσόρροπος is uneasy till late. Examination of τάλαντον and related words clearly favours their relation to an unstable balance. Further Greek literary references, metaphors, symbolism confirm (though not exclusively) the balance as the equivalent for the Greeks of our seesaw.[43]

It does not necessarily follow from this that the usual Greek balance was unstable (still less that all were). Much of what the Greeks were trying to achieve with their balance in fact (and in metaphor) was simply to differentiate rather than equate, and both types of balance could do this. But we may at least wonder how they came to be doing this, rather than balancing.

The Greek habit of weighing like against like is very much consistent with this comparative aim. It is confirmed by all pictorial representations, none of which show a weight. Weights were clearly used, though not probably till after the 6th century, nor commonly till the time of [Arist.] Mechanics when we know however that the unstable form of balance was in use.

The question of most likely development is relevant here. The comparative, non-measuremental aspect appears prior to the balancing operation necessary for weight measurement, and involving weights. This order is more likely than that the unstable type of balance was introduced for unknown reasons towards the 3rd century B.C. Furthermore there are reasons to suppose that modifications to the unstable balance can have led to the Greeks' adopting the stable form, which will emerge in the following discussion.

Some weight can finally be given to the link which may exist between Homeric usage ( ἐπ ξυρου ἀκμης ), Lysippas' 4th century Καιρος , and the Hellensitic K.6-7 that are the clearest Greek representations of the unstable balance type.[44]

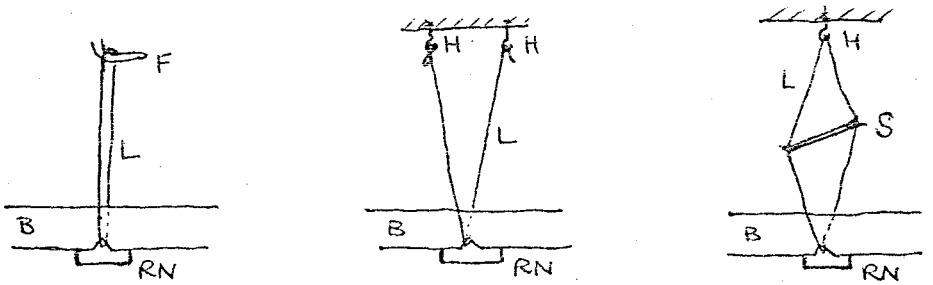
The likelihood that early Greek balances were unstable is not contradicted by what can be seen on pictorial representations. To these we can now return. As I do not wish to foreclose the issue however, I shall attempt to interpret this evidence as widely as possible, indicating the details involved in both basic suspension types where both are open.

On simpler representations the beam suspension is represented by two short parallel lines: H.1, P.5, and especially P.6. These are drawn between beam and supporting hand or frame, and in no case is it clear how they support the beam. There being two lines is however an indication that they passed around the beam. If they were simply tied to the beam, no knots are indicated, nor is it clear why two cords were necessary. However two

cords can encircle the beam either as a simple loop or as a "slip loop" as in the vollowing diagrams:




In both cases a convenient loop handle is available at the upper end, but at the lower we come up against a straight choice between possible instability (the simple loop), and what is clearly a stable form of beam suspension (the "slip loop") to judge from experiments carried out (see Appendix B). The "slip loop" is attractive because of its simplicity, efficiency, ease of adjustment, tendency not to skid on an inclined beam (unless very loose). The simpler loop, however, will skid immediately the beam is inclined unless some notch under the beam is provided. Though it may be unlikely for this to be shown on the roughly-drawn representations, I am uncertain about the omission of a necessary spacing "spar" to keep the cord away from the sides of the beam. This concern may not be important, as the upper part of such a loop, held by hand or finger, would probably be held widely enough to avoid the resultant danger of friction. The details probably necessary for an unstable suspension can be seen from the following diagrams:



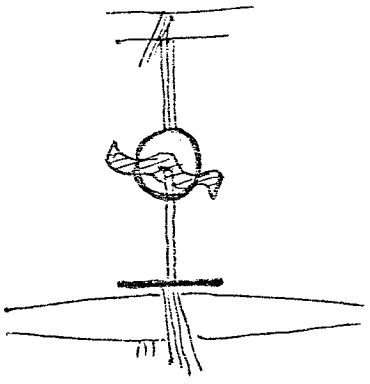

B · Beam
L · Loop cord
R · Ring to prevent slipping
N · Notch for pivot position

F · Finger
H · Hook
S · Spacing Spar.

A stable balance interpretation is undoubtedly more straightforward for those cases, but it is not possible to be sure how much the artist has simplified.

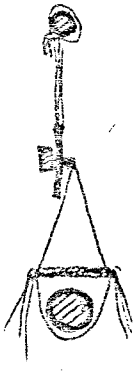
This is certainly not the case on C.1, the most detailed representation

to survive. I reproduce the beam suspension here:



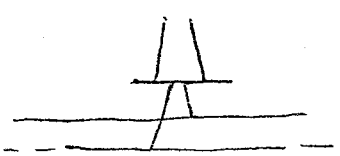
The best way to approach this is from the top. The ring held by three cords, knotted to the yard-arm,engages a "toggle" fastened to the vertical strip that descends towards the beam. As drawn, this "toggle" could not engage the ring unless the vertical strip were flexible. It must be therefore a cord, and a thin line of incision down it, shows it is in fact two cords. The problem is what happens to these cords after they reach the short horizontal cross-piece close to the top centre of the beam. Below this we are only shown several short pieces of rope or thong hanging both in front and (carefully indicated) behind the beam. A second problem is what these cords join and do. A third is the cross-piece from which they hang.

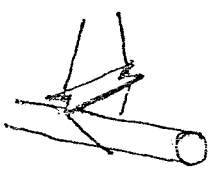
Discussion of all possible interpretations here could be virtually endless. I should proceed as follows: the cords hang loose and do <u>not</u> encircle the beam, they are too numerous to be the ends of the double vertical cord. Something is knotted therefore at the cross-piece. The beam suspension cord, presumably a continuation of the double vertical cord, is obscured by these loose ends. The cross-piece is too wide to be a simple ring and we cannot tell how deep it is. I suggest its position, and the fact that so many ropes are tied to it, indicate a "spar" to keep the double "vertical" cords (to which it is lashed) apart, while its width acts as a check on excessive beam inclination. A possible side view would therefore be:



This reconstruction is of course of an unstable beam. I do not see how the various details of the drawing can be explained on the assumption of a stable type of design.

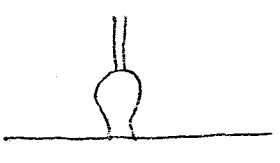
It is possible that this arrangement of unstable suspension on C.1 was very similar (though differently handled by the artists) to that on C.3. Above is a two-tier arrangement, with a vertical cross-piece to which the upper parts of the cording extends. Below this two cords pass round the beam (that is the most likely interpretation of the right-hand cord, as no Greek beam is known to be drilled for a cord to pass through it vertically); they are splayed, and this I think is to show they pass around a fairly fat beam. The problem in this representation is that the lower cords come closer together apparently under the cross-piece and do not directly meet the upper cords which go towards the ends of this piece. Has the artist changed his angle of viewing the system at the vital moment, too concerned to show that two cords passed round the beam at different angles from their upper parts? Is what we see (left) an attempt to indicate an unstable beam suspension (as right)?





I can imagine no other reason for the cross-piece here on C.3.

Finally the large loop that is all that is shown of the beam suspension on C.4 can only be interpreted as a loosely wound unstable balance cord. Two further cords then rise from it:



These three large balances, the only ones drawn in relevant detail, do seem to indicate basically unstable constructions. The others, less clearly drawn, may possibly have therefore been on the same principle. The mechanics of this, and the essential elements of notch, and also spar or other means to ensure no side-friction, have been mentioned; further

discussion will be found in Appendix B on experiments carried out with reconstructions of similar beams as also with several of the stable sort for comparison.[45]

It would be wrong to insist too strongly on the general instability of Greek balances.[46] The evidence is insufficient to decide the matter, though I hope at least to have established that as a type it did exist. The borderline between stable and unstable is not always clear-cut: breadth of pivoting cordage, or side friction on the beam, would tend towards characteristics of the stable sort. Even empty see-saws, and pencils poised on a finger, though unstable, will oscillate without necessarily overbalancing. However the unstable beam best suits the symbolism and metaphors of Greek literature (Ch.VI), just as it best explains the absence of such features as pointers or horizontal levelling lines. These are much more significant and decisive than any hypothetical interpretation of obscure pictorial representations.

It will be possible at a later stage to conclude not only that both types of suspension were used by Greeks, but further that the stable balance was a later introduction. It reflected the different approach to weighing occasioned by the change from simple comparison (where the steep overtilt of an unstable beam was eloquent and accurate) to precise measurement (where level balance was wanted). The method of operating these balances is discussed in the next section; further details will be found in Appendices A and B. Though the unstable beam would appear of higher sensitivity than the stable, it probably should be regarded as less accurate, and certainly less convenient for level-balance-weighing. See Ch. VIII and again Appendix B.

## 3. Procedures of weighing with Greek balances

Virtually all the evidence for the use of the balance by Greeks points to a single, and strikingly simple, procedure: the comparing of two similar objects, placed in each pan, in order to determine which of them is the heavier. There is only one possible (not certain) reference to the use of weights, and no evidence of what could be called measuremental weighing: weighing, that is, to discover the weight (in absolute terms) of an object (of unknown weight). Yet the Greeks had weights and we read frequently of measured weights. This surprising contradiction in the evidence will be pursued in later chapters (especially VII) where I infer that all but the comparative method was known only to a few specialists - if established at all. In this section however, some attempt must be made to consider the procedures followed (rather than their extent), by using both what evidence direct and indirect is available, but also by considering the possible procedures necessary for different balance designs and aims of weighing. This element of conjecture is sufficient to show that there is no need for the more difficult conjecture of advanced, stable balance designs in order to explain the apparent contradiction mentioned above. I shall use here the same evidence as already considered in the last section on balance design, as also the results of experiments conducted with balances reconstructed from the evidence discussed above (see Appendix B).

Procedure is very much related to the purpose of weighing. It may be helpful to distinguish comparative weighing (to discover simply which of two objects is the heavier) from equalising (where an attempt is made to alter the weight of one side towards the other), and from measuremental (to discover the weight of one object). The distinctions are not necessarily absolute, and indeed a comparative procedure can be followed in order to measure weight just as independent weight measurements can indicate the comparative weights (lightness or heaviness) of two objects. Similarly

weight measurement with a two-pan balance may use comparative equalising procedures. Nevertheless the distinctions are generally helpful and clear: weights (of some sort, even if just an ad hoc single standard) are necessary for measurement, as also some procedure involving equalising the balance (for which alone weights are not necessary); and neither are necessary for comparative weighing. Similarly balance design can reflect both procedure and purpose: the stable balance is best suited for measurement and equalisation, the unstable for comparison.

This sort of a priori distinction lies behind my argument here as elsewhere. It is I believe a valid way of making some advance on the very fragmentary evidence. The possibility of such distinctions breaking down in practice should however not be ignored. It may very well be that balances designed for simple comparative procedures were used to perform equalising or measuremental functions. I shall show how this is possible, and later (chapters VI-VIII) consider whether it may indeed have occurred. The reverse, measurement in order to distinguish or compare, can be discounted as improbable, but also is ruled out by the general historical development of Greek weighing.

## 3.(1) Comparative weighing with two-pan balances

There is no lack of reference to comparative weighing.[47] The procedure is described in detail by several ancient writers; it is illustrated on many representations; and both can be supplemented on several points by further indirect references. Simplest and clearest is the account in Homer Il. 8.69-75, repeated in all essentials at 22.209-12; also see Plato Tim. 63B; Protag.356B; Ar. Ran. 1365-7, 1378-1413. Il. 12.433-6 is problematic (and see below in section 3.(2)). I quote first here Il.8.69-72:-

καὶ τότε δὴ χρύσεια πατὴρ ἐπίταινε τάλαντα·
ἐν δὲ τίθει δύο κῆρε τανηλεγέος θανάτοιο,
Τρώων θ' ἱπποδάμων καὶ Ἀχαιῶν χαλκοχιτώνων,
ἕλκε δὲ μέσσα λαβών· ῥέπε δ' ἀίσιμον ἦμαρ Ἀχαιῶν.

The balance is the hand-held type. The procedure comprises five stages (including that of observing the outcome). First, the strain is taken up in the pan suspension strings by raising the beam with the pans themselves still on the ground. For ἐπίταινε compare Il.8.266 παλίντονα τόξα Τιταίνων[48]: it may even be the case that the beam of the balance similarly bent.[49] Though there is no evidence of this stage of the procedure, with hand-

held balances it seems virtually essential for a variety of reasons: accidental unevenness can be misleading when hand-held stable balances are raised from the ground and this stage ensures the pans are properly spaced; the possibility of pan suspension strings wound round the beam is avoided (and this otherwise can lead to very serious error); mainly however it facilitates the next stage. Second the objects to be compared are placed[50] in the pans. Again this is in practice advisable: with stable balances excessive swinging is avoided, with unstable the placing of any one object would overtilt pans held in mid-air, and greatly favour that object's appearing (falsely) the heavier. Thirdly the beam is grasped by its point of pivot (and, as argued above, it very much appears that Zeus' balances were to pivot on his finger) and, fourthly, is lifted.[51] Finally, fifth, the inclination of the beam and pans, that only now occurs, is noted. It appears that both pans were initially lifted clear of the ground, the Achaean side subsequently comes down to rest on the earth (ἔσεσθην 1.74). An alternative procedure, suggested by experiment, is to raise the beam slowly so that the inclination develops without the heavier side ever leaving the ground: the advantage of this is to reduce swinging (though this is not in any way noted by Homer: such silence being a further reason, if more were needed, that Zeus' balance was of the unstable sort). There is little danger of error however in raising both off the ground fairly quickly with unstable balances.[52] Representations of this scene, and others related to it (Reps. group P) do not show hand-held balances greatly inclined, though the sizes would suggest that (if the balances were unstable) the heavier weights should land on the ground. It is possible that the representations show the moment of one side's descending.[53] The only hand-held commercial balance represented (C.2) is obscure. No one appears interested in the weighing, and I wonder if the woman is simply carrying the balance and contents rather than using it to weigh at the particular moment depicted by the artist.[54]

Slight modifications are necessitated by the use of a non-hand-held stand-type balance to this same end. The pattern is set by Ar. Ran where Dionysos uses a balance to compare phrases by Aeschylos and Euripides. It seems likely that Aristophanes was using an actual balance as a stage prop for this scene: the relevant part begins at line 1378:

ΔΙ: ἴθι δὴ παρίστασθον παρὰ τὼ πλάστιγγ', ΑΙ+ΕΥ: ἰδού.
ΔΙ: καὶ λαβόμενω τὸ ῥῆμ' ἑκάτερος εἶπατον
καὶ μὴ μεθῆσθον, πρὶν ἂν ἐγὼ σοῖν κοκκύσω.

The two contestants are instructed first to stand by each pan. Second they are to grasp the pan, and hold on to it while, thirdly, they speak into the balance. They are told fourthly to let go only when Dionysos should shout "κοκκυ" ("give the word","say 'when'", but also "quick" which is of relevance).[55] Dionysos only tells them to let go when both have spoken. This third stage is equivalent to the loading of the pans, and after the pans are released the inclination of balance and pans is observed.

The procedure, which is repeated in detail twice in this passage, is precisely paralleled by representations of larger balances, suspended from above.[56] Assistants stand or sit by each pan (the right hand attendant of C.1 has temporarily been distracted from his proper function); on Taleides C.3 they are actually shown holding the pan cords while loading is going on. The command to hold the pans while loading both sides is significant. It is relevant to stable balances (as reducing swinging), but essential to unstable as noted above, for otherwise error would be considerable. It is precisely equivalent to loading both pans of a hand-held balance while they are still on the ground. I find it interesting that this practical point should gain such prominence in both accounts.

The procedures just described apply equally to stable and unstable balances. I should argue that details, and the overall decisive nature of the operation, favour the unstable balance's being actually used. The comparative aim includes all weighing of one commodity against another, or against itself: thus all weighing of A προς B. It is involved in distinguishing (thus Herodas 2.90f. ταυτα τρυτανη Μινως οὐκ ἀν δικαιων βελτιον διηγησε cf. [Plato] Just. 373 D E διακρινει τί ὀν το τε βαρυ και το κουφον ), and the Apatouria ceremony of finding under-weight (μεταγωγεν Eupolis K.fr.116; Ar. Ran. 798, probably anticipatory of the later scene discussed above, τί δέ; μεταγωγήσουσι τὴν τραγῳδίαν;) It also lies behind the symbolism of fate etc. involving inclination (ῥοπη etc.). On a practical level it is what the Agoranomoi did in checking (stale?) loaves against others (fresh?) (Xen. Symp. II.20). The two overriding features of the procedure are (1) absence of weights, (2) simple observation of which way the beam inclines.

No comparative procedure is applicable to one-pan balances, so we can pass immediately to equalisation. For this and the following procedures the evidence from ancient Greece is increasingly meagre.

3.(2) Equalisation with two-pan balances

Equalisation falls midway between comparative and measuremental weighing in that weights are not necessary. However it is closer probably to measuremental in that the essence of both is equalisation of the weights of objects in both pans. It is an uneasy category, and most of the evidence for it is ambiguous.

First again is Homer. In Il.12.433-6 the equal (ἴσα) battle is compared to a woman, working with wool, and doing something described as ἰσάζουσα with a balance. I shall show later (ch.VI.4(2)) that most references to the equality of battle play on the idea of a tug-of-war in a rope stretched rather than on the balance as has been suggested. Here however there is no doubt that the balance is involved - at least in the text as it stands:

ἀλλ' ἔχον ὡς τε τάλαντα γυνὴ χερνῆτις ἀληθής,
ἥ τε σταθμὸν ἔχουσα καὶ εἴριον ἁμφὶς ἀνέλκει
ἰσάζουσ', ἵνα παισὶν ἀεικέα μισθὸν ἄρηται·
ὣς μὲν τῶν ἐπὶ ἶσα μάχη τέτατο πτολέμός τε ...

It is essential, but impossible, to determine the objects involved. The word τάλαντα being plural must probably be allowed as an alternative for later πλαστιγγες ; supporting arguments being: χρυσεια τάλαντα Il. 8.69 (the only metal parts of an ancient balance are the pans; but this argument is vulnerable to the observation that only gold was measure-weighed in Homer, and so it is possible that χρυσεια here means "for weighing gold");[57] Aesch. Persae 346 τάλαντα βριθεις οὐκ ἰσορροπῳ τυχῃ; Bacchylides 16.25 (μοιρα ἐκ θεων) Δικας ῥέπει τάλαντον (singular);

Lycophron 270 σκεθρῳ ταλαντῳ τρυτανης ἠρτημενον (+ scholiast). Thus though both τα ταλαντα and το ταλαντον are used of the whole balance, it seems possible for the pans in particular to be implied here. The reason for establishing this in detail is the question of whether σταθμον means (actual physical) weight or balance. The latter sense is just possible (cf. Hdt.2.65[4]; Ar. Ran.1365, 1407, ?1386); but the former (in the strictly physical sense, as opposed to generic weight as "temperature", and as opposed to specific weight as "2 drs") is remarkably rare in Greek literature: [Dem] 25.46; [Plato] Just. 373E (but I doubt it); Lycophron 269-272; Plut. Mor. 723 B; otherwise I can establish its use only in inscriptions (as ML.45 12; IG ii[2] 1407.41 etc.) or in the official description of Agoranomoi in Arist. Ath.Pol. 51.3; no weights are shown on pictorial representations of balances, and nowhere is their use described. Of course weights were used (and have survived), but the question importantly arises of whether their use was at all generally known (and certainly whether it was early known).[58] I feel therefore that the uncertainty over σταθμον in this simile should be allowed to remain until further support for its identification as a physical weight can be found.[59]

The balance is a simple hand-held sort (ἀνελκει must mean no stand is involved): comparison evidently is made to the equality of what is in the two pans. Ταλαντα, whether the whole balance, or just these pans, is naturally placed at the introduction of the simile and we may note that no beam (or pointer etc.) is mentioned. Because of the uncertainty over σταθμον two interpretations of the woman's activity are possible - in one she tries to equalise weight against wool, in the other she simply equalises two amounts of wool. In both these cases a definite attempt at equalisation is made:[60] it remains unclear as to why this operation would help her income; it is also unclear how the woman actually accomplished the process.

As already observed the balance is hand-held, the main verb is it's being lifted (ἀνελκει), the participle ἰσαζουσα could either be one of action or intent.[61] Because the battle is even, rather than approaching even, and because of the practical difficulties of adjusting hand-held balance-pans while they are freely suspended, I feel sure the latter interpretation (ἰσαζουσα "intent on an equalisation") is here correct. If so, we may assume a number of earlier attempts (with the balance lowered each time and slightly more wool added or removed) preceding that which the simile focusses upon.

The procedure, therefore, is the same as in comparative weighing, but is repeated. Such adjustments are possible with both stable and unstable balance types. The implication of the simile in my opinion points conclusively towards the unstable balance.

The few other references to positive equalisation do not add any details on the procedure involved: Lycophron 269-272 (as noted above) equalising gold and weights, and doubtfully Diotimos ap. Anth.Pal.VI.267 ἴθεις ... ταλαντα δικης[62]. Level beams, and balancing, though the ideal of this weighing procedure apply equally to the next two. They are not however always thought of as ideal, and probably more often represented in literature the precariousness of a particular moment. This of course relates to the unstable balance and comparative weighing as I am arguing to be the general rule until the 3rd century and later. See further below in ch. VI and following.

The comments by [Arist.] Mech. §1. on the accuracy of balances should be referred to here. Whether the emphasis is on detectable speedof movement (as I believe is indicated by ὀκκιον and so implies the unstable balance)[63] or simply on displacement (so the stable balance), the writer is concerned with detecting deviation from the horizontal level position. This implies an attempt is being made to achieve such a position, which is equalisation. That the Greek balance was so badly designed to register this position is entirely in keeping with the late date at which accurate notice of it became important.

There is no evidence of single-pan balances operated for simple equalisation (see below 3(4)): but it should be assumed that the converted trumpet of Ar. Pax 1240-9 would weigh only one particular amount. The principle is closer to that of equalisation in that the weight is neither determined, nor (presumably) known.

3.(3) Measurement with two-pan balances

Assuming that the σταθμον of Homer's χερνητις (above), if a weight, is a fixed weight, there is no Greek evidence, literary or pictorial for measuremental weighing with two-pan balances. On the other hand the vast numbers of weights, the epigraphic references to their use and conservation, coinage, and much else clearly shows that at least some people in the Greek world measured weight. We must briefly conjecture how this was done, and consider both general types of balance.

Obviously it must be a repetitive process, very similar to equalisation (which used comparative technique) but using known constant weights (and subdivisions) against the unknown weight of the commodity to be weighed. Some indication of the repetitive nature may lie in the early form of giving weights. Herodotus repeats from the accounts of Delphi: τριτον ημιτεταρτον etc. (Hdt.I.50.2, 51.2; also Olbia 4th century, Pleket 7, of staters). This system was peculiar enough to merit explanation by Pollux IX.54f. It implies some sort of sequence, and is not simply a progression by ½-talants etc. as the example given is equivalent to 2½ T (not 1½T or three ½-talants). I should suggest the operators proceeded with the largest unit they had until it proved too clumsy. Thus, perhaps: first weighing IT: too light; second weighing IT + IT (again too light); third weighing IT + IT + IT: too heavy, but ½T (if actually checked and not immediately assumed!) satisfactory. If this interpretation appears too pedestrian, it should be compared with the measurement of the capacity of several pithoi, marked with a series of single units because the vessel was, on a reasonable interpretation, being filled from another vase in these units.[64]

Another similarity between measuremental weighing and equalisation is clearly the need to approach equality. With a two-pan balance this can be registered by a horizontal beam (or non-declined beam ends or pans) and this is the only way of determining equality with stable balances. It is the procedure with modern chemical balances and does not need further justification.[65] Somewhat essential are markers to indicate this equalised position when it is attained: their absence on Greek balances makes determination of this position extremely difficult. Experiments show the sort of sacrifice to accuracy that it seems reasonable to assume would result from such balances used in this way. However with unstable balances a much closer approach can be made to accurate equalisation, and one which is also not dependent on observation of minute deviations. The only

difference is that a decision on a certain weight measurement is reached without stable equilibrium necessarily being attained.[66] All this is explained in Appendix B. A further feature of the unstable balance used in this connection, is that it should be possible always to know whether (if not by how much) one's most accurate measurement is above or below the true weight of the object concerned. This feature has natural relevance to the commercial context (the seller giving the impression he is selling more than a certain amount to the buyer, who is in turn impressed by the scales over-tilting dramatically in favour of what he is buying), but is also no less applicable to others (such as inventory or accounting) where measurement is attested. This point will be pursued below in ch. VIII.

3.(4) Measurement with single-pan balances

It is fortunate perhaps that of the three sorts of Greek single-pan balances, the operation of one, the bismar of [Arist.] Mech. § 20, is described in some detail.

The description begins by making it clear that the machine measures weight: αἱ φάλαγγες τὰ κρέα ἱστᾶσιν ἀπὸ μικροῦ ἀρτήματος μεγάλα βάρη (853b25f). The way this was done is implied later: a particular piece of meat in the single pan would be suspended by various cords until the beam was level, and its weight could be deduced: ὥστε γιγνώσκειν, ὅταν ὀρθὴ ἡ φάλαγξ ᾖ, ἀπὸ ποίου σπάρτου πόσον βάρος ἔχει ἡ πλάστιγξ (854a1f).

Although the efficiency (and accuracy) of this particular machine cannot usefully be estimated, it was the speed and applicability to measurement in particular that led to this sort of balance becoming standard throughout the Roman world. We have however transgressed the limits of this study of the Greek.

Conclusions

The most important conclusions to be drawn from this discussion of Greek balances are probably the negative ones. No balance incorporates a pointer, or plumb-line to indicate deviation from the horizontal. There is no evidence of design features to counteract any of the basic theoretical problems of two-pan balances: especially controls to establish and maintain equal arm-length (which requires attention to point of pivot and points of pan-suspension, as well as to the means of making these points as precisely fixed as possible). It appears in fact that the most basic Greek two-pan balance was in principle unstable (with support under the beam centre). Possibly this was artificially rendered stable by crude pivoting (esp. the breadth of cord supporting the beam) and by the friction on the beam sides at this point of pivot. These negative features together point towards a lack of interest in balancing precisely, and indeed further evidence of such an attitude has already been anticipated in the course of advancing the above interpretation of beam suspension.

The evidence of development is difficult to assess. Significant references to alternatives to the two-pan balance are nevertheless minor and scattered. Secondly, the conservatism of Greek iconography may have obscured changes in design, just as the lack of detail in most representations prevents proper interpretation. Arrangement by context does in fact prove a quite satisfactory way of grouping the types of scales it appears the Greeks used: but it is possibly very misleading:-

| | |
|---|---|
| 6th to 3rd Century. | Commercial context: large semi-portable two-pan balances; also smaller hand-held two-pan balances; two types of one-pan balance (late 5th and 3rd century). |
| Homer to 4th cent. | Psychostasia-erotostasia: smaller two-pan balances, hand-held in all but one (Campanian 4th century), which has an axle pivot. |
| Mid 5th to 4th c. | Hector's ransoming: smaller frame-supported two-pan balances only (first Melian, second Italiote) |
| Hellenistic | Kairos: small 2-pan balances, occasionally balanced on a razor. |

The sizes here refer to beam length: 6' or over, around 3', and under 2'. The Greeks did not calibrate their balances, however, either by beam-length (beyond the generic πῆχυς ) or by load-capacity.

The lack of extant remains would indicate perishable materials were mainly used in these balances: certainly wood is most likely for the beams, and cord, rather than chains and hooks, for suspension. Though lead may have been used for some small pans (and for weighting some beams) I have argued clay to be also probable (wood, however, unlikely).

One other observation calls for further comment in the light of the following chapter. No Greek balance is illustrated with any weight in one of its pans; the only possible literary references to weighing with weights are: Il. 12.433-6 (which, as discussed above, is obscure) and Lycophron 269-72 (which is late and again unclear).

The position the Greek balance occupies in the development of weighing machines is not an important one. More interesting is the reason for this: not so much the Greek disinclination towards technological problems, fair comment though this be, as the peculiar Greek attitude to the point of weighing itself. I shall return to this question in Chapter VI and following. Further direct evidence (weights, coins, and weighed amounts) must first be considered.

chapter two

# G R E E K  W E I G H T S

- "The study of ancient weights and measures is among the more demanding and least rewarding of occupations"
  G.R. Davidson, Corinth XII (1952) p.203

Introductory

The greater part of this chapter is devoted to the assembly and analysis of what can be properly identified as weights. The Attic weights call for most attention (1.(1)), and the weights from other areas are considered together (1.(2)). In the second part of the chapter I discuss coins. As these are generally held to be weighed amounts of precious metal, and so in effect weights, an equally detailed analysis might have been in place. I have restricted this part however to a general discussion (with a short excursus exempli gratia on Sicilian Greek coins and some observations on the weights of more significant mints). This I have done for three reasons: proper and detailed consideration of coins as weights would demand the complete re-examination of all Greek mints; such an undertaking, even it it were possible, would be only partially justifiable in view, secondly, of the doubts I have about the relevance of coin weights to weighing; these doubts, thirdly, are more conveniently considered in subsequent chapters.

## 1. Weights

### 1.(1) Attic weights


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- key to references
- Wheel
- Boukranion
- Astragalos
- Dolphin
- Amphora
- Turtle/Tortoise
- Shield
- Crescent (and Cornucopia)
- Owl
- weights without symbol, marked with value: multiples and fractions of (A) staters, (B) minai, (C) drachmai.
- weights marked "demosion" only
- reconstruction of Attic weight systems from these type analyses

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## I. Introductory

The Greek weights to be collected under this heading and the next comprise only those identifiable by type and marked by symbol or legend. Unmarked weights probably were used extensively (cf. SW.16 for a borderline case), but they cannot be identified, still less interpreted (see general criticisms of metrological speculation in this field). The weights I consider here form series that can in most cases be associated with certain city-states; they are therefore immediate evidence of official weight systems and standards. Whether they also throw light on the use of weights will be discussed in a later section.

Weights range in date from the late sixth century to the first where the borderline with Roman weights becomes rather blurred. I am very doubtful about the existence of much earlier weights (see below). It has been necessary however to consider the whole of this range, and so to go beyond the chronological limits of this thesis, for two reasons. First, chronological indications are scarce and the development of a complete series can usefully resolve problems of the dating and ordering of its early stages. Second, several developments can be shown to occur within the later period that it is most important to rule out of the earlier (especially multiple standards at Athens and the vast increase in number and extent of weights generally).

As the Attic weights present the sole corpus of any significant size and accessibility (from publication or collections) I shall examine it here in considerable detail. First a comprehensive analysis of the weight types is attempted followed by a concluding section in which the problems of identification are discussed and a revised chronology of the whole series proposed. This part unavoidably makes use of several further conclusions that only properly emerge in subsequent discussions of particular aspects of the weights. The most important of these concerns stamps which I argue to have been used to mark such weights as were used in their duties by

public officials in Athens, in the Peiraeus, and in Eleusis. The three following sections cover the related topics of weight manufacture, official marking, and precision. Finally the more interesting conclusions of the whole analysis are collected together even though many will be found reaffirmed in later chapters. A set of graphs in Appendix F accompanies this analysis, and is most particularly used in the section on precision.

Non-Attic weights are considered together in a second part: 1.(2). As there is little scope for detailed analysis of these scattered and mainly incomplete or unidentified series, I have concentrated my comments in an extended general survey.

## II. Analysis of Athenian Weights

The attempt is made here to set out all the Attic weights published to date. While naturally relying on the two major studies in this field by Pernice (1894) and Lang (1964),[1] I have tried to avoid the preconceptions and theoretical pre-structuring that both these scholars used to arrange the weights. These problems of interpretation are discussed subsequent to the analysis (especially the question of what counts as official standard or weight system). Some anticipation of my later conclusions has however proven necessary to avoid lengthy repetition of ambiguities of interpretation and I have in particular made use of the evidence of heavier standards of 138dr and 150dr from IG.ii$^2$.1013 while being careful to examine any independent evidence for applying these standards outside the second century (where they are incontrovertibly placed by the decree itself).[2]

The difficulties of the analysis as a whole will be discussed in the summary section following examination of the individual weight series, but certain remarks of a more practical nature can be made here about the lists that immediately follow. The weights are described by types, the order being generally that suggested by the heaviest weight associated with each type: Wheel, Boukranion, Astragalos, Dolphin, Amphora, Turtle/Tortoise, Shield, Crescent/Cornucopia, Owl. There then follow weights inscribed with weight value only - stater, mina, and drachma multiples and fractions. Finally, I have added a short list of weights marked "demosion" (or cogn.) only.

All the weights are lead, with Attic or ? Attic provenance, unless otherwise specified. Legends are presumed to be in relief (though this is not always clear) again unless I have noted them as incised or relevantly doubtful. For the abbreviated references to publication see above pp. (xi)-(xii). Queries by groups indicate doubts about Atticism (normally raised at the start of each subsequent commentary). The principles followed in constructing these groups are:-

— different main groups (A,B,C...) for variant symbol types (whole, half etc).

-- first-order sub-groups (I,II,III...) for variant weight ranges that can be indicated by legend or weight, alone or in association.

-- second-order sub-grouping (A.Ia,b,c...) is used for variations in legend where this may be interesting, although on several occasions this variation is so extensive that I have left the heading simply as "various".

The commentaries that follow these lists attempt to identify the Attic series in chronological sequence, and also, as noted, to discuss problems arising in detail. The general problems of overall system, stamps, official marking, and of precision are discussed in subsequent sections.

WHEEL

[Group A.Ia] LW.1,2 wts 1792.5 - 1779gm (4 minai @ 448.1 - 444.7gm)
no legends
contexts 200BC and Hellenistic

[Group A.Ib] P.274 "Auf der oberen Seite vier grosse runde Stempel, in diesen die Buchstaben TE TP AM NΩ"; identified as "wheel" also by Lang p.7.
wt. 1786.4gm (4 minai @ 446.6gm)
from Markopoulo towards Brauron (Attika).

[Group A.Ic] P.280, 285 (similarly identified by P. but not mentioned by Lang)
wt. 1741.7 - 1681.8gm (the latter worn)
legend (on P.280 only) "DEMO"
4 minai @ 435.4 - 420.4gm

[Group B] ? Lang p.7 claims to have seen in the Nat.Mus. Athens a wheel weight (no. 8192:3094) "which may be read: δισταστερ". She mentions however neither its weight nor the type of sigma involved.

This series must be identified as Attic as all the known provenances are Athens or Attika (as further the prominent ATHENA METPO stamps on the Group C, to be added below). The wheel series is not large; it was not identified by Pernice, and Lang's enthusiasm springs from the fact that the symbol appears on the Wappenmünzen. Her guarded reading "δισταστερ " is reflected in her comment (p.6 n.12) "the wheel and amphora are not definitely known for this period [ie.6th - 5th cent] but may be presumed from the regular system". As far as I can tell however there is no evidence for the symbol on weights until those late in Gp.AIa.

The association of Gps. AIa and AIb seems unavoidable, and the small weight variation remarkable (see further in VI following on precision); it is less than 1% even though the weights are lead. Gp.AIc widens this degree of precision, though the last weight is of course too worn to really count.

With rather less confidence I shall note here a further group that I have identified simply by the lettering DEMO in the four corners: see illustration in Michon (fig.5729). Both weights are stamped centrally METPONOMON:-

[Group C.I] ? P.271 (well preserved) wt 1854.4gm (4 minai @ 563.6gm), but Michon gives 1821gm [the weight is now BN BB.2232]. Michon (n.40) also notes two further similar weights.

[Group C.II]? P.405 (fair) wt. 57.1gm (? 1/8 mina of 456.5gm: Pernice)

The head of Athena in the central stamp to both these weights (illustrated on the title-page to Pernice GG , and contrast Michon fig.5729) is not yet adequately clear for dating. I certainly suspect Pernice's view of c.400 BC (Pernice p.22; see below III on stamps).

[Group A.I] Boukranion; ΔIMNOYN (on P.604 ΑΓΟ ΔIM); all from Athens.
P. 603-605
Wts. 1559.7, 1360.7, 1310.3gm (two minas @ 779.9-655.1gm)

[Group A.II] Boukranion; MNA (as read by Pernice and Lang); fr. Peiraeus.
P. 610 (badly worn)
wt. 589.6gm

??? [Group A.III] Boukranion; DAMOSIA [mna] AGOPANOMEONTOS MENEXENOU (incised with circular letter punched dots); no provenance.
Kroll C bronze
wt. 414.5gm (uncleaned, but in good condition)

? [Group A.IV] Boukranion (with large horns and ears: Pernice); legend T⋮ (Pernice) which might well be ST[ATHP] (chg); no provenance.
P. 288
wt. 409.8gm (rather worn)

? [Group A.V] Boukranion; DE(mosion) HMIMNAION; from Athens.
Munich: AA 28(1913)438
wt. 212gm (claimed to be in fifth cent lettering). (424gm mna)

? [Group A.VI] Boukranion; no legend; "from Corfu" Woodhouse.
P. 762 bronze
wt. 121.24gm (??)

??? [Group A.VII] Boukranion (with sacrificial fillet); no legend; from Phocis
P. 701 (shaped as a segment of a sphere - ? conical; lead)
wt. 106.14gm (??) ? hemisphere (Kroll).

??? [Group A.VIII] Boukranion; incised in "archaic Corinthian letters" ΠΕΝΤΑΚΙΟΝ and on reverse [Κ]ορινθιον around I or H (? HMI-); fr.Attika.
Hultsch, Jnl.Int.d'Arch.Num. 8(1905)5-6; Davidson, Corinth XII p.204 and pl.147.c.
Bronze discoid weight.
wt. 85.52gm (fifth of 412.60gm, ?? five staters 16.50gm)

This list includes all boukranion weights that I have yet collected, and well illustrates the difficulties of identifying what can only have been a very minor Attic series. Reliance on coin type as a guide to weight origin (the basis of Kroll's recent discussion of the weight in Gp.III) is clearly misleading as no Corinthian coin can be cited to support the legend on the weight in the last group. This is virtually certainly non-Attic (and as found in Attica must have been incised at an earlier period: see sv.Corinth) as also the two weights plausibly argued to be Phocian (Gps.III and VII; they are however hardly compatible in type or weight: see sv.Phocis). The problem of the light weight mina (?) P.288 (Gp.IV) is avoided by Lang who appears to have mistaken the weight for the mastoid marble weights with which it is described by Pernice (in n.29 p.15 Lang omits P.286-290 as all marble; this should be corrected to P.286-7, 289-91). Pernice's comments (GG.p.41) are not helpful though a rather different type may be implied by his description. The weight lacks provenance, but if the letters do read ST[ATHP] it is unlikely to be Athenian (see however variant stater on P.2 noted below sv.stater frs.). The attribution of the four weights in Gps.I,II to Athens was made by Pernice on grounds largely of provenance (GG.p.18); it can be supported by their weight system and standard. Gps.V and VI may also be Athenian, but if so belong to a different system from I and II. None of the possibly Attic weights are confirmed by stamping.

Lang and Pernice both comment on the appearance of the boukranion type on Attic Wappenmunzen. This Lang then uses as a justification for postulating a boukranion weight in the early (stater based) period equivalent to 1½ staters (later 3 minas; Lang p.7). This is pure speculation in answer to a non-existent problem (gaps in explanation of the development of Lang's version of Attic weight systems - the version I feel needs revision, and the whole justification for "explanation" is suspect). There is no evidence for any early Attic boukranion weights, and all those marked in my lists belong to the later mina-base period.

The two first groups, A.I and II, are compatible, giving a heavy mina that is explicitly labelled as commercial by the mention of agoranomoi on P.604 (on this interpretation see below). Correction on the assumption of a 138dr standard gives too high a coin mina (565.1-474.7gm) and the weights must belong to the 150dr standard (giving a coin mina range of 519.9-436.7gm) if not to a higher (but see elsewhere and conclusions which indicate that this high range might well be acceptable).

Troublesome is the marked half-mina of A.V. Type and provenance, as well as legend DE(mosion), indicate Athens (mina-period so I suspect the published possibility of fifth-century lettering). However, the lack of symbol fractionalisation, and the fact that a different standard is implied (viz. the normal coin mina), make it difficult to suppose this single weight to represent a standard Attic series. It need not be Athenian (as demmosion appears on other states' weights) and this may also be true of the unmarked weight of A.VI (? a quarter-mina of the same series).

ASTRAGALOS

[Group A.I] Astragalos, STATHP
P.5, 6; LW.3, and ? 4 (all good condition)
wt. 1422.5 - 1301.5 and ? 1102gm.
(giving 2 minas @ 711.3 - 650.7 and ? 551gm)
contexts Hellenistic LW.3 and Late Hellenistic LW.4

[Group A.IIa] Astragalos, STATEP DEMOSION AΘENAION (S)
Bronze BW.1 (good condition)
wt. 795gm (giving 2 minas @ 397.5gm)
context c.500 BC

[Group A.IIb] Astragalos, STATHP
P.7-9; LW.6 (this last only fair condition)
wt. 924.9 - 909.7 and 841.5gm (giving 2 minas @ 462.5 - 420.8gm)
context for LW.6 late 4th/ early 3rd. cent.
note that δημοσ✓ incised in later hand on P.9

[Group A.IIc] Astragalos, DEMO or DHMO
P.10-12; LW.5 (this last only fair)
wt. 902.4 - 883 and 863gm (giving 2 minas @ 451.2 - 431.5gm)
no contexts

[Group A.IId]? Astragalos; no legend (all with non-Attic provenances)
Rob. 2417-8 [from Olynthus] wts. 896, 812.5gm
P. 685 [from Corinth; also incised dr.class IIA] wt. 858.92gm
P. 694 [from Thebes; symbol very worn and ?] wt. 840.18gm
overall range 896-812.5gm (giving minas of 448-406gm if Attic)
context 5th/early 4th cent. for Rob.2417 and the other Olynthus weight must also be first half 4th cent.

[Group A.III] Astragalos; no legend.
P. 13; LW. 7 (both damaged); ? also Rob.2419 [from Olynthus].
wts. 480.7, 456, 415gm (? minas)
no contexts given (though the Olynthus weight again should be early fourth cent.).

[Group A.IV]? Astragalos ("rising from the surface" (?) Murray); HMIMN(AION).
P. 14 [from Crete]
wt. 255.6gm (giving mina of 511.1gm)

[Group A.V]? Astragalos; no legend.
P. 15 [? from Athens], 16 [no provenance]
wt. 122.8-112.6gm (?? quarter minas of 491.2-450.4gm)

[Group B]?? Two astragaloi; no legend.
P.17 [from Peiraeus] (corroded)
wt. 95.0gm (??)

[Group C]?? Bronze weight in form of astragalos; no legend.
P. 772 [? provenance] wt. 332.24gm (??)

The type, which occurs on Attic Wappenmunzen, is however of general Greek usage (see Robinson, Olynthus X 461-2 n.55) and the weights collected here include examples from Olynthus, Corinth, Crete and possibly Thebes that it is not possible to insist on being Attic. For the remainder of the series however the provenance is where known Attic and an explicit reference to Athens on the bronze weight of Gp.A.IIa fits the technique of that weight and the general weight system to which it and most of the other weights belong, including those of non-Attic provenance in Gps.AIII and IId. The possibility that these foreign weights were originally taken from Athens in antiquity must be left open (see further below on travelling weights). Gps.B and C, however, are untypical in both weight and type, and are certainly not part of the standard Attic series even if they cannot be placed elsewhere as yet. Only one astragalos weight is stamped: DIONYSOS METPO on P.6 (Gp.A.I and illustrated by Lang, Agora X Pl.V). This stamp is particularly appropriate, but the absence of other stamps may possibly be due to the usually heavy weights of this series (see further below on stamping).

The main series of astragalos weights divides by weight into two groups A.I and II. The first of these, including the stamped weight P.6, is the heavier, with a general Hellenistic context. Though it is not easy to be categorical on the matter (cf. other mina ranges on the graphs below), it is easier to interpret this group as on the 150dr standard (thus giving a coin mina range of 474.2-433.8gm and ? 367.3gm) than as on the 138dr standard (which would imply an even higher coin mina range of 515.4-471.5gm and ? 399.3 gm). The lowest weight LW.4 may even be separated, as it is in good condition, and in fact assigned to the earlier 138dr standard. On this hypothesis the group A.I divides around the reform changing from 138dr to 150dr standards, i.e. IG.ii$^2$.1013, and the available context dates offer some support.

The second group, A.II, is generally of a lighter mina-weight. Late in the series must be set P.9 which is incised with a legend relating to the mina-base system rather than the stater-base for which that weight (as the others of A.IIab) was made. Since the group in which this weight occurs (AIIb) can be dated to the fourth century, this change to the mina-base must be later. An obvious problem arises from the fact that the first group (A.I) still bears the legend "stater" rather than "dimnoun". Furthermore this reinscribed weight P.9 is not compatible with the heavy weights of A.I. The explanation is not clear. Both heavy and light systems adopt the mina-base (see Wheel A.I and Boukranion A.I). To postulate however a 150dr standard in the earlier stater-base period (as Lang) is to ignore the late date contexts for the heavy astragalos Gp.A.I, as also its legend STATHP (in this form the eta is a criterion for dating: see conclusions). The only acceptable alternative is to doubt the significance of the system base (mina or stater) for higher weights than this base, and this I shall adopt.

Associated by weight with this group A.IIb is that marked DEMO or DHMO (for the fourth century the distinction is immaterial: see elsewhere as above), A.IIc, and the non-Attic provenance weights (unmarked) of A.IId. It is remarkable that no staters with Attic provenance bear no legend (contrast most other weight symbol series) and I am inclined to treat these weights as Attic also — they certainly belong to the Attic weight system (see elsewhere; it is unfortunately impossible to distinguish foreign weights based on the Attic system and Attic weights that have travelled to foreign states).

Apparently to be analysed as an earlier part of this same series is the solitary bronze weight of A.IIa dated by context and lettering to the very early fifth century. Although in good condition its weight is rather low (a fact obscured by Lang whose statistics exclude all bronze weights) and can be compared with early bronze weights in other series that present the same disparity (cf. Dolphin A.Ia).

Gp.A.III contains weights that despite their bad condition cannot be interpreted as two-mina staters, but must be classified as some sort of mina. They appear related in weight to the possible quarter minas of A.V, and may even be related to the certain "half-mina" of A.IV. It is not easy however to reconcile this set of weights (and the mina of around 500gm it seems to indicate) with the Attic system and the Cretan provenance of the "half-mina" is possibly significant [The light -weight 415gm Olynthus wt. of Gp.A.III is only very doubtfully identified as an astragalos, and cannot anyway much alter this suggestion]. If however they are Attic they do not observe the normal Attic practice of dividing the symbol to indicate decreasing weight values.

[Group A.Ia] Dolphin, hEMISTATERON (though misread by Pernice; ≠ IG $I^2$917)
Bronze P.1 (slightly damaged)
wt. 426.6gm
context Persian sack (the weight is in the Akropolis Mus.)?

[Group A.Ib] Dolphin, MNA
P. 245-248, 252-256, 263-264; LW. 12-14, 16.
wt. 471 - 422gm
contexts c.300 BC (LW 12, 16); Hellen. (LW 14); Late Hellen. (LW 13); "Corfu" Woodhouse (P 255 [M.126]).

[Group A.Ic] Dolphin, DHMO (illustrated Michon fig.5726)
P. 243, 249, 257; also a weight cited Pernice p.62.
wt. 479.5 - 450.2gm
context. Pernice p.62 from Smyrna.

[Group A.Id] Dolphin, no legend
P. 244, 250-251, 258-260, 262; LW 11, 15 (last poor cond.)
wt. 475 - 424gm
contexts. Hellen.(LW 11); late 2nd/ early 1st (LW 15).

[Group A.IIa] Dolphin, MNA with METPO(NOMON) on P.507, LW.10; and with AΓOP(-..) on P.598-599 [see following III and V discussion]; Michon (557 n.30) cites another Dolphin METPO- from a sale catalogue but gives no details.
wt. 708 - 624
context. Hellenistic (LW 10)

[Group A.IIb] Dolphin, MNA only
P. 596, 600, 602; LW 8, 9.
wt. 741 - 632.6gm
context. Hellen.(LW 8) and late Hellen.(LW 9)

[Group A.IIc] Dolphin, no legend
P.601
wt. 634.4gm

[Group A.IId] Dolphin, MNA
P.612 (only slightly worn)
wt. 579.5gm (??)

[Group A.III] Dolphin, no legend
marble P.261
wt. 2153gm (? 5mn @ 425gm as Pernice; 4 @ 538 or 3 @ 717.6)

[Group A.IV]? Dolphin, various legends uncertain
P.268 ("Corfu" Woodhouse) ? incised ΓΙΤΞΠΑΝΞ wt.110.36gm
P.269 (from Peiraeus) ? incised ΤΥΤΓΙ wt. 91.74gm

[Group A.V]? Small dolphin, no legend
P.270
wt. 24.96gm

[Group A.VI]?? Dolphin engraved
Robinson 2420 from Olynthus
wt. 58gm
context 5th/early 4th cent (Robinson)

[Group B] Half-dolphin, HMI MN (Murray describes the type as "head of dolphin" M.129 [P.266])
P.265-266 (both Attic provenance)
wt. 225 - 223.5gm (½ minai of 450-447gm)

[Group C]?? Three dolphins, no legend
P.267 (good condition - Attic prov.)
wt. 203.4gm (? 1/3 mina of Gp.A.II, in fact of 610.2gm)

[Group D]?? Eros on dolphin, no legend
P.293
wt. 428gm (? mina of Gp.A.I)

Note: I have not treated as significant in these groups the difference between right- or left-handed dolphins: both types occur in all groups (except those of only one weight).

The dolphin does not appear on Attic Wappenmunzen or later coin (Lang p.7; Pernice GG.p.17) though it is a frequent type on coins of other Greek states. Certain non-Attic weights with the symbol can be clearly identified: Cyzicus (as inscribed), Ptolemaic (Dolphin round trident), Argive stamp (two dolphins round ? quiver on P.681). More attention than usual should therefore perhaps be paid to non-Attic provenances of otherwise unidentifiable dolphin weights: Olynthus (Rob.2420, Gp.A.VI), Smyrna (Pernice p.62, Gp.A.Ic and more likely to be Attic than these other weights), and possibly Corfu (P.268 of Gp.A.IV if not P.255 of Gp.A.Ib also). Suspicion must also fall on the odd weights and types of Gps.A.IV,V and C,D (see following). Nevertheless there remains a series of dolphin weights which by all indications can only be Attic (provenance; the peculiar technique for the early bronze weight P.1; the METPO legend in relief on weights in Gp.A.IIa). It is however worth remarking that no dolphin weights are stamped (although the series would appear to extend into the period when stamps are found on other Attic weights); this fact may simply relate to the fact that the normal dolphin weight was other than those used by Attic officials normally in their duties (see further below on stamping).

The chronological extent of the dolphin series is considerable - from the early fifth cent. (ϟ on P.1) through to the first cent. (Gp.A.Ia-d). Noteworthy is the change from "half-stater" to "mina" weight legends, a change which can be placed before the end of the fourth century (see above on Astrag.; lower fractions need not be involved at this stage). The weight standard throughout is that of the usual Attic 100dr coin mina.

Another group, A.II, also inscribed "mina" is much heavier. The main series is A.IIab and half the weights in this are also marked metronomoi or agoranomoi (on this interpretation see below). It would seem reasonable to compare the Boukranion Gp.A.I and interpret these dolphin weights as also commercial, giving a corrected coin mina of 494-416gm on the 150dr standard (again the 138dr standard would give too high a mina of 537-452.1gm compared with the coin mina of the dolphins of Gp.A.I). The contexts of the weights in Gp.A.IIab support association with the period of IG.ii$^2$.1013. The plain weights of Gp.A.IIc falls within the above weight ranges.

Also connected is the weight of Gp.A.IId, identical in type to both Gps. A.Ib and IIabc, but with a weight between the two. A single weight is hardly sufficient grounds for certainty, but I am inclined to interpret this weight as based on the 138 standard that according to IG.2$^2$.1013 preceded the 150 standard that has been argued for Gp.AIIabc On this lower standard the weight in question indicates a coin mina of 419.9gm; this, although low, is within the corrected coin mina limits of Gp.A.IIabc.

More difficult to interpret is the unmarked heavy marble dolphin of A.III. By weight it can belong to any of the three standards so far certainly attested (100, 138 or 150 coin drs to the mina), but unmarked it should best be assigned to none. Pernice only notes its provenance as "possibly" Attic. I prefer to omit it entirely.

The remaining dolphin groups show variations in type. Only one, Gp.B, bears a readable weight legend; this is unmistakeably "½ mina" and corresponds to the half-dolphin type (a corresponsion parallelled in the Amphora, Tortoise and Crescent weights to be analysed below). The weight is in line with the normal coin mina of the largest whole-dolphin group, A.Ib, that is similarly marked mina. Lang's comment that these weights are "exceptional and outside the ordinary system" (p.7) is unjust criticism of a group that is twice as substantial as each of the early fifth-century weight groups.

Group C, with three dolphins, should on the Attic principle of types represent three of some lower unit, ie. of around 67.5gm. This falls within the range for 16drs. (see elsewhere, apparently there were no 15dr.weights) or could be regarded as one tenth of the heaviest dolphin Gp.A.IIa. Neither makes much sense and the weight, P.267, which has no provenance, is probably not Attic.

Group D, though falling within the normal dolphin mina range of Gp.A.I and so included by Lang in her statistics (ex n.29 p.15), has neither inscription nor provenance. It is clearly late, and should be disregarded.

Other dolphin weights not covered by this survey are: P.268 269 (Gp.A.IV), and 270 (Gp. A.V). Neither in weight nor in type do they form part of the main Attic series already identified; the legends of Gp.A.IV may when deciphered offer some explanation, but at present these groups cannot be located within or anywhere outside the Attic series. Gp.A.VI, clearly not Attic, may simply be Olynthian (qv).

[Group A.Ia] Amphora, TPITH(MOPION) or TPIT(--)
P.21-22,24,26-27,30,33-40,45; LW.17-18; Pnyx 1; P.727
wt. 325 - 276.1gm (peak around 300gm: see graph - c.900gm stater)
contexts. late Hellen. LW.17 (with DIONYSOS METPONOMOI stamp);
P.727 from Aegina.
amphora type (where recoverable) Early Panath.III

[Group A.Ib] Amphora, TPI(THMOPION)
LW.20
wt. 301gm (903gm stater)
context 4th/3rd/2nd cent.
amphora type Early Panath.I

[Group A.Ic] Amphora, no legend
P.18-19,23,28-29,31,41-42,44 ("Corfu"); LW.19; Pnyx 2 (though I can see ?DEMO so possibly this belongs to Gp.A.Id);
Munich weight AA 28 (1913) no.18a.
wt. 337.9 - 276.1gm (disposed as Gp.A.Ia)
context 4th/3rd/2nd cent
amphora type (LW 19 only noted) "plump" (Lang)

[Group A.Id] Amphora, DEMO (never DHMO, contrast Dolphins)
P.25,32,(?43); LW.21; (?Pnyx 2: see above Gp.A.Ic).
wt. 301.9 - 298gm (again thirds of a stater c.900gm)
amphora type Early Panath.I

[Group A.II] Amphora, HMI- or HMIMN(AION) and on P.97 AΓOP AQ NO HMI (??)
(on which see below sect.V.2, and illustr. in commentary)
P.96,97; LW.30.
wt. 375 - 335.4gm (mina of 750-670.8gm)
context 1st cent BC (LW 30)
amphora type Late Panath (LW 30); Early Panath III (P.96-7 see Lang p.8).

[related ? to Gp.A.II] Amphora, HMI- and METPO(NOMOI)
BN Babelon-Blanchet no.2233 (illustr. following in commentary from Michon).
no other details at present known - apparently this weight also bore a stamp.

[Group A.IIIa] Amphora; TPITH(MOPION)
P. 98-99
wt. 211.4 - 207.4gm (giving thirds of 634.2-622.2gm)

[Group A.IIIb] Amphora; TPITH(MOPION)
LW. 22-23 (condition described as good but "thin"by Lang)
wt. 170 - 121gm (thirds of 510 and 363gm)
context first cent.BC (LW.23); amphora types both Early Pnth.III

[Group A.IV]? Amphora; D.MO (second letter uncertain)
P. 83 (Murray no.93 describing type as whole amphora) "from Corfu" Woodhouse.
wt. 192.8gm (if Pernice is not right to call this a "half-amphora", where its weight naturally places it [see provisional Gp.B.IIc], this is not part of the main Attic series).

[Group A.V]? Amphora; no legend
P.111 wt. 126.935gm

[Group A.VI]?? Amphora in wreath (with DEMO and uncertain stamp on P.104 only)
P.104 - 107
wt. 64.02 - 55.18gm

[Group A.VII]?? Small type amphora (probably Chian); no legends
P. 108 - 109 (both "from Corfu" Woodhouse)
wt. 38.85 - 26.87gm

[Group B.Ia] Half-amphora; HMITPITON (doubtful on the poor condition P.110)
P. 47,(52),55-6,59-61,64,73,(110);
Pernice p.62 from Smyrna (and the heaviest weight of the group);
LW. 25-6,29.
wts. 168.11 - 136gm (127.22gm) (sixths of stater 1068.66-816gm)
contexts fourth cent.(LW.26,29); Hellenistic LW.25, but of the same, or closely similar, mould as LW.29.
Type-amphora: early Panath.I (LW.26), II (LW.25,29).

[Group B.Ib] Half-amphora; HMIT (presumably as before sixths; but eighths possible)
P. 67,74; LW. 24,28
wts. 158.5 - 134gm (? sixths of 951-804gm)
contexts both Hellen., LW.28 mid-second cent.
amphora types Early Panath.III (the latest of all Gp.B.I)

[Group B.Ic] Half-amphora; DEMO
P. 51,53,58,70-1,72 ("from Corfu" Woodhouse); LW. 27
wts. 159 - 143gm (? sixths of 954-858gm)
context Late Hellenistic LW.27 amphora type Early Panath.I

[Group B.Id] Half-amphora; DEMO and HMITPI(TON)
P. 54,66,69
wt. 157.5-143.7 (sixths of stater 944.8-862gm)

[Group B.Ie] Half-amphora, DHMO
bronze BW.4 (poor condition)
wt. 112gm (?? sixth stater 672gm)
context Hellenistic
amphora type Early Panath.II

[Group B.If] Half-amphora, DHMO and D[-]MO
P.50,63
wt. 159 - 152gm (? sixth stater 954-912)

[Group B.IIa] Half-amphora, TETAPTON; legend METRO(NOMOI) on LW.31, ?32.
P.81; LW.31-32.
wt. 212.4 - 183.5 (quarters of mina 849.6-734gm)
contexts. Late Hellen. and 1st cent BC.
amphora type Late Panth.

[Group B.IIb] Half-amphora, no legend
P.82,84-85 ("Corfu" 85).
wt. 198.6 - 191.2 (within the range of Gp.B.IIa)

[Group B.IIc]? Half-amphora, D[-]MO. This group is identical with A.IV.
P.83 ("Corfu")
wt. 192.8gm (also within the range of B.IIa)

[Group B.III] Half-amphora, various legends:
P.100 marked TAPTHMOPON wt.172.4gm, so mina 689.6gm
P.102 marked DHMO wt.174.9gm, ..... 699.6gm (?)
P.103 unmarked wt.171.8gm, ..... 687.2gm (?)
P.101 uncertain legnd. wt.182.74gm, ..... 730.96gm (??)

[Group B.IV] Half-amphora, TETEPTON
LW.33 (condition good but "thin": compare Gp.A.IIIb)
wt. 99.5gm
context - ; amphora type Late Panath.

[Group B.V] Half-amphora, ? [H]MI[SY] P.87, and unmarked P.86
wt. 117.9 - 106.6gm

[Group B.VI]? Half-amphora, HMI[-- (?)
P.46 (fair condition)
wt. 289.2gm

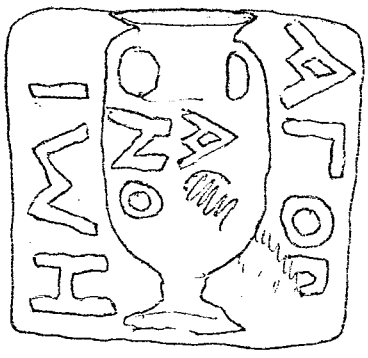
[Group C.I] Quarter-amphora, various legends:

| | | |
|---|---|---|
| P.88 | marked DEMO | wt. 105.82gm |
| P.89 | ,, HMIS | wt. 101.33gm |
| P.90 | unmarked ? | wt. 96.61gm |
| P.91 | marked HMIS | wt. 91.23gm |
| P.75 | unmarked | wt. 85.59gm |
| P.76 | HMYSIHMITPIT(ON) | wt. 84.15gm, so stater 1009.8gm |
| P.77 | [DE?]MO | wt. 79.79gm |
| P.78 | unmarked | wt. 76.81gm |
| P.79 | ,, | wt. 76.79gm |
| P.80 | marked HM[-]S | wt. 75.1gm |

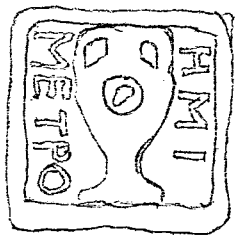
weight range 105.8 - 75.1gm

[Group C.II] Quarter-amphora, various unmarked
P.92-95
weight range 58.38 - 51.81gm

Identification of this series as Attic is based on provenance (only two weights come certainly from outside Attica - P.727 [Aegina] and that noted by Pernice p.62 [Smyrna]) and the fact that a fair number bear stamps : OWL (LW.26 of B.Ia; P.32 of A.Id); ROSETTE (P.30 of A.Ia; LW.28 of B.Ib); SHIP'S PROW (P.77 of C.I); CORNUCOPIA (LW.28 of B.Ib - doubts could be raised as to the Atticism of this second stamp on the weight: see elsewhere); KALATHOS/ OLIVE WREATH (LW.27 of B.Ic); DIONYSOS METRO (LW.17 of A.Ia); CICADA ? (P.99 of A.IIIa); AMPHORA (LW.33 of B.IV). As a type in itself the amphora is clearly too general although the shapes represented in the main groups are identifiable as properly Attic (cf. Lang's dating and contrast the amphoras of Chian weights, possibly included here under A.VII if not concealed in other groups also). Fabric, marking and in most cases weights are consistent with the Attic weight system as a whole. The weight in Gp.A.IV awaits further clarification; those in Gps.A.V-VII and B.VI are unlikely to be standard Attic weights but none can as yet be securely located elsewhere (compare the Tortoise in wreath Gp.A.IV with Gp.A.VI).



P.97 drawn from CIG 8536b Taf.XI
My Amphora Gp.A.II.
Early Panathenaic Amphora III (Lang)
[? scale]



BN Babelon-Blanchet no.2233 drawn from Michon DS sv pondus fig.5742
[? scale]

These amphora weights form the second largest series of Attic weights. While I have divided them by type (whole, half, quarter) and weight, a more direct indication of date has been used by Lang from the actual amphora types, which can be divided into Early Panathenaic I, II, III and Late Panathenaic on Beazley's criteria. The difficulty however is to decide how reliable this stylistic criterion is for dating the weights, and correlation with context where this is available is not promising:-

Early Panath.I: LW.20 (4-2nd cent);21;26 (second ½ 4th cent);27 (Late Hell.)
..... II: LW.25 (Hell.); BW.4 (Hell.); LW.29 (340-310 BC)
..... III: LW.17 (Late Hell.);22;23 (1st cent);24 (Hell.);28 (mid 2nd).
Late Panath.: LW.30 (1st cent) also 32; 31 (Late Hell.); 33 (?)
"plump" (?) LW.19 (4-2nd cent)

There is also some confusion in Lang's own position; on p.8 she starts the new "Late type Panathenaic" in the fourth century reaching the exaggerated form with New-style coins in the third, whereas in n.16 she places the start of this coinage, correctly, in the second century; her whole dating scheme might therefore need reducing in that it relies on the amphora dating (p.7 n.13).

I am inclined to treat the style of amphora in the first place only as evidence of in fact the earliest possible date for any particular weight (just as context properly only indicates its possible currency. The two often seem to go together as with LW.26 (E.Pan.I and 4th cent context), but there is room to doubt whether LW.27 (E.Pan.I but Late Hell. context) should be placed in the same period (though on other more general grounds of weight it is clearly of the same series as the earlier weight). Important here is Pernice's weight P.97, that is in fact said by Lang to be E.Panath. type (p.8) and to show by its association with the heavy mina (and marked "AΓΟΡ" this is tempting; but see discussion below ch.I.1.(1)-V and esp.chapters IV-V .) that there was a 150 standard in the fifth century pre-Teisamenos. This is impossible, for not only is the dating on amphora style alone itself unreliable for the reasons I have given, but the lettering on thisweight, that Pernice accurately reproduces (compare illustration drawn from CIG.8536b.Taf.XI), is very late, if not Roman period and the possible reading of magistrate names (but doubtful ) is a feature found first on the New-Style coins.

The greater number of amphora weights can be immediately divided into two groups, or entirely different weight systems. The first group consists of fractions of a stater ranging from 1009 to 804gm; these fractions are thirds (so marked on Gp.A.Ia,b with associated by weight A.c,d), sixths (marked Gps.B. I.a,b,d the rest associated by weight with the exception of BW.4 in Gp.B.I.e on which see further below), and at least one marked twelfth (P.76 in Gp.C.I). All these weights bear Early Panath. types of amphorae as far as can now be told from Pernice and Lang, and as a series can be started in the late fourth century on the strength of the sixths LW.26, 29. In every case the fully written weight legend is associated with earlier contexts than simply "Demo(sion)" or no mark. The lightweight BW.4 is noted by Lang as being in poor condition, and most likely does belong to this series as it is even more under weight for the others.

The second group consists basically of fractions of a mina approx.750 - 670 gm.; these fractions are halves (marked "hemimn(aion)" Gp.A.II and possibly certain unmarked weights of A.I.c, especially the upper half of that gp.), and quarters (Gp.B.III is constructed round the one marked weight P.100 "gut erhalten at 172.4gm). There may be further fractions in the general series C.I but they cannot be identified, and the greater part of that group with "hemis-" seems to be twelfths "hemis(yhemitriton)" rather than the other possibility of sixteenths, "hemis(yhemitetarton)", as there are no intermediate ½ths. All the recorded amphora types in this group are Late Panath. and the context that is known is also Late Hell. (LW.30 first cent BC). That the heavy mina of these weights is the commercial mina of 150drs. mentioned in IG.2².1013 is a likely inference: the weights then imply a corrected coin mina of 500-447.2 (Gp.A.II) and 459.76gm (for P.100 in Gp.B.III), so 138drs (543.5-486gm) would be too heavy.

METPO(NOMON) legend appears on weights in a rather heavier group of quarters (my B.IIa with associated groups within its weight range of 212.4-183.5gm). The recoverable unit for this group is 849.6-734gm and so lies either at the lower limit of the stater of my first class of amphora weights, or is somewhat above the mina of my second class (itself on the 150 standard). If the weights of B.IIa are stater fractions they clearly form an intermediary series, with changed fraction-system, between the 4-3rd cent stater thirds and the late 2-1st cent heavy mina quarters. I am more inclined however to take them as in fact also quarter heavy minas, and so to disregard their weights (part of the point of this analysis is after all to discern how secure a guide the weights themselves are). My reasons are (a) both context dates and amphora types of B.IIa are as late as my second class, first cent BC and no earlier than second cent for types; (b) the metronomoi legend on LW.31 (and traces on LW.32) plausibly indicate commercial standard officially controlled (as from IG.2$^2$.1013: see also footnote on first cent BC metronomoi stamp on the earlier weight LW.17); (c) although the half-minas of A.II apparently last quite a long time, there are extremely few quarters (corresponding half-amphorae) in the presently related Gp.B.III; the quarters of B.II would fill this gap. Indeed, (d), the weight problem is not necessarily so awkward: taking the whole range of B.IIa we get an absurdly high corrected coin mina on the 150 standard of 566.4-489.3gm (there is no literary evidence for a commercial st. higher than 150, nor is this group yet reason for supposing it); if however the top weight (P.81) is omitted the corrected range becomes more reasonable - 529.6-489.3gm - the officially marked weights lie at the bottom of this range, and of course all errors have by our calculations been at least tripled (see general comments on this). A final argument (e) which I advance perhaps rashly here, is that the METPO legend appears to be common both to Gp.BIIa and BB 2233, a weight which seems (see illustration) to belong to Gp.AII. Confirmation of the weight of this weight would of course be necessary to clinch the argument, but the concurrence of stamping on LW.17 (see NOTE 1 below) is encouraging. All should then be placed in the post IG II$^2$ 1013 period.

There remain a considerable number of unplaced amphora weights. Several are unmarked (P.101?, 104-9, 110-1); groups marked simply as halves I have placed as B.V and B.VI (though the weight of the latter is more than twice that of the former even though the symbol is the same half-amphora). More important, as more clearly marked, are three groups A.IIIab and B.IV, two of which have been suspected by Lang as "tampered with in antiquity"; this may well be the case as also of the "third", A.IIIa (I attempt a discussion on the possible interpretation of the weights in these small groups below: the conclusions however are entirely hypothetical). Two quarter-amphora ranges may contain further subdivisions of the main groups already discussed but only four weights in them are at all marked (and have been interpreted as twelfths of the first amphora class).

NOTE 1: Metronomoi stamp (Lang dates early 1st cent coin type: and see also discussion below on stamps in general) on the amphora wt. LW.17 of my first group (A.Ia). The problem caused by this stamp is also reflected in the late Hellenistic context of the weight which on all other grounds should be assigned to the early amphora series, with thirds and sixths of stater, rather than the quarter and half minas (heavy) that properly appears dated to first century BC. If this difficulty is thus correctly formulated, the weight in question, at 325gm (and in fact the heaviest of Gp.A.Ia), could be taken as the half mina (heavy) as my Gp.A.II (it would give a corrected "coin-mina" of 433.3gm). The metronomoi stamp may well then have been thought sufficient to indicate its belonging to the late series. It has thus in effect been brought into line with the METPO legends (AII rel, BIIa).

NOTE 2: Thirds of Gps.A.IIIab and Quarter of Gp.B.IV. All these weights are lightweight, and the question arises whether they indicate further amphora series or, as Lang has suggested from the thinness of the Agora weights, whether they are false weights, tampered with in ancient times. First it should be noted that, weight apart, these groups lie by symbol, amphora type, and legend straightforwardly in the main amphora series (Gps.A.IIIab with the first, Gp.B.IV with the second later series of Late Panath. type amphorae quarter-minas). The present weights of A.IIIa are thirds of a unit which, at 634.2-622.2gm, is apparently a heavy mina, and would correct to 422.8-414.8gm (on the 150 standard) or 459.6-450.9gm (on the 138 standard). That both standards are possible is convenient, as it allows this group to be set early second cent. after the change to mina unit base and in the period before IG.2$^2$.1013 when the 138 standard (otherwise rarely found) was in use. Gp.IIIa therefore follows naturally on from A.I and it seems that the third fraction was more closely associated with the amphora type than its weight.

A.IIIb contains two widely separated weights, 170gm and 121gm; their context (that of LW.23, the lower weight, only) is first century, belying the Early Panath. ~~amphxxxxx~~ III. amphora type, and not corrected by any stamp as on LW.17 of NOTE 1 above. The unit of which these are marked thirds, 510-363gm, if anything is the normal, non-commercial coin mina. Again a single change has occurred from A.IIIa if these two weights of A.IIIb now represent thirds of the coin mina, rather than commercial mina of the 138 standard. The date then can be later in the second century without doing too much injustice to either context or amphora type.

Another stage is possibly shown by the quarter of B.IV, which at 99.5gm is again a fraction of the coin mina (though high at 497gm). The Late Panath. amphora type would indicate a slightly later stage than A.IIIab, and furthermore the fraction system change to quartering (and so we could infer also halving with unattested whole amphora weights) the mina leads naturally onto the second main series of amphora weights than treats the heavy (150dr) mina in just this way and which is entirely found with Late Panath. amphora types.

In favour of this hypothetical interpretation of these weights is therefore the documentation it provides for the change in amphora weights from thirds of the stater to quarters of the 150dr mina between the early second and early first centuries BC. About the only support for my interpretation is the good condition of the weights involved apart from their thinness that Lang noticed. This thinness is itself odd, for the weight and size variation of these groups can hardly have escaped notice in antiquity. To what end were they tampered with if this was in fact the case ?

The amphora series of weights can now be summarised, with these doubtful groups in square brackets:-

| | | |
|---|---|---|
| 4th-3rd cents. | thirds, sixths, twelfths of stater | Gps.A.I, B.I, some of C.I |
| [early 2nd.c. | thirds of 138dr mina | Gp.A.IIIa ] |
| [late 2nd.c. | thirds of coin mina | Gp.A.IIIb ] |
| [later 2nd.c | (halves ?), quarters of coin mina | Gp.B.IV ] |
| end 2nd-1st c. | halves, quarters of 150dr mina | Gps.A.II, B.II-III |

NOTE 3: "Demosion" weights of heavy standards. It will be seen from the final table (and also from the graphs in Appendix F) that the heavy standard weights usually do not bear the legend "demosion", but instead are marked, if at all, METPO or AΓOP. Exceptional are those Amphora weights in Gp.BIIc (P.83) and BIII (P.102) that I am assigning to the 150dr standard. It is true that they lack denomination legends, but their weights, 192.8 and 174.9gm, are impossibly high for the normal 100dr standard on any of the systems of subdivision attested for the Amphora series as a whole. Besides it is more difficult to argue official weights out of the main series (as was possible with the odd weight of B.VI). As the Amphora series has still many associated, but unclassifiable weights (especially those, in fact, marked "demosion" in Gp.CI - and see further below in following analysis on how little this legend seems after all to guarantee), some room for manoeuvre may still remain, and a further sub-group may yet become recognisable to remove these "demosion" weights from where I have at present placed them.

TURTLE/TORTOISE

[Group A.Ia] Turtle; hEMITPITON DEMOSION AΘENAION
bronze BW.3
wt. 126gm (sixth of stater 756gm, and in good condition)
context c.500 BC.

[Group A.Ib] ? Tortoise in all wts (Pnyx 4 certainly); no clear legend
P.200-208,(731 bronze from Euboea); Pnyx 4.
wt. 161.7 - 140.1gm (? sixths of 970.2-840.6gm or thirds of mina 485.1-420.3gm)
context "fifth-fourth cent" (Pnyx wt).

[Group A.IIa] Tortoise; TETA, TETAPTO, or TETAPTH
P.112,114,117,123,132,(134),136,139,142-3, 746 (from Naxos); LW. 34,37-38.
wt. 302gm for LW 34, the rest lie within 260 - 208.5gm (quarters of stater 1208gm and 1040-834gm)
context 375-350 BC (for heavy LW.34); 4th cent also (LW.37); Hellenistic (LW.38).

[Group A.IIb] Tortoise; no legend
P.113,115,119-120,122,127,131,137; LW.35-36,39-44.
wt. 251 - 217gm (? quarters of 1004-868gm or ½-minai 502-434)

[Group A.IIc] Tortoise; DEMO, DHMO
P.116,118,124-126,129-130,133,135,138,140-141; Pnyx 3.
wt. 235 - 210.6gm (? quarters of 940-842.4 or ½-minai of 470-421.2gm)
context 5th/4th cent (Pnyx 3).

[Group A.IId] Tortoise; legend uncertain - [de]MO[sion ?]
P.144-145
wt. 186.5 - 185.7gm (?? as Gp.A.IIc, though light).

[Group A.III]? Tortoise; no legend (Lang p.15 n.29 identifies type).
bronze P.209 from Athens (fair condition, but with accretion)
wt. 71.1gm (Lang ibid discards as "unparalleled"; Pernice notes careless work).

[Group A.IV]? Tortoise in wreath (cf.Amphora Gp.A.VI); ? legend.
Two round weights noted by Michon (553 n.4); no details.

[Group A.V]? Tortoise on rectangular lead weight (? from Athens)
P.230
wt. 89.87gm

[Group A.VI]? Tortoise on round bronze weight (? in fact weight)
P.231
wt. 43.48gm

[Group B.Ia] Half- ? Tortoise; HMYSYHMIT(P)[iton].
P.211,214.
wt. 88.2 - 82.6gm (twelfths of stater 1058.4 - 991.2gm)

[Group B.Ib] Half-tortoise; no legend (or DHMO on P.216 at 81.9gm).
P.212-213,215-226; LW.49; bronze P.227.
wt. 87.8 - 61.7gm (? twelfths of 1053.6-740.4gm or sixths of mina 526.8-370.2gm); the bronze wt. is the lightest.
context. Hellenistic (LW.49, at 67.5gm).

[Group B.IIa] Half-tortoise; EMITET, EMITETAPT, etc and HMITE etc.
P.146,153,156-157,(158),160,164-166,170,174,176-178,183, 185; LW.45,47.
wt. 132.8 - 105gm (eighths of stater 1062.4-840gm; the low range from LW.45,47, described as "poor" and "fair" condition)
context. mid 4th cent. LW.47; 3rd cent. LW.45.

[Group B.IIb] Half-tortoise; DEMO/ or DHMO/ HMITE.
P.(147),152,169,180,188-189,197.
wt. (132.1gm) 120.7 - 104gm (eighths of stater [1056.8gm] 965.6-832gm).

[Group B.IIc] Half-tortoise; no legend.
P.148 ("Corfu"),149,151,154-155,159,171,187,195,(198), 696 (from Thebes)
wt. 124.4 - 108.8gm (? eighths of 995.2-870.4gm, or quarters of minai 497.6-435.2gm).

[Group B.IId] Half-tortoise; DEMO or DHMO, plus incision on Kroll A.
P.150,161-163,167-168,172-173,175,179,181-182,184,186, 190-194,196,199,693 (from Peloponnese); LW.46,48(with broken corner); bronze Kroll A (at 104.43gm).
wt. 121.2 - 99.8gm (? eighths of 969.6-798.4gm or quarters of minai 484.8-399.2gm).
context. 4th cent (LW.46 at 108gm); AΘE OWL stamps on Kroll A probably indicate 4th cent.

[Group C] Quarter- ? tortoise; no legend.
P.228-229.
wt. 36.4 - 35.2gm (?? 1/24th of 873.6-844.8gm or twelfths of minai 436.8-422.4gm).

Despite the obvious parallels with Aeginetan coinage (even in the change from turtle to tortoise that apparently occurred in the fifth century: see analysis following), and despite the fact that no weights have yet been attributed to that island (see Aegina in ch.I.1.(2)-III below), there can be no doubt that this series is in fact Attic. Some weights it is true moved outside Attika: P.731 (Euboea), P.746 (Naxos), P.148 (doubtful as "from Corfu" - ie.the Woodhouse collection on Corfu), and P.693 (Peloponnese). The vast majority however appear to have been found in Attika, or Athens. More decisive as proof is the clearly-marked bronze weight of Gp.A.Ia, and the stamps which appear on a number of other weights: ATHENA ? (LW.46 of Gp.B.IId); OWL (Kroll A and P.182, also of Gp.B.IId; Pnyx 3 of Gp.A.IIc); BOAR'S HEAD (P.185 of Gp.B.IIa); STRIDING PIG (P.120 of Gp.A.IIb); KALATHOS/OLIVE (LW.48 of Gp.B.IId again); ROSETTE (LW.45 of Gp.B.IIa). Note however that the Seleucid HORNED HORSE-HEAD stamp appears on P.158 (Gp.B.IIa), though the provenance is suggested as Athens. Further confirmation of Attic origin lies in the shape of the series as a whole and its obvious cohesion (despite changes of weight values). As untypical, I have noted four groups (based on almost as many weights): A.III-VI; no obvious identification for these is apparent, unless Gp.A.IV (comparing the Amphora Gp.A.VI) is in fact Aeginetan.

The Tortoise weights constitute a major series. Problems surround the chronology of the series even though it can without difficulty be divided into two distinct weight groups straightforwardly corresponding with the two fraction systems shown by the legends. These groups are first sixths and twelfths (marked Gps.A.Ia,B.Ia and associated unmarked AB.Ib) and here should best be set as a 1/24th the unmarked quarter-tortoises of Gp.C (which otherwise should by its symbol be a 1/16th in the next group and so far too light, giving a stater of 582.4-563.2gm although Pernice expressly notes that the first weight is "tadellos erhalten, nur unten eine kleine Bestossung"). The second group is the larger, comprising marked quarters and eighths (Gps.A.IIa, B.IIab) and many associated weights (Gps.A.IIb, B.IIcd though some overlaps may be apparent from weight alone they are ruled out by symbol differences). All the marked weights of both groups are subdivisions of a large unit that must be the stater rather than heavy mina, and the weight ranges would indicate that only one stater standard is involved (overall naturally exaggerated at 1208gm (LW.34) to c.740gm (P.227 bronze) and 756gm (BW.3 also bronze) though the greater number of reconstructed staters probably lies between 1000 - 900gm).

In ordering these weights chronologically an immediate difficulty is that they should properly be divided between tortoise and sea-turtle symbols whereas Pernice, seeing no weight differences between the two types, does not distinguish them in his lists (see GG.p.35). Lang makes much of the distinction: she compares the similar change in Aeginetan coinage and thereby dates the turtle-tortoise change on weights to the period 446-431 BC of the coin-type change (citing Robinson NC 7(1961)110-2); she then uses the association with Aegina to develop the hypothesis that the turtle/tortoise weights were specially meant for use in converting Attic to Aeginetan weights (see detailed section pp.8-11, note p.9 "Both for ease of commerce with Aegina and for the sake of conservative Athenians who had grown accustomed to Aeginetan weights, Solon [sic] may well have arranged to symbolise the new relationship by putting the Aeginetan turtle on a fraction of his new stater which was equivalent to some part of the Aeginetan mna"). This last hypothesis is clearly far-fetched and need not be considered seriously here. If the conversion piece was as important as Lang makes out it is difficult to explain its disappearance from the Attic system before the mina became the normal unit for subdivision; besides the similarity of type with Aeginetan coin may be entirely coincidental (see other weight symbols for which Lang is over-anxious to identify a source; but from where does the Attic owl come ?), and the change from turtle to tortoise is certainly an Athenian change (made in the period of Athenian control of Aegina) and whatever its reasons they did not concern weight (as the Aeginetan standard resumes unaltered in the later tortoises). Even apart from the general improbability of Lang's conversion-piece hypothesis (for this I rely on the greater part of this whole thesis), there is no plausible argument to support it in detail.

It nevertheless seems reasonable to accept the parallel of Athenian-control led Aeginetan coinage and date the change of type on the weights to the same period, 446-431 BC. All turtles should therefore be before this period. At this point the inadequacy of Pernice's descriptions becomes serious. Lang's general picture seems clear: turtle sixths and twelfths according to her changed to tortoises during the fifth century, and then this system was revised in the early fourth century so that tortoises became quarters and eighths prior to the adoption of the lower mina unit for subdivision (see general conclusion for this). Lang states categorically that there are no turtle quarters and eighths, but her claim for turtle twelfths (half-turtles that is) is supported by no references (p.8), no half-turtles are listed in her Agora weights, and no turtles at all are said to be taken from Pernice's weights for her table on p.15. This last might seem to imply that she has taken all Pernice's weights as tortoises, which on Pernice's own declaration they are not (GG.p.35). Nevertheless it remains unclear to me that there are any half-turtles.

If there are no half-turtles my next point is considerably strengthened, although it does not rely on this somewhat provisional fact. Though Lang places all sixths and twelfths before the fourth-century quarters and eighths, I should prefer to divide the first group and place (see Pnyx weights 5/4) probably the greater part of it after the quarters and eighths. My reasons are as follows:-
(a) While the one certain turtle (BW.3) is firmly dated by context to c.500 BC, at least one half-tortoise (LW.49) was found in a Hellenistic context though belonging to the sixth/twelfth system of the earlier weight. As this weight LW.49 bears no legend its currency in this late period after tortoises have symbolised quarter/eighths should imply a resumption of the earlier system (though a single context could be deceptive, the vast gap involved here makes the survival of an outdated weight so confusingly close to those in current use extremely unlikely).
(b) Though the number of turtle/tortoise sixths and twelfths is not large, it is still more than seems likely for weights used only in the fifth century which in other series are usually represented by solitary specimens.
(c) Early (c.500 BC or other fifth-century contexts) weights appear generally with very full weight legends; this is exemplified by the early turtle sixth (Gp.A.Ia) and might be extended to the marked twelfths of Gp.B.Ia (though these use H for E and four-bar sigma which in addition to doubtful type turtle/tortoise makes me hesitate). The larger groups A.Ib and B.Ib are unmarked, and in the latter comes LW.49 with Hellenistic context.

The development of this series of weights can therefore be provisionally set out as follows.

first period Early fifth century lasting to late fifth century if the marked twelfths are to be set here -Gps.A.Ia, B.Ia plus certainly any of AB.Ib that are turtles); only the bronze turtle of Gp.A.Ia can at present be definitely assigned to this period, ie. sixths of stater.

second .. Early 4th or late 5th (depending on Shield) to Hellenistic are the marked quarters and eighths of Gps.A.IIa, B.IIab; the lower limit is the introduction of the mina unit base (probably c.200 BC). Also some unmarked weights of AB.II (as LW.46 with fourth-cent.context).

third period (here alternatives must be proposed depending on the date of the marked twelfths of Gp.B.Ia, for if these are late the reversion to sixth/twelfth division must precede the mina period)
either change of marked quarter/eighths of stater to unmarked half/quarter minas (greater part of Gps.A.II.bcd, B.II.cd.)
or reversion to sixth/twelfths of stater soon changing to third/sixths of mina (taking Gp.B.Ia here, then Gps.A.Ib, B.Ib).
The date of both alternatives is around the introduction of the mina base (say c.200 BC). But the first alternative is preferable.

On the first of these alternatives a fourth period is required for the reversion to the ~~third~~ sixth/twelfth system of the unmarked Gps.AB.Ib, though now, post c.200 BC, these should be third/sixths of the mina. The group is small, and possibly did not outlast the standard changes made in the next few years.
It is not possible to assign the quarter-tortoise (?turtle) Gp.C more precisely than to the third/sixth/twelfth series (to which it must belong by weight).

It must be emphasised that this account is extremely tentative (and also uncertain, though largely through uncertain identification of turtle/tortoise type). I should find the change from turtle to tortoise certainly easier if I could be sure there are no tortoises in my first period. In general however the arrangement proposed here for turtle/tortoise weights will be found to combine remarkably well with the amphora series that is so similar in changing its fractional system (see concluding table below, and also Shield series).
A final point to note here is the extreme variation permitted on what has been identified as a single weight standard. All bronze weights of the main groups are rather lightweight; that of Gp.AIII (unmarked P.209) unclassifiable, and so doubtfully Attic (because of its whole tortoise symbol: again compare the bronze Shield weight BW.2).

[Group A.I] Shield; TETAPTE(MOPION) ΔEMOΣION AΘENAION
bronze BW.2
wt. 190gm (good condition; quarter stater 760gm)
context c.500 BC

[Group A.IIa] Shield; TETA
P.233
wt. 231.14gm (quarter of stater 924.6gm)

[Group A.IIb] Shield; no legend
(1) normal type (with insets) P. 232, 235-6, 239
(2) round shield P. 234, 237-8
wts.231.7 - 211gm (? quarters of 926.8-844gm)

[Group A.III] Shield; no legend
noted AA.28(1913) no.18b in Munich (inset type)
wt. 110gm (? eighth of 880gm)

The pedigree of this small series would appear to be established beyond doubt by the legend of the first weight and the fact that all provenances where known are also Athens. Disquieting however is the variation in weight (to be discussed below) which in fact isolates the first weight, and the slight variation in type of shield (though this is confined to the largest, and so possibly the chronologically longest, group A.IIb and contained there within the weight limits of the normal inset type). The symbol is not found on the Wappenmunzen but the parallel with coins of Salamis that Pernice notes (GG.p.18) and Lang developes (p.12 using the subjection of Salamis in the first half of the sixth century as a reason to place the series early) seems to me to me rather too tenuous. None of the weights bear stamps, nor is the symbol treated to the systematic subdivision found on other series.

The peculiarities noted in this attempt to locate the series may plausibly be attributed in part to what appears to be its early date - of the bronze weight by context and lettering and of at least the marked lead weight of A.IIa by its clearly belonging to a stater based system just as the first weight. The small size of the group further confirms this impression. I am therefore inclined to follow Lang in placing this whole series before the end of the fifth century when tortoise"quarters"would take its place. [The possible similarity of type is however not an argument if there were contemporary turtle sixths in the fifth century].

The weight variation is remarkable, even though it is paralleled between early bronze and later lead in other series. To a certain extent it is over-exaggerated by comparison of stater projections (see elsewhere on precision). [Nevertheless the possibility of an extended shield series into the fourth century (and considerable down-dating of the tortoises placed there) could also be considered.] All the lead weights form a coherent sequence, albeit unsignalled, of quarters and eighths that fits neatly into the suggested reconstruction of Attic weight system in the fifth century.

CRESCENT (and Cornucopia)

[Group A.1] Crescent; some uncertain legends on 336,343; 335 ΣIK; bronze only P.341 (wt 110.36); P.344 "from Corfu" Woodhouse.
P. 335-344
wt. 122.6-105.7gm (quarter mina 490.4-422.8 or eighth stater 980.8-845.5gm ?)

[Group AII] Crescent; miscellaneous untypical weights
LW.50 (poor condition "crescent weight" 46gm)
LW.58 (cut down to a marked 12drs 53gm)
P.390 (prov. ? Athens 58.75gm)

[Group A.IIIa] Crescent; EXHM(OPON)
P. 346-7, 356
wt.84.9 - 79.7gm (sixths of mina 509.4-478.2gm)

[Group A.IIIb] Crescent; no legend but some weights marked with pentagram (348,350-2,354-5,380) or star (369,375,386) [see sv.stamps]; P.388 (Woodhouse "from Corfu") bears the legend ΔAMO but it is unclear whether incised (as on P.687 sv.Sicyon and Corinth) or relief (in which case the weight should not appear here; P.383 is also Woodhouse "from Corfu".

P. 345, 348, 350-2, 354-5, 357-60, 363, 365, 367-9, 372, 375, 378-80, 382-3, 386, (388)
wt. 88.5 - 66.6gm (63.21 for P.388) (? sixths of 531-399.6gm)

[Group A.IIIc] Crescent; DEMO, DHMO (with pentagram on 366); P.385 Woodhouse "from Corfu".

P. 349, 353, 361-2, 364, 366, 370, 373-4, 376-7, 381, 384-5,387
wt. 83.2 - 65.9gm (? sixths of 499.2-395.4gm)

[Group B.Ia] Half-crescent; HMIS- (on symbol see also Lang p.12)
P. 307
wt. 60.9gm (sixteenth of stater 974.4gm)

[Group B.Ib] Half-crescent; OΓΔO, OΓΔOH, OΓΔOHMO(PION), or simply O (P.319); the legend on P.295 is uncertain so omitted here; several of Pernice's weights may be cornucopia.

P. (295), 310, 317-20, 328-9
wt. (66.4), 59.3 - 53.1gm (eighths of mina 476.4-424.8gm)

[Group B.Ic] Half-crescent; various legends - DEMO, DHMO, or simply D; one weight is bronze and weighed 55.63gm before, 54.8gm after cleaning (Kroll B:P.321,also under drachma class IIA as incised drachmae, also stamped sv.stamps OWL); P.733 came from Euboea but is otherwise normal (57.53gm).

P. 301, 308, 315, 733, 319, 321(Kroll B), 333-4
wt. 62.9 - 47.9gm

[Group B.Id] Half-crescent; no legend but Pentagram on 298,300 star on 299; P.728 (from Aegina) also bears legend ETOYS MH MH and the sign may be a misnoted cornucopia if the weight is Ptolemaic ?; heaviest weight P.697 is from Tanagra, lightest P.332 "Corfu"

P.697, 296-300, 302-6, 309,(728 ?), 311-14, 316, 323-7, 330-2
LW. 55, 57

wts 68.27 - 49.1gm (?? all eighths mina as 546.16-392.8gm !)
context fifth-fourth cent. LW.55 (59gm); METPO- stamp on P.323.

[Group C.Ia] Cornucopia; OKΔO (rather than OΓΔO of B.Ib above)
P. (322) (very poor condition)
LW. 51-53
wt. 88-75gm (55.7) (eighths of mina 704-600gm)
contexts second half second cent. (LW.51); Hellenistic (LW.52-3)

[Group C.Ib] Cornucopia/half-crescent ?; no legends
P. 391 (also drachma class IIB); LW.54
wts. 73.3gm and 74gm
context Hellenistic (LW.54).

[Group D]? Opposed crescents ??; no legend
P. 389 (? from Athens) wt 59.84gm

[Group E]? Two half-crescents/cornucopiae ?; relief Δ between
P.583 wt 16.07gm

Identification of the mass of crescent weights as Attic is certain for the usual reasons (provenance, types of legend, lead majority with a number of similar bronze). As Pernice pointed out the symbol is characteristic of Attic coinage, the half-moon on the usual owls not perhaps as significant as the use of crescents to distinguish by their number small fractional coinage (GG.p.17). Four whole crescent weights are said to originate from Corfu (Woodhouse) and no other provenance seems recorded from outside Athens. It would seem certain however that at least one of the "Corfu" weights (for once) had a certainly non-Attic history as marked ΔΑΜΟ (P.388 in A.IIIb); there are however doubts surrounding this weight, which must therefore be discounted in the following analysis.

The half-crescent shares much the same comment as the crescent type and clearly in many cases represents the normal practice of halving the symbol for half the weight value. The matter is however complicated by the fact that a closely similar cornucopia type has been identified by Lang on Athenian weights, although this type is also (with little noticeable difference) found on explicitly marked Syrian weights (both Seleuceia and Ptolemaic general qv.). Lang's identification is based largely on provenance, and it is perhaps rather disquieting that she can also point out the variant ΟΚΑΟ for the usual ΟΓΑΟ on other Attic eighths as well as the half-crescents themselves. Pernice did not identify the class, although it would appear that one or two of the weights he called half-crescents were non-Attic cornucopia (eg. P.728 ?). In no case, beyond my vague uneasiness about the cornucopia class as a whole (and see further below when it is shown to be extremely difficult to place the class), are these uncertainties sufficient to affect the general shape of the basically Attic series. Weights from outside Athens are again in evidence (P.733 from Euboea, 697 from Tanagra, 332 "from Corfu" Woodhouse, and the doubtful 728 from Aegina).

Apart from P.728 two additional weight groups (D, E) are produced by the variant types of two further weights that cannot be part of the Attic series and are most probably from the Seleucid or Ptolemaic area (qv).

Stamps appear on weights of all three types (Crescent, half-crescent, and Cornucopia: see below in section III on stamps for lists). This probably is confirmation of the Attic origin and cohesion of the series as a whole.

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Crescents form another major type, comparable to the Tortoise and Amphora series in the number of examples that have survived. The cornucopia is closely related (and the distinction ½-Crescent/Cornuc. unclear); it will considered below after the proper crescents. Though the mass of crescent weights are insufficiently marked for classification (my groups A.I,II and B.Icd), this seems to be because the series lasted over a considerable period, and some confirmation for this comes from the few weight groups that are clearly marked.

Earliest is the single half-crescent marked as a sixteenth, that can by its weight only be a sixteenth of the stater (Gp.B.Ia - although marked simply HMIS, HMIS(YHMITETAPTON) must be understood rather than the other possible supplement HMIS(YHMITPITON) which is ruled out by the fact that the weight, though slightly damaged, is still far too light to be a twelfth of a stater and wrongly marked for any mina- fraction). Associated with this sixteenth must be some of the unmarked Gp.B.Icd. The LW.55 has an early context (5th-4th.cent) and the stamps on the bronze P.321 (Kroll B) may well also be 4th cent (see elsewhere on stamps). Both these weights fall well within the stater period. No whole crescent weights (ie. eighths of the stater) seem to have survived (if they ever existed), as there are difficulties in assigning any of the available Gps.A.I-II to this early period (see below).

A later stage of this same series is indicated by the half-crescents of Gp.B.Ib. These are similar in weight and type to the earlier sixteenths but are marked as eighths, and so are mina-fractions (note also that this fraction is written OΓΔOH rather than what would have been HMITETAPTON in the earlier style). No marked weights are dated by context, but it may be presumed that they belong to the period after the mina was generally adopted as the basis for fractions, ie. c.200BC following, and therefore probably should be associated with several of the unmarked Gp.B.Icd (for example the METPO(NOMOM) stamp on P.323 that is likely to be 2nd cent at the earliest: see below on stamps). The legend on P.295 is uncertain, and its weight very high for the range of Gp.B.Ib in general; it should therefore be left unclassified. The very wide range of the unmarked Gp.B.Icd is remarkable, but may best be explained as the result of the long period over which these weights seem to have been in use (see elsewhere on precision). LW.54 however is so far out of line to be unclassifiable; by its Hellenistic context it seems to belong to the most involved period of weight system changes (see table in conclusion to these analyses), and I am tentatively suggesting it be in fact a Cornucopia weight (along with P.391).

Neither of these classes of half-crescents can be associated with whole crescent weights with much certainty. If the fragmentary marks noted by Pernice on the weights in my Gp.A.I are at all reliable, TAPTEMOPON or TETAPTE are perhaps more likely reconstructions than HMI- etc (given the small space available and TP on P.336 and TA on P.343). This would favour identification as quarter-minai of my second class . Some confirmation comes from the arrangement of all the weight fractions in general (see general concluding survey and table): the eighth-stater is already certain for the fourth century (½-Tortoise Gp.BIIab) and the second-century quarter-mina more hypothetical (derived only from the unmarked ½-Tortoise Gp.BIIcd). Clearly it would be wrong to insist here on there being no eighth-stater whole crescents, but I feel that the half-crescent acts well for what would have been a not dissimilar type (the quarter-tortoise) in this earlier period. Despite this uncertainty the crescent weights of Gp.A.I are without doubt of weights suitable for either the eigth-stater or the quarter-mina.

Further, possibly similar, fractions lie behind the mutilated whole crescent weights of Gp.A.II. The reinscription on the cut-down weight LW.58 is in acrophonic numerals (as also that on P.321); however, as crescents as a whole continue well beyond 100 BC, I suggest that the weight LW.58 was no longer valid when it was altered. On this basis it should belong to one of the earlier classes of crescent weights, rather than to the third class of sixths, that continued (to judge by its size) well beyond the use of acrophonic numerals.

This third class of crescent weights (A.III) is the largest, and, although only three weights are actually labelled, the whole group must be taken as sixths of a (very variable) mina. The weight range is comparable to the variation of the unmarked half-crescents of my second class (in their lower limit), and no corrections can be applied to the whole range on either 138 or 150dr standards: the highest marked sixth, P.346, gives a mina of 509.4gm and so would suggest a 369.1gm "coin mina" on the 138dr standard, and 336.3gm on that of 150dr (both of which "coin" weights are impossibly low for what should be the upper limit of such a corrected range). The third class contains only marked whole crescents (and no likely unmarked half-crescents). It is therefore the reverse of the earlier class (largely half-crescents). There is no possibility however of combining the two classes and of supposing, as Lang, that both were valid at the same period: this is because so few of the sixths are properly marked. The size of the third class is an argument for dating it over a fairly long period, but no precise contexts are available. Late 2nd to 1st century is suggested however by the following analysis of the cornucopia class; it also fits the general picture of Attic weights.

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That the Cornucopia was not noted by Pernice need not be important. The weights, and also the legend, of the weights identified by Lang are quite distinct from those of the half-crescents in the groups described above. Closeness in type might also indicate that the Athenians were not too concerned to make a distinction (though similarity of coin types would tend to undermine this possibility). The Cornucopia weights are comparable to my second class, marked as eighths, but written as Lang notes ΟΚΔΟ rather than ΟΓΑΟ. If generally true of Cornucopia weights this slight difference would suggest a considerable distinction in date rather than authority or standard (as Lang would prefer). On this basis a date for the Cornucopia class might also help date the crescents, by indicating when these crescents were not in current use.

The date of the cornucopia weights can probably be fixed as the latter part of the second century. The most closely dated of Lang's weights is placed there by its context (LW.51) and the parallel type on the New Style coinage is close (starting possibly within the century: see elsewhere). A further indication of date would be provided if it could be shown (as Lang has urged) to be on the 138dr standard which was superseded by the 150dr standard towards the end of the century. This I feel cannot however be done given the apparently permissable variation of Attic weights which is too great to distinguish these standards: see general conclusions on precision.

Clearly one of these higher than 100dr standards is indicated by those cornucopia marked as eighths of a unit 704-600gm (C.Ia). This range could be corrected to give coin minas of 469.3-400gm (on the 150dr standard) or of 510.9-434.9gm (on the 138dr). In both cases the range of the unmarked C.Ib would be lower (395-1gm and 429-425gm respectively). These ranges are both possible (although the 138dr standard range is extremely high, a glance at the graphs will shown that is is not unduly so for such a distant fraction and for weights as all those found in the Agora here are in good condition). It could further be argued that the cornucopia group is small so associated only with a shortlived standard, but while I can find no evidence for the 138dr standard before the second century, similarly it is very much open to doubt fo how long the 150dr standard outlived that century. Equally the argument that the type change from crescent halves to cornucopia might well have been occasioned by the differing standards (first from 100 to 138dr) could be countered by the negligible difference apparent between the two types. This last however is a valid point to make if it be suggested that the cornucopia eighths were on the 150dr standard at the same time as the latest group of whole crescent sixths were on the 100dr standard. In such an area of doubt I am inclined to follow this last consideration and tentatively would place the cornucopia with the 138dr standard. In any event the outcome is slight given the lacunae in both 138 and 150dr systems; for accuracy the effect might be to err on the side of preciser weights than could otherwise be deduced (but again the effect of this one case is insignificant: see below).

On either view however the cornucopia weights make considerably easier the transition from (? quarter)-eighths to sixths that is shown by the crescent weights for this change can as a result be placed around the change to multiple standrads of the second century. Nevertheless I should end with the uneasiness I expressed at the start of this analysis about the certain identification of the cornucopia weights (marked OKΔO) as Attic.

OWL

[Group A.I] Incised owl, on bronze weights, no legend (both good condition)
P.4 wt 71.4gm (drawn at the end of GG)
BW.5 wt 69.9gm
context for P.4 the Persian destruction level, early 5th cent

[Group A.II] Incised owl AN~~Θ~~ on bronze weight from Sicyon
P.686 wt 418.71gm

[Group A.III] ?relief/incised owl T~~Θ~~ ΔVA (?) on bronze weight (no provenance)
P.779 wt 155gm

[Group B.Ia] Relief sitting owl with kalathos and A~~Θ~~E; no weight legend
P.492 wt 16.14gm (good condition)

[Group B.Ib] Relief owl A~~Θ~~E; incised subsequently ~~IIII~~ (4dr)
P.503 wt 15.33gm (worn at back)

[Group B.II] Relief owl on lead truncated cone; no legend
P.528 wt 8.31gm (fair)

[Group C] Stamps with various owls and legends (found on both unmarked and marked weights): see elsewhere sv.stamps.

[Mina equivalents, assuming the interpretation proposed on the next page, with number of drachmae suggested in brackets, orxder as above weights:- 446gm(16), 437gm(16), 418.7gm(100), 430.5gm(36), 403.5gm(4), 383gm(4), and 407.75gm(2)].

This series of weights is unusual and of considerable significance in the general pattern of Attic weights. I shall argue that unlike the preceeding types these owl weights are coin weights, representing drachma-multiples rather than fraction/multiple values of the stater or mina as the other types. Although the weights of A.II and III are uncertain (? even Attic the two in A.I are possibly mint weights.

Unusual is the range of types of marking in this series (incised symbol, relief type, and stamp, though I shall wish to dissociate this below), the complete lack of any indication of weight value (the drachma incision on B.Ib being subsequent to the relief type), the unique legends (surprisingly AΘE, but also the uncertain legends on A.II and III), and finally the weights themselves (both in their range down to smaller units than in any other series and also their intermediary values, esp. A.I). On the other hand the series is clearly identifiable, directly based on the design of Attic coin; and it is interesting that this is especially true of the otherwise doubtfully Attic A.II and III (note esp. the arrangement of the letters on A.III). The stamps however should be dissociated from the series of weights as it is clear that there is no weight significance (eg.value or standard) in stamps as a whole or this one in particular (which can also be identified on clay capacity measures: see elsewhere on stamping).

With no weight legends it is naturally impossible to be certain about the interpretation of the weights. The lowest standard weights (excluding the somewhat extraordinary truncated cone shape of B.II) are both apparent 4drs (B.I); this unit is a factor [illegible] of the plain bronze weights of A.I (where the alternative 16drs would be [illegible] by itself surprising) and a possible factor of both other bronze weights (nine 4drs for A.III [could this explain T(etradrachmai) Θ (alphab. nine) ??], and twenty-five for A.II). The reason for suggesting this interpretation will be more clearly seen with the noting of the possibly early bronze weight P.2 below: this weight is marked as "ten staters" and the stater unit is, from its weight, again apparently the tetradrachm (17.752gm) [illegible] The excluded weight B.II could be returned to the series now as a "half-stater".

This suggested interpretation must remain tentative (although if correct it is of considerable significance: see elsewhere - refs. as from P.2 below). It is however possible to rule out other alternatives. Explanation simply in terms of drachmae raises the awkward multiples noted above (only the bronze weights are firm enough guides, giving 16drs (A.I), 100-95drs (A.II), and c.35drs (A.III) if a drachma of around 4.4gm is assumed); moreover there remains in any case the problem of the tetradrachm "stater" in the weight P.2. The alternative, that [illegible] the weights are normal fractions of the stater/mina unit, is even less likely because of the low value range of the series as a whole, and because of the clear connection with coinage that would suggest that some form of drachma unit was involved. In particular the weights of A.I cannot be mint weights and sixths of a mina as Lang has suggested: there was no coin mina (see below on weight systems), and the mint anyway would not operate (however theoretically) in sixths of it as these are not round numbers of drachmae (but 16drs 4ob).

I shall conclude with three general observations consequent on the interpretation here proposed. Firstly, the extremely few weights of this series is natural if mint use is understood, but the relief types might be distinguished from the incised as meant for external use on a rather larger scale; it would be interesting therefore to compare them with the more clearly marked (but not coin-typed) drachma weights (below). Secondly, the improbable unit and its multiples may, if definitely mint-based, conceal a feature of minting procedure at present obscure (eg. making tetradrachms in blocks of 4 or 9, and checking them in 25s ?). Finally the accuracy (c.2%), good weight (contrast drachmae reconstructed from the lead weights below), practicality (incised with no vulnerable appendages or lumps) and durability (bronze) of at least the two weights of A.I are noteworthy.

Weights without symbol, marked with value

Provenance Athens, or ? Athens, unless noted otherwise

[Group A] Staters, multiples and fractions

SW.16 ΔIϟTA "slab of fieldstone apparently uncut, but much polished or worn, letters roughly cut" Lang. 5th cent. lettering (pre 450 BC) 1737.5gm (the mina would be 434.3gm)

P.241 HMI[TPI]T[O]N incised on well-preserved rect. lead wt.148.8gm (sixth of stater, the mina being 446.4gm)

LW.56 HMISYHMITET(APTON) relief on good lead wt. 55.5gm (sixteenth of stater, the mina being 444gm); context late 5th/early 4th. [also with THYRSOS circular stamp]

P.242 HMISYHMITET(APTON) incised on good round lead wt. with bronze ring (no provenance) 53.5gm (sixteenth of stater, 428gm mina)

P.2 ΔEKAϟTATEPO incised on square bronze wt. (boustrophedon) 177.52gm (ten staters of 17.752gm, equivalent to tetradrachm); context possibly the Persian destruction level by Acropolis; IG.i$^{2}$.918.

[Group B] Minai, multiples and fractions

P.281 MMM incised on corroded lead wt. 1301.25gm (3 minas @ 433.75)

P.277 M relief on good lead wt. 442.5gm (mina)

? P.283 MN(A) incised on clay, truncated pyramid wt. 429gm (mina)

? P.392 DE(MOSION) TET(APTH) ?relief/inc. on round lead wt. 116.6gm (quarter mina of 466.4gm); M.112, formerly Woodhouse "from Corfu"

? P.395 [D]HMO[SION] EKT[HMOPON] (?) ?relief/inc. on truncated lead pyramid wt. 76.6gm (sixth of mina 459.6gm)

P.402 OΓΛO ?relief/inc. on lead wt. 57.5gm (eighth mina 460gm) [no provenance]

P.403 DE OΓΛO ?relief/inc. on lead wt. 57.3gm (.. .. 458.4gm)

P.406 DE OΓΛO ..... on lead wt. 56.7gm (.. .. 453.6gm)[no pr]

P.414 DE OΓΛO ..... on lead wt. 50gm (.. .. 400gm) [no prov.]

P.699 DE OΓΛO relief on lead wt. 57.4gm (.. .. 459.2gm)[Tanagra]

? BW.6 MNA [Θ]ASIMH (or HMIS- ?) incised on bronze wt. 27gm later, or also (?), incised with drs. (see below)

? ? P.Supp.12 Square lead weight with unclear stamp over which (so later) incised MN(A); 409.75gm (poor condition) [from Asia Minor]

[Groups A and B]

The problem of identification of weights as Attic is possibly at its worst in these groups of value-marked weights (the drachma class included). They are only one step removed from the unmarked weights which are being excluded from this analysis but which individual Greeks seem to have used either as ad hoc standards or known (or suspected) approximations to official standards. The untypical shapes of many of the weights in these groups probably indicate private manufacture or adaptation; but for its early date (on which see below), the stone weight SW.16 would illustrate this most graphically. Further, private weights in the hands of traders are most likely to travel with their owners; without more explicit evidence it is impossible therefore to deduce origin from provenance and the weights listed here may as well be Olynthian (say) as those found at Olynthus be Athenian (see in brief survey below). If this problem is not resolvable, it is equally unclear whether much could be deduced from its solution unless the identity of the private individual could also be established.

A certain degree of artificiality therefore is involved in the isolation of these groups under Athens, or any state in particular. However, not all the weights fall into this private category for certain, and many are explicitly standard being relief marked or bearing the additional legend "demosion" in some form or other. This last class, DE TET, DE ΟΓΛΟ (and the uncertain sixth P.395), can be considered together with the plainer DEMO weights (see elsewhere, mainly probable "eighths" also) as supplementing in some way the apparently more usual relief symbol weights. Without clear indication of whether these legends are relief or incised and without precise dating it is unfortunately not possible to pursue the possibility that <u>at some point</u> they were the norm - at least for the "eighth mina" value.

If, on the other hand, these weights are entirely supplementary then they may (as will be urged in particular below for incised drachma weights) indicate which weights were in greatest practical demand, within, but also beyond, such areas of official control where the more usual weights would be required. In a similar way these two marked groups indicate the weight systems in use in Athens/Attika, and in this they confirm the picture emerging from the earlier analyses of symbol types. Not only can the marked weights be divided between fractions of the stater and those of the mina (with drachmae a third category), but the early date of the stater period is also confirmed by the two 'dateable' weights of the group (SW.16 and LW.56; on P.2 see below).

Although the groups are not large, the weights can be compared with those of the more standard types. Lack of precise chronology here makes the fact that they show little variation from usual precision less effective.

Four minor details should be noted. The stamp occurring on LW.56 is thereby the earliest certainly recovered (see elsewhere on stamps); unlike the DEMO series, weights with DE ΟΓΛΟ are not stamped. Secondly, the 10-stater bronze weight P.2 is of a totally different weight system from the other stater weights; I tentatively identify it as a coin weight, being ten multiples of the tetradrachm; this unit was suggested for <u>owl</u> weights (above, both 4- and 1- staters) and its appellation here as "stater" would be, if certain, most significant (see elsewhere on weight systems and coin, also on ATH.POL.10) Thirdly, the mina weight, BW.6, is included without any conviction in Lang's interpretation as "informed against mina"; under no circumstances could the weight have been passed as a mina, and the legend appears to begin to make more sense if read in the reverse of Lang's direction; probably it is best ignored. Fourthly, the final mina weight, P.Supp.12, <u>may</u> be an Attic weight that has travelled before marking; however the low weight and unlikely type (very few weights bear stamps <u>only</u>) should make this improbable.

[Group C] Drachmai, multiples and fractions

These are generally marked only with value (in acrophonic and alphabetic numerals) either incised or in relief: weights are mainly lead, with only 6 of bronze (Class I B(a): P.563 [also corrected so Class II C], P.515, P.478, BW.7; and Class II A: BW.6, Kroll A, Kroll B (P.321)); stamps occur, but are never explicitly official; several weights can be associated by their weight values, although not marked.

A great number of drachma weights were identified by Pernice; some I have omitted as uncertain (eg.P.570,574,578) or have corrected (P.507, a misprint ?, for example). The Agora has itself produced but few (LW.58-61 and BW.6-7).

Many difficulties surround the use of this corpus: doubtful provenance (with the exception of the few Agora weights); doubtful attribution at the low weights involved; inadequate modern description of marks or stamps; mistaken marking in antiquity (see Class II C, and also an explanation for Pernice's "heavy drachmai" , my Class I AB add, as they can certainly not, as drachmai be assigned to either of the heavy minai of IG II$^2$ 1013).

The distinction between relief (mould-made) and incised (including here punch-marked as also subsequent to manufacture) seems now to be fundamental. The identification of corrected weights is made easier in the case of P.617 by the fact that an earlier , and erroneous, legend of "2drs" was in relief whereas the correct weight, "3drs", was incised (also P.451; but note that P.563 is not a corrected weight as the line in Pernice is misprinted from P.562 [M.1]). The whole group of drachmai weights can be divided thus into relief and incised, with diiferences apparent between them: with the former are associated some subsequently incised corrections, but no stamps and no relief types (of the series already analysed above Wheel-Owl, and, with the exception of certain Owl weights, all based on minai or staters); the incised group of drachma weights however includes both relief-drachma types and other relief types, it also includes stamped weights. This suggests re-use.

A discussion of the chronology of this whole group follows the lists. These are arranged in the following categories:-

I.A relief legends (a) acrophonic (b) alphabetic (but not including those wrongly marked: see I.AB add)

I.B incised legends (a) acrophonic (b) alphabetic

I.AB addenda - "heavy drachmai" and one "light drachma"
- uncertain relief or incised weights

I.C unmarked weights but with either relief type (even where duplicating other sub-sections) or stamp to indicate that the objects actually are weights

I.D plain and unmarked weights (numbered only)

II.A weighed lumps of metal etc

II.B re-used weights (again even where duplicating)

II.C corrected weights ( ... )

The purpose for making these divisions is to draw attention to the latter group of weights in Class II, and to contrast it with the bulk of less interesting weights in Class I.

Class I.A (a) relief legends, acrophonic numerals

| | | | | |
|---|---|---|---|---|
| 100drs | P.292 (marked H) | 428.5gm giving | 4.29gm dr | (1 wt.) |
| 25drs | P.420-421 | 107.63-100.2 | 4.30-4.01 | (2) |
| 20drs | P.423 | 90.11 | 4.51 | (1) |
| 16drs | P.430-431 | 66.3-64.52 | 4.14-4.03 | (2) |
| 12drs | P.432-434 | 52.01-50.54 | 4.34-4.21 | (3) |
| 10drs | P.440-442 | 41.8-38.8 | 4.18-3.88 | (3) |
| 8drs | P.443 | 35.9 | 4.49 | (1) |
| 7drs | P.450 | 30.61 | 4.37 | (1) |
| 6drs | P.452-454,456 | 24.9-24.51 | 4.15-4.08 | (4) |
| 5drs | P.457-61,463-67,470 | 23.13-20.22 | 4.63-4.04 | (11) |
| 4drs | P.472,474,476,480,483,487, 493,498,504,507-9 | 17.78-14.29 | 4.32-3.57 | (12) |
| 3drs | P.513,518-519,520-521 | 12.73-11.39 | 4.24-3.79 | (5) |
| 2drs | P.525,527,531-532,536 | 8.64-7.71 | 4.32-3.86 | (5) |
| 1dr | P.538,550 | 4.7-3.65 | 4.7-3.65 | (2) |

Class I.A (b) relief legends, alphabetic numerals

| | | | | |
|---|---|---|---|---|
| 8drs | P.566,573,575-576 | 33.0-25.31 | 4.13-3.16 | (4) |
| 5drs | P.579-580 | 16.74-16.72 | 3.35-3.34 | (2) |
| [ 4drs | P.583 (on double ½Crescent, but "Δ" better "D[emosion]") | [16.07] | [4.02] | (1)] ?? |

Class I.B (a) incised legends, acrophonic

| | | | | |
|---|---|---|---|---|
| 20drs | P.422,425-427 | 98.16-76.19 | 4.91-3.81 | (4) |
| 16drs | P.(391),429 | 73.3-69.5 | 4.58-4.34 | (2) |
| 12drs | P.435; LW.58 (see II.B) | 53.0-47.51 | 4.42-3.96 | (2) |
| 10drs | P.419 (??), 439 | 49.89-42.27 | 4.99-4.23 | (2) |
| 8drs | P.444-445 | 35.01-34.9 | 4.38-4.36 | (2) |
| 6drs | P.451 (see II.C),455;LW.59 | 26.5-24.52 | 4.58-4.08 | (3) |
| 5drs | P.462,468-469 | 20.33-20.24 | 4.07-4.05 | (3) |
| 4drs | P.(473),485-6,488,491,494-7 499-500,502-3,510-1; BW.7; punched - 478 (Æ),(479), 490, 506. | 17.32-12.23 | 4.33-3.08 | (20) |
| 3drs | P.514,515 (Æ),516-7,522,617 | 12.30-10.86 | 4.10-3.62 | (6) |
| 2drs | P.523-4,526,529-30,533,535, 537 | 8.89-6.6 | 4.45-3.3 | (8) |
| 1½drs | P.((552)),553-555 | 6.67-5.76 | 4.45-3.84 | (3) |
| 1dr | P.540-2,(547),549,551;LW.60. | 4.9-3.36 | 4.9-3.36 | (6) |
| 4ob | P.556 (written "T") | 2.85 | 4.28 | (1) |
| 3ob | P.558-559 | 2.07-2.04 | 4.14-4.08 | (2) |
| 2ob | P.560 (punched) | 1.55 | 4.65 | (1) |
| 1ob | P.562 (incised ▯) | 0.65 | 3.90 | (1) |

Class I.B (b) incised legends, alphabetic

| | | | | |
|---|---|---|---|---|
| 10drs | P.565 | 41.29 | 4.13 | (1) |
| 8drs | P.567-9,571-2 | 32.67-30.5 | 4.08-3.81 | (5) |
| [ 7drs | P.577 | [28.74] | [4.1] | (1)] ?? |
| [ 6drs | P.578 | [24.8] | [4.12] | (1)] ?? |
| 4drs | P.581-582, (484) | 16.73-16.6 | 4.18-4.15 | (3) |
| 3drs | P.586-589 | 12.5-11.67 | 4.16-3.89 | (4) |
| 2drs | P.590-593 | 7.7-7.29 | 3.85-3.64 | (4) |
| 1dr | P.594-595 | 3.68-3.57 | 3.68-3.57 | (2) |

Class I.AB addenda

- "heavy drachmai"

| | | probable value | actual weight | indicated dr |
|---|---|---|---|---|
| 10drs | P.606-7,613-4 (all incised △) | [?20/16drs] | 76.89-58.33 | [7.69-5.93] |
| 5drs | P.608,615 (both relief) | [?8/7drs] | 34.76-25.43 | [6.95-5.09] |
| 4drs | P.616 (relief) | [5drs] | 21.46 | [5.37] |
| 2drs | P.451 (see II.C: relief, then incised 6drs),617 (relief, then incised 3drs; also II.C) | [6 and 3 drs] | 25.44-12.15 | [12.72-6.08] |
| 1dr | P.609 (relief) | [2drs] | 8.04 | [8.04] |

- acrophonic queries

| | | | |
|---|---|---|---|
| 16drs | P.428 | 70.35gm giving | 4.39gm dr |
| 10drs | P.436-437 | 49.02-48.19 | 4.9-4.82 |
| 8drs | P.446-448 | 34.20-33.0 | 4.27-4.13 |
| 4drs | P.489,501,505 | 16.32-14.76 | 4.08-3.69 |
| 2drs | P.524,530,534 | 8.87-7.9 | 4.44-3.95 |
| 1½drs | P.553 | 6.67 | 4.45 |

- alphabetic queries

| | | | |
|---|---|---|---|
| 4drs | P.584 (pyramid ?),585 | 14.75-14.70 | 3.69-3.67 |

- "light drachmai"

| | | | |
|---|---|---|---|
| 4drs | P.675 (round; relief ⊢T⊣) | 6.69gm | |
| 1dr | P.563 (bronze; relief ⊢) | 0.58gm | |

Class I.C unmarked weights with relief-type or stamp

| | | | |
|---|---|---|---|
| [4drs] | P.492 (relief Owl AΘE) | 16.14 | 4.04 |
| [3drs] | P.512 (stamp OWL) | 13.49 | 4.49 |
| [2drs] | P.528 (relief Owl) | 8.31 | 4.16 |
| [1dr] | P.546 (stamp ARTEMIS) 548 (stamp BEARDED HEAD) | 4.21-4.04 | 4.21-4.04 |
| [4ob] | P.557; LW.61 (stamp OWL) | 2.8-2.72 | 4.2-4.08 |
| [1ob] | P.561 (unclear stamp) | 0.665 | 3.99 |

Class I.D unmarked weights plain (wts not given)

P.424,438,475,477,481-482,539,543-545,654.

Class II.A weights or lumps of metal weighed in drachmai

P.449: lead weight incised ΠΗIIII (?) 7dr 4ob (Pernice gives ΠΗIIII ?); some damage but possibly before incision made.
Wt. 30.5gm (3.97gm dr).

P.471: lead weight incised 𝍠 III [reverse "X"] ie.4dr 3ob; good condition.
Wt. 18.18gm (Pernice) but 17.36gm (Murray).

P.321 (Kroll B): bronze ½-crescent (B.Ic) incised (or punch-marked) ΔΗΗCT 13dr 3/4ob; several OWL stamps; good condition.
Wt. 55.63gm before, 54.8gm after cleaning (4.18gm dr cleaned).

Kroll A: bronze ½-tortoise (B.IId); punch mark ΔΔΠΗIC 26dr 1½ob; several OWL stamps; good condition.
Wt. 104.4gm cleaned (3.98gm dr cleaned).

BW.6: bronze weight incised MNA HMIS A on one side (that Lang reads, rather improbably, as MNA [Θ]ASIMH) and ΠΗIX on the other (6drs 1ob 1ch); good condition.
Wt. 27gm (4.36gm dr).

P.685: lead Astragalos (A.IId) weight; corners considerably worn "so dass die ursprünglich quadratische Form verloren gegangen ist"; deeply incised ΗΗΠΗ (206drs); from Corinth.
Wt. 858.92gm (4.16gm dr).

Class II.B re-used weights (with a drachma value added)

P.391: lead ½-crescent (? cornucopia - but like LW.54 overweight for Gp.B.Id); reputedly marked ΔTIΗ according to dealers in Athens, but in view of the weight this is more likely surely to be ΔΠΗ (16dr) and incised; good condition.
Wt. 73.3gm (4.58gm dr).

P.503: lead Owl AΘE (B.Ib) weight; incised 𝍠 (4dr); worn behind.
Wt. 15.33gm (3.83gm dr).

LW.58: lead Crescent (A.II) weight [Lang mistakenly takes as ½-crescent, but see her own illustration]; incised ΔΗΗ (12dr); considerably cut down; Hellenistic context. Included in Class I.B(a) above.
Wt. 53gm (4.42gm dr).

Class II.C corrected weights

P.451: Lead weight incised ΠΨ under (? in relief)ΗΗ; from the weight this should be read as a correction to 6drs from mistaken 2drs, the total of 8drs giving too low a drachma (3.18gm); fair condition. Included in Classes I.B(a) and I.AB add above.
Wt. 25.44gm (4.24gm dr).

P.617: lead weight with relief ΗΗ, and incised ΗΗΗ; from weight again this should be taken as a correction to the incised 3dr legend, as the addition, 5drs, would imply too low a drachma (2.43gm); good condition. Included in Classes I.B(a) and I.AB add above.
Wt. 12.15gm (4.05gm dr).

Chronology:

The analysis of these drachma weights is as a whole severely limited by the difficulty of dating the many examples ~~xxxxxxxxx~~ that have been collected. Four pointers towards a chronological arrangement can briefly be indicated:-

(A) Numerals. These provide only a very general guide; acrophonic are unlikely after c.100 BC while alphabetic are not usual before the second century (Woodhead Gk.Inscrs.1967 Pbk.109,111). However neither limit can be applied to any particular weight.

(B) Contexts. Only four of the Agora weights were found in dateable contexts: BW.7 and LW.58,61 Hellenistic; LW.59 Late Hellenistic.

(C) Stamps. Poor description and the unclear state of these tiny marks are a general difficulties in establishing the chronology of stamps in any case (see elsewhere). The OWL types are particularly variable, and though found on LW.61 which has been placed by context in the Hellenistic period are not necessarily similar on P.512 and 557. Kroll has identified the OWL on his wt.A (Class II.A) as similar to the early 4th.cent Attic triobols (Kroll p.88 n.4) and the stamp is indeed unlikely to be later than the fourth century (see elsewhere); however, the stamp, though contemporary in this case with the relief type (tortoise B.IId), need not also date the drachma inscription (incised, on its interpretation see following below). Pernice assigned the BEARDED HEAD stamp on P.548 (a weight otherwise unmarked) to the fifth cent. (GG.p.158), but this is surely as uncertain as the ARTEMIS stamp on the other drachma P.546 (? Ephesus cf.P.641).

(D) Reinscription. A relief type marked with drachmae should give some indication at least of sequence. Kroll A has already been noted and is perhaps the best example; other relief types are unfortunately amongst the most uncertain themselves (crescent A.II [LW.58]; owl B.Ib [P.503]); the crescent C.Ib (properly "cornucopia") and so P.391 (drachma class IIB) should derive from the second century.

If none of these arguments are particularly precise, they do add up to a general indication that the drachma weights are overwhelmingly of Hellenistic date, none need be earlier than the fourth century and many are probably of the first or later.

Comments: class I

The importance and extent of the distinction between relief and incised legends is difficult to assess. Incision becomes proportionately more usual in the later period of alphabetic numerals; and the ratio of relief to incised varies with individual drachma values as will be analysed below. Comparison with other relief stamped types on lead (or cast on bronze) weights suggests that only the relief drachma weights properly belong to the series of Attic weights (that is of the standard type). Certain of the incised weights were (arguably) officially noted, but not all; this I should infer from their being stamped (see elsewhere, as I argue that the stamping probably means that the weights were used by officials). On the other hand there is the fact that relief marked drachma weights do not seem to overlap with other weight systems [P.583 is exceptional, but extremely doubtful both as a drachma weight as could as well be "demosion" as alphabetic "4", and as part of the Attic crescent series, more probably Ptolemaic/Syrian]. Incised drachmae however do appear on the symbol-marked stater/mina weights. This I take to imply some chronological interval - it could hardly be maintained that official weights, checked and marked in drachmae, could continue in use, least of all as standards, when this re-marked value clearly indicated variation from the mina fraction that the weight might in practice be supposed to represent [thus against Kroll's general argument, although there could be a case made that the reinscribed drachma values do in fact represent whole fractions of a 105 drachma mina; this however I would dispute. See elsewhere]. Some change of use might also be suggested.

Further indications of the distinction between relief and incised weights arise from the foregoing lists. I shall mention four significant areas of variation.

(A) The relief drs of I.A(a) have a fuller range of values, from 100drs to 1dr (but not below 1dr, and only doubtfully 1½drs), than the corresponding I.B(a). This series of incised acrophonic drs has a shorter range, yet contains 4,3,2 and 1 obol weights.

(B) Alphabetic drachmae are almost entirely incised, I.B(b), with only 8dr, 5dr, and ?? 4dr, in the relief class I.A(b).

(C) Most importantly, the frequency of survival of weight values varies.

| relief acroph. | | incised acroph. | |
|---|---|---|---|
| | 4drs - 12 | | 4drs - 20 |
| | 5drs - 11 | | 2drs - 8 |
| | 3drs, 2drs - 5 | | 3drs, 1dr - 6 |
| | 6drs - 4 | | 20dr - 4 |
| | 12drs, 10drs - 3 | | 6, 5, 1½drs - 3 |
| | 25, 16, 1dr - 2 | | 12, 10, 8dr, 3ob -2 |
| | 100, 20, 8, 7drs - 1 | | 16dr,4,2,1ob - 1 |
| | total wts - 53 | | total wts - 66 |
| relief alphab. | | incised alphab. | |
| | 8drs - 4 | | 8drs - 5 |
| | 5drs - 2 | | 3drs, 2drs - 4 |
| | (??4drs - 1) | | 4drs - 3 |
| | total wts - 6 (7) | | 1dr - 2 |
| | | | 10drs - 1 |
| | | | total wts - 19 |

Between the first two groups (acrophonic) the most noticeable difference concerns the 5dr value, almost as common as the 4dr relief but more than six times as rare as the 4dr incised. This is partly because the 4dr, though the most common weight in both groups, is rather more frequent in the incised (of which it represents c.30%) than in the relief group (c.22½%); on the other hand the 2dr, and probably the 3dr, are consistent in both groups (around 10%). The alphabetic groups are hardly large enough for comment, but the 5dr is again represented in relief while not appearing at all incised. Here the 8dr is consistent.

(D) Few patterns emerge from the weight ranges which are in many cases based on extremely inadequate numbers of examples. Generally alphab. weights are lower than acroph. (as Pernice observed and related to the lower Attic coin weights of the later period, GG.p.57-9). No distinction clearly emerges ~~xxxxxxx~~ between the relief and incised groups, and the 4dr in particular seems consistent throughout.

From the third point, C, some indication of the frequency of use of these weights should be derivable. On a simple count of all marked acroph. drachmae most common is the 4dr, second 5dr then 2dr followed by 3dr, and finally together 6dr and 1dr - others follow in too small amounts to be distinguished.

[4dr (32); 5dr (14); 2dr (13); 3dr (11); 6dr, 1dr (7); 20dr (6) etc]

Of these values 4dr,2dr and 1dr are natural coin weights, but the 5dr,3dr and 6dr are not and their frequency calls for some explanation. It is possible to go further however: by taking out the series of relief-marked weights and looking only at the incised, we arrive at precisely the natural frequency order of what would be expected if these were coin weights for 4dr,2dr and 1dr occur in the first three places. If this procedure is valid the main use for these incised weights might be inferred to have been to measure (or check) Attic coin weights; and this is further confirmed by the large proportion of these weights that are tetradrachms. The implication for the use of weights and the awareness of coin weights must be considered in the light of this evidence elsewhere.

The function of the relief acrophonic drachmae, that by the distinction used above are not coin weights, must now be considered. The fact of their being carefully made in relief and the apparently impractical values (esp. 5dr but also 3dr and 6dr) as far as Attic coin would be concerned, seems to imply a more general application, the weighing of small commodities in general and not especially coinage (for the coin values do of course also appear in this group).

The interesting conclusion is emerging that certain Attic weights were made and used for weighing coin, but that this class of weights was not made by the same process (relief moulding) standard to the main series of weights. As this main series includes clear officially marked weights it can be argued to be state manufactured, and the counter-implication is therefore that the incised drachma coin weight production was entirely unofficial. It could further be pointed out that this type of weight can only tentatively (on the basis of weight and provenance) be assumed as Attic, and amongst such individuals as might thereby be assumed to have felt concern for the weights of Attic coin may certainly be included foreigners/inter-state traders. [It is therefore possible to maintain the disinterest of the state and most literate Athenians in their coin weights, a position I am most concerned to argue in the latter part of this thesis].

(There is no reason to extricate varying standards for the "heavy" and "light" drachmae of class I.AB Addenda; I have already suggested that the relief weights of this class are mistakes, as is clearly indicated by P.451 and 617; this is further confirmed by the fact that all the weights in question can be said to be relief (the incised Δ on the 10dr group is plausibly either for "demosion" or as I should prefer "4-staters" on the 4dr base of P.2: see elsewhere). It is important to demand especially convincing arguments if the variation of mina-standards is to be supposed to entail lower drachma variation as Pernice's treatment of this class assumes; it is in fact I believe a fundamental impossibility: see elsewhere on weight systems)

Comments: class II

I have isolated these three groups to draw attention to them even though they do not properly form drachma weight classes in addition to those already assembled under I. In later sections however the significance of these groups will be discussed in greater detail (esp. precision and more generally the approach to weighing and the use of weights). Provisionally I include some brief notes here.

II.A. All acrophonic, these are not proper weights but rather re-weighed lumps of metal. They illustrate an entirely different approach to weighing by this measurement; their subsequent value as weights is difficult to substantiate; meanwhile, however, they give an opportunity for estimating how accurately contemporary Greeks felt that they could weigh. I have not included the apparent odd weight value set on P.391 as I believe a correction of the reading on this weight to be justified (it therefore appears in the next group); the relief legend ΔΔΔΔΔΔΔΔΔΔ on P.507 must be a mistake for ΔΔΔΔ (which is indeed how Pernice takes the weight). Stamps occur on both bronze weights, but do not necessarily relate to the drachma incisions (or indeed at all, as I argue elsewhere).

II.B. This group comprises weights re-marked with a round number of drachmae; they have been converted from stater/mina fractions to the drachma system, but their use as weights can be regarded as continued. No stamps, it could be noted, support their subsequent use.

II.C. These weights have been corrected from erroneous marking in relief by subsequent drachma incision. If the "heavy" and "light" drachmae of class I.AB Addenda had not escaped notice they would now be appearing in this group. Again it is noteworthy that no stamp accompanies the revised (and correct) weight (see elsewhere on stamping in Athens).

Weights marked "demosion" only

With the majority of these weights it is not clear whether the legend is in relief or incised; most appear to be lead, but Pernice's descrs. cannot alwa be relied upon ; variations from this pattern of uncertainty will be noted, as also provenances however recorded; finally interpretation of the weight value will be suggested....most are hypothetical.

P.Supp.1 ΔHMOΣ(ION) AΘHNAIΩN relief on square lead weight 1340gm [from Asia Minor] - three minas @ 446.6gm ?

?? Pernice p.62 ΔH relief on lead weight 323.68gm [from Ephesos] - mina

? P.760 Δ on lead weight 140.54gm [Woodhouse "from Corfu"] - third of 421.6gm ?

?? P.763 EV ΔH (though Walters omits V) in relief on bronze weight 91.70gm [Woodhouse "from Corfu"] - ??

? P.788 $\Sigma^{\Diamond}_{\Sigma}$ on lead weight 80.05gm [no provenance] - ??

P.394 DEMO on wt.79.4gm [? Athens] - this and the following ?$\frac{1}{6}$or$\frac{1}{8}$?

P.396 DEMO on wt.65.43gm [? Athens] plus stamp PLEMOCHOE

P.397 DEMO on wt.63.21gm [Peiraeus] plus stamp STRIDING PIG

P.398 DEMO on wt.61.30gm [Peiraeus] plus stamp KALATHOS/OLIVE WREAT

P.399 DEMO on wt.60.166gm [Athens] plus stamp OWL A

P.400 DEMO on wt.58.77gm [Athens] plus stamp OWL/OLIVE BRANCHES

P.401 D[EM]O on wt.57.577gm [Athens]

P.404 DEMO on square bronze weight 57.21gm [? Athens]

P.408 DEMO on wt.55.66gm [Athens] plus uncertain stamp

P.409 DEMO on wt.55.57gm [? Athens]

P.410 DEMO on wt.54.93gm [Athens] plus stamp OWL DH

P.411 DEMO on wt.54.27gm [? Athens] plus stamp DOUBLE OWL

P.412 DEMO on wt.53.21gm [Athens] plus uncertain stamp

P.416 D[E]MO on wt. - [no provenance] plus stamp OWL AΘE

? P.415 DHMOS[IO]N (?) on lost weight [no provenance or weight] plus stamp ATHENA HEAD and stamp DOUBLE OWL

?? P.732 ΔH relief on bronze weight 64.82gm [from Karystos, Euboea]

?? P.698 Δ on round lead weight 63.36gm [from Akraiphnion, Boeotia]

This group has been isolated largely for purposes of completeness as it is extremely difficult to identify any of these weights (apart from the first as Athenian). A contrasting series, marked DAMOSION, exists though it is too uncertain for separate comment as yet [The greatest difficulty is to decide whether in each case the DAMO- legend is a separate marking from the relief type on which it is often found. I discuss the series especially under Corinth (qv), for no necessary reason: it comprises P.687, 388, 83; Walters 3007; Kroll C; Lang ANSMN 1; and Davidson Corinth XII fig.32 p.204 ].

No indication of date or system is given by this group (see elsewhere on the retention of archaising E). Two points however will be discussed in the following sections (a) the distant provenance of the first weight (P.Supp. 1) which, because of the weights unusually explicit relief legend, should indicate an overseas settlement (eg. cleruchy) rather than that the weight was carried in trade; and (b) the large proportion of DEMO weights around 60gm marked also with a stamp

It is particularly unfortunate that I cannot as yet ascertain whether the legends, especially on this last class of weights, are incised or in relief. I hope shortly to be able to check on those in the BM, but one or two (such as P.415) are completely lost.

Weights found out of Athens will be further briefly noted in their contexts (on the general question of identification of "Attic" weights see elsewhere).

The reconstruction of Attic weight systems from these type analyses

It is right to stress the difficulties encountered before a more general reconstruction is attempted. Weight variations are for the present least important as it is largely to assess the extent of these that the analysis has been made. It has however been possible to reconstruct the Attic weight series on the minimum number of variant weight standards, those directly indicated in other sources (100,138 and 150). Further intermediary standards are not apparent from type or group distinctions; and I shall argue below that there are no proper grounds for inventing them.

More immediately relevant have been the difficulties in subdividing and associating the several weight types. Haphazard variation in legend - whether marked or not, whether officially marked, whether marked with denomination - makes very difficult the assignment of every individual weight to a particular sub-class. It is also itself of uncertain significance (see especially section V following).

A further problem is the lack of consistent association of symbol with denomination (clearly attested for Amphora, Tortoise, and Crescent weights; less certain in the case of Dolphin). Again the significance of both association and change is highly debateable; it should at any rate, like the derivation of weight standards, follow from an independently established scheme of the development of the Attic weight system rather than serve to establish such a scheme. Lang's whole reconstruction depends upon the assertion of selected connections of this type (for example Aeginetan weight with the Turtle/Tortoise symbol), but for which there is no sure proof at all.

Difficulties of a more practical sort are produced by the inadequate publication and description of certain types of weights. Thus Pernice does not expressly recognise the Wheel and Cornucopia types, nor distinguishes Turtle and Tortoise weights in his catalogue; he is not always explicit on the sort of legend (relief or incised) on drachma weights, and is never so on weights simply marked apparently as mina fractions.

The criteria for dating weights are far from decisive or at all comprehensive: (a). Type parallels with Athenian coins, while begging

the question of a necessary connection and while being vulnerable to archaistic tendencies, only properly apply to amphora types (less certainly to crescents). Other coin connections are not helpful: the derivation of certain types from early Attic Wappenmünzen still leaves many more without any such origin; the connection of the change on Aeginetan coin from turtle to tortoise type, or the derivation of the shield from Salamis, are hardly compatible, however likely individually; the dolphin on weights remains obscure. The relationship of coinage to the weights can only usefully be established for the period starting with the New Style coinage of the early second century BC. (b). Special problems are produced by weights bearing stamps similar to (if not identical to) known coin types, as it is clear that frequently these stamps have been made at late stages in the life of the weights involved (see further below). At best such stamps might indicate the period in which the weights were acceptable, though for the reason just given this need not imply acceptability at their original face value. (c). A similar difficulty concerns the interpretation of dates secured by context and find-place. Such dates are only available for a very small proportion of surviving weights (they are rare even for Lang's weights), and are usually too wide to be of much interest. Again however they indicate no more than the period up to which the weights were currently in use. It remains always possible furthermore that individuals might continue to use certain weights, with which they may have been familiar, even after a new series was (officially) introduced. (d). Lettering is the last guide I shall list to dating, and is again of only partial value. As Lang pointed out,[3] such archaisms as AEMO persisted (though without any discernible rule) late into the period of "H" (and both letter forms appear together in the relief legends of some weights, for example P.54 and 66). On the other hand, ϟ seems to guarantee an early fifth-century date; letters with ornaments (as P.97, 598) should be very late; and the acrophonic and alphabetic numbering systems, despite their chronological overlap,[4] do give some help in ordering the Attic series.

A final difficulty to note here is that it is not always certain that a particular weight should be classified as Attic. While the main types, and their sub-groups, are fairly clear, many isolated weights are less easily included because of their slight variation in type, in the relationship between their symbol, weight, and denomination, and in their shape or type of inscription. Such uncertain weights must be ignored, even if they may have been used in Athens and by Athenians. The purpose

of this section is to examine in detail the one series of official weights that can be studied. Since the series can be established, the isolated weights beyond the areas of reasonable doubt in the main classification system are for the present irrelevant.[5]

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The main criteria for identifying weights as belonging to the Attic series (and which were used in the foregoing lists) can briefly be set out here. They may eventually prove useful for the elucidation of non-Attic weight series (though evidence at present is insufficient to pursue this), and they clearly are relevant to the practical questions of recognition and use, by contemporary Athenians, of the many, inadequately marked weights.[6] Few of the criteria are by themselves sufficient to identify any individual weight as Attic.

(a). Relief type symbol. This is one of the most frequently-applied criteria,[7] and is especially relevant for the identification of weights as non-Attic where strong correlation can be seen between weight sysmbol and non-Attic coin types (cf. Chiot and Seleucid weights below; also the Argive type dolphin on the stamp of P.681). It only properly applies to the Owl type of Attic weights, and even in this there are exceptions.[8] Moreover, the Turtle/Tortoise symbols, which appear to bear a striking resemblance to Aeginetan coin types (including their development), is one of the more certain Attic weight types and cannot plausibly be argued to belong to Aegina.[9] Quite apart from the universality of many of the other weight symbols (boukranion, amphora, and crescent are identified on certainly non-Attic weights), is the very variety of the collection of symbols itself.[10] Such variation may be illustrated from outside Athens (cf. Alexandria in the Troad, Antiocheia, etc), even if it seems more usual for a set type to be reproduced on weights of varying magnitudes (cf. Tomis in Thrace, Chios, Cyzicus, and Priene). The same type may, it is true, be treated differently by different states (thus the Attic amphora is recognisably different from the Chiot); on the other hand local variation also occurred (and both shield types are apparently Attic). The relief type should therefore be treated only as a guide to provenance; it cannot alone identify a weight. Many places appear to have imitated the Attic series (cf. Olynthus).

(b). Other marking. A preliminary distinction must here be drawn between relief- and incised legends because the latter can have been placed on a weight at a stage subsequent to its manufacture and initial use. This point is less applicable to bronze (where incised legends seem almost general) than to lead weights (which usually bear legends in relief if at all); however the bronze weight P.687 from Corinth is a convenient example: relief ΣΙ (Sicyon) but incised ΔΑΜΟΥ (a legend appearing on other Corinthian weights: see below under Corinth).

Attic weight marking appears most consistent in its variability. Nevertheless it is possible to find explicit naming of the state even if the rarity of such clarity might raise the suspicion of a cleruchy weight were Athens not also indicated by provenance.[11] Legends bearing the names of other states appear more reliable in this respect, and are also more frequent.[12] Named officials (as part of the weight legend) distinguish the Roman, as opposed to earlier Greek, period, but official titles (metronomoi or agor[anomoi]) are properly Greek. Metronomoi are only known for Athens and indeed the title is only found on weights which can be identified as Attic.[13] Weight value alone is no certain criterion given the variety of systems in daily use.

(c). Provenance. With a number of otherwise similar weights, the fact that the vast majority were found in a single state is of undoubted significance in determining their origin.[14] This is the case with all the Attic series set out above, and will also help to establish the unity of one or two non-Attic series (eg. the Thracian, the Olympian, but less clearly the Theran). Certain Attic weights however can be shown to have travelled outside Athens,[15] and several non-Attic weights have been found in Attica.[16] This fact of travelling weights renders the criterion of provenance invalid for individual cases of doubt. It is important to note however that the identity and size of the series localised in Attica is sufficiently established to rule out the possibility that this series should be regarded as generally standard throughout the Greek world.

(d). Stamping or countermarking. The practice of stamping weights in addition to symbol and legend seems virtually restricted to Athens. Certain stamps of non-Attic type may indicate that this rule is not quite invariable, but no surviving literary evidence for the practice applies outside Athens. Only a small proportion of Attic weights however are stamped, and so the value of this criterion is somewhat limited.[17]

(e). Weight system and standard. Pernice considered the metrological criterion the most decisive,[18] but he also felt he understood the Attic weight system. Lang has since modified this, and introduced a series of further weight standards derived in part from extant weights. There is no necessary end to the procedure until (with some ingenuity) most of the remaining non-Attic weights were discovered to lie precisely within the Attic system.[19] It is important to regard any such metrological argument with extreme circumspection until it can be established how precise weights belonging to a certain standard were, and how sophisticated was contemporary Greek manipulation of standards. I shall show that in neither respect were the Greeks at all as advanced as presumed by such scholars. A systematic framework can be deduced but it is not precise enough for even such attested standard differences as between 138 and 150 dr. standards to be recognised from extant weights.

(f). Fabric. The fabric of the majority of Attic weights[20] is too similar to that of many non-Attic series to act as a clear criterion here. Deviations (such as round, triangular, or modelled weights) do however appear to be non-Attic.

As was suggested above, the identification of the Attic weight series relies on a combination of these criteria and also on the large number of weights available for classification. The problems are therefore very much increased in the analysis of the small groups of non-Attic weights; these, as will be seen, can for the most part be no more than identified as belonging to a particular state. The present reconstruction of the Attic series continues now with consideration of further general aspects of this particular series.

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Materials. By far the greater number of Attic weights are made of lead. Bronze weights exist, and are especially of the earliest chronological period (fixed by context and letter-forms to the early fifth century). No lead weights need belong to this period;[21] I suggest that they do not in fact begin until the fourth century[22] and that the only official weights up to that time were the bronze. This is supported by the fact that weights are rare in the early period (and so mass-production, in cheap materials, would not be necessary), and further by the evidence of small numbers of bronze weights continuing in the later periods where lead is so very common.

At least one weight was made of clay (P.283), but both material and shape are unusual. Stone weights should be noted: marked SW.16 (early fifth century) and the unmarked, but carved Dolphin P.261. Again, however, such weights are neither normal nor apparently official.

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Working. The usual shape of these weights is square and flat; occasionally, rectangular and also round, conical or truncated pyramid shapes can be identified by their legend as weights though they cannot be associated with the main series. As the designs are in relief it is likely that moulds were used to make them, with minor adjustments made to the weight while the metal was still soft.[23] Bronze weights were certainly mould made - the symbol being on Attic weights often cast separately and then attached by rivets.[24] The alternative technique, incision, was used both for the symbol (but rarely, as on the two bronze Owl weights Gp.A), and quite frequently for the legend. The distinction between relief and incised markings may be significant, affecting not only dating but further whether the weights were mass-produced, whether in fact originally meant as official weights (or only so taken at a later stage). The mould technique implies the production of considerable numbers, the need for such numbers, and a factory producing them.

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Two classes distinguished (stater/mina and drachma weights). There are several variations in the manner of weight-marking that suggests division into categories could be made. First, the main bulk of weights, lead and bronze but with relief symbol. Many, though not all of these, bear a legend in addition to the symbol; this might be a version of demosion (or another official body), or a denomination, or (most rarely) a combination of both. As will be argued below, no distinction in weight (standard or accuracy) necessarily accompanies any one type of legend, although those without any legend at all may perhaps be slightly less precise than the others. Some of these weights are also stamped, but the significance of this practice (to be considered in the following section) is immaterial for the initial classification of weight types.

More helpful is the fact that this central group of weights comprises fractions and multiples of the stater and mina. Associated with it in this way are other weights without symbol but also marked with similar

denominations. The legends on this sub-group are invariably incised as opposed to the usual mould-made legends on the relief weight group.[25] The point of distinguishing the sub-group is to be able to consider whether it represents an unofficial supplementation of the relief weight series. No weights of the sub-group belong to other than the normal weight standard (100), though it might be possible to find such deviants as 138, or 150, in the relief group.

All these stater and mina (fraction or multiple) weights are consistent with a discernible development in the Attic weight system. Subdivision of the stater preceded that of the mina. This is true even though the stater unit name continued in use into the period where fractions were expressed in terms of the mina (Astragalos A.I which is second to first century BC), and though the mina occurs as a unit in the earlier stater period (Dolphin A.Ib with "MNA" on two weights in a context around 300 BC). The change from stater to mina systems seems to have occured towards the end of the third century; I am taking it to be c.200 BC in what follows, but it should perhaps be slightly earlier. The weights of this first group therefore fall into three main periods - the early fifth century (bronze, but possibly a few lead towards the end of the century), fourth to third centuries (stater fractions, lead now usual), and finally the second to first centuries (mina fractions). By far the greater number of weights fall into this latter period; it can also be said that no weights of an appreciably deviant weight standard need be earlier than this period.

The second general category of weights comprises in the first place those drachmae weights with relief legend only. These extend over a considerable period (from acrophonic to alphabetic numerals), but cannot be at all precisely dated. I have discussed in detail above the differences between this class and those incised drachmae weights. The relationship is comparable to the two stater/mina groups just identified.

None of the relief drachmae weights are marked demosion (nor are any stamped, though this is less significant); this fact, in addition to their lacking any symbol, raises the question of whether these drachmae weights belong to the same weight system as the stater and mina weights. In favour of association is little more than the common material and method of manufacture,[26] the common Athenian provenance, and the assumption that drachmae weights would form the lower range of the overall weight system. I would argue against association however; and although the evidence is

not decisive this last assumption should in particular be questioned. There are four reasons for insisting on an initial (and fundamental) distinction. (1). That drachmae were associated with minae on a weight scale cannot be assumed, and indeed can be shown not to have been the case on contemporary Greek inscriptions (see ch.III). (2). Lack of symbol is significant on these drachmae weights as a special group of them (the Owl weights) does have a symbol. (3). The fractional subdivision of the mina (on mina weights) is not in suitable drachma amounts: twelfth-, eighth-, sixth-, and third- of a mina are not round numbers of drachmae (on the 100dr to mina ratio), and 50dr (half mina) and 25dr (quarter mina) are not common drachmae weights, although these mina fractions are frequently found. (4). Further early weight groups can be identified as drachmae weights yet are untypical of the majority of drachma weights: thus the incised bronze groups (Owl A and the "10 stater" P.2 at 177.5gm. The more conventional symbol-marked, relief, lead Owls (group B.I) are later, and have been mentioned already above. Their late date is proof of the lateness of the association between stater and mina weights and the drachma weights.

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Tables of development and distribution (on following two pages). The results of this analysis of the Attic weights can tentatively be set out in tabular form to show in particular the historical development of the system. I should insist that this has here been considerably simplified, and for the sake of clarity several questionable groups have been omitted entirely, or even repeatedly inserted. Excluded are the drachma and Owl weights that I have argued did not belong to the main series of stater, then mina, fractions. As a summary these tables are convenient, and they should be compared with the no less over-simplified picture in Lang Agora X pp.6-7.

TABLE

The development of the major Attic weight series

A: late 6th/5th cent. ??distater.....Wheel Gp.B
stater.....Astragalos Gp.A.IIa
hemistater...Dolphin Gp.A.Ia
tetarte.....Shield Gps.A.I,II
?hemitetarte..Shield Gp.A.III
hemitriton...Turtle Gp.A.Ia plus ?? tortoises A.Ib
??1/12.....half-turtle/?tortoise Gp.B.Ia
??1/24.....quarter- .. .. Gp.C

(all fractions are of the stater)

B: 4th cent, but mainly 3rd (taking the point about numbers raised by the contrast with non-Attic weights: see below)
?distater.....Wheel Gp.B
stater.....Astragalos Gp.A.IIbc
mina.....Dolphin Gp.A.Ibcd
tetarte.....Tortoise Gp.A.IIa
hemitetarte..half-tortoise Gp.B.IIab
? also Crescent Gp.A
hemisyhemitetarte..half-crescent Gp.B.Ia,?c
trite- .....Amphora Gp.A.I
hemitriton...half-amphora Gp.B.I
hemisyhemitriton...quarter-amphora Gp.C.I (in part only ?)

(all fractions are of the stater)

C: 2nd/1st cent (Defined at its start by the change to mina fractions; this may have begun in the third cent. During the second century the 100dr mina was accompanied by others of 138dr then 150dr [IG.ii$^2$.1013]; I see no reason for extending this situation earlier than this century though the 150dr may continue into the first)

100dr mina from 2nd to 1st cent.

| | | | |
|---|---|---|---|
| tetramnoun...Wheel Gp.A | | | |
| ["dimnoun"....Astragalos Gp.A.IIb | | | |
| mina.....Dolphin Gp.A.Ibcd | | | |
| ?? 1/2 mina.....Tortoise Gp.A.IIbcd | | ??[1/2 mina....Amphora]?? | |
| ?? 1/4 mina.....half-tortoise Gp.B.IIcd | | ?? tetarton....half-amph.Gp.BIV | |
| ogdoon.....half-crescent Gp.B.Ib,?c,d | | | |
| ?? trite- .....Amphora Gp.AIIIb | | ? 1/3 mina....tortoise Gp.AIb | |
| ?? - | | ? 1/6 mina....half-tort. B.Ib | |
| ?? - | | ?? 1/12 mina...quarter-tort. C | |

138dr mina early 2nd cent.

? stater.....Astragalos LW.4 Gp.A.I
? mina.....Dolphin Gp.A.IId
?? -
?? -
?? okdoon.....Cornucopia (half-crescent C)
?? trite.....Amphora Gp.A.IIIa
?? -

(all fractions are of the mina)

Ib

e

y ?)

his

see
gh

---------- ? 4 minas.....Wheel Gp.C.I
---------- ? -
---------- mina.....Dolphin Gp.A.Ibcd
---------- ?? hemimn(a).....half-dolphin Gp.B
Gp.BIV ---------- ? -
---------- ?? 1/8 mina.....Wheel Gp.C.II
p.AIb ---------- ? -
B.Ib ---------- hexemoron.....Crescent Gp.A.III
rt. C ---------- ? -

150dr mina late 2nd/1st cent

stater..... Astragalos Gp.A.I and dimnoun.....Boukranion Gp.A.I
mina..... Dolphin Gp.A.IIabc and mina.....Boukranion Gp.A.II
hemimn(a)... Amphora Gp.A.II
tetarton.... half-amphora Gp.B.II-III
?? okdoon if not 138dr standard

TABLE

Distribution of weights in the major Attic series (numbers representing weights included in the foregoing analyses)

A: late 6th/5th cent.

| | |
|---|---|
| ??distater ... | ?1 |
| stater ..... | 1 |
| 1/2st ..... | 1 |
| 1/4st ..... | 9 |
| ?1/8st ..... | 1 |
| 1/6st ..... | 1 (plus ? some of a further 11) |
| ??1/12st ..... | ?2 |
| ??1/24st ..... | 2 |

B: 4th cent, but mainly 3rd.

| | |
|---|---|
| ?distater ... | ?1 |
| stater ..... | 8 |
| mina ..... | some of 28 |
| 1/4st ..... | 14 |
| 1/8st ..... | 25 (plus ? some of 56) |
| 1/16st ..... | 1 (plus ? 8) |
| 1/3st ..... | 36 |
| 1/6st ..... | 31 |
| 1/12st ..... | ? some of 10 |

C: 2nd/1st cent. -

100dr mina standard:

| | |
|---|---|
| 4 minai ... | 5 (plus ? 3) |
| 2 mn. ..... | 4 |
| mina ..... | some of 28 |
| ??1/2mn. .... | 33 (plus ? 2) |
| ??1/4mn. .... | 36 plus 1 |
| 1/8mn. .... | 36 plus 1 (plus ? 8) |
| ?1/3mn. .... | 11 (plus ?2) |
| ?1/6mn. .... | 16 plus 43 |
| ?1/12mn. ... | 2 |

138dr mina:

| | |
|---|---|
| ?stater ... | 1 |
| ?mina ..... | 1 |
| ??1/8mn. ... | 6 |
| ??1/3mn. ... | 2 |

150dr mina:

| | |
|---|---|
| 2 mn./stater ... | 7 |
| mina ..... | 11 |
| 1/2mn. ..... | 3 |
| 1/4mn. ..... | 11 |

## III. Stamps

Stamps, or countermarks, on Greek weights appear to confirm the persistent impression that the vast majority of these weights belong to a single source - the Athenian. No weight of classical or hellenistic date with a relief type that clearly indicates a non-Attic origin bears, to my knowledge, any stamp; those stamps of clearly non-Attic type, which are extremely few in number, need themselves be no more than the impressions of coins on lead pieces,[27] if indeed they are not in fact Attic versions of the types of such coins. The provenance of stamped weights is almost invariably Attica.[28] Furthermore the literary evidence for the practice of stamping is only available for Athens, whereas other areas (at later dates) adopted other ways of certifying or marking weights.[29] Stamps other than the Attic seem only to belong to the Roman administration and, even there, are somewhat unusual.[30]

If then stamps on weights are a peculiarly Attic feature, they nevertheless appear on too small a proportion of the series of Attic weights to affect the identification of this series as a whole as Attic (rather than general Greek). The interpretation of the practice of stamping remains within the Attic context, and is an important part of the general question of the administration of weights. The restriction to Athens is indeed helpful as it narrows the field, and allows more certain correlation with other (mainly literary) pieces of evidence.

Various explanations have been offered.[31] Most recently Kroll expressed the assumption that stamps marked official checking of weight, their duplication on certain weights being done to prevent defacement. Earlier Lang hesitated between the periodic certification of weights and the validation of changes in the weight standard. I do not however feel that the evidence will support any such general interpretation - be it checking, authorising, or changing weights. In what follows I shall argue that stamps were required on weights to be used (possibly for such general purposes) by public officials in Athens. Thus stamped weights are an entirely different category from both official standards (kept in special

places)[32] and weights for public use (those marked demosion). The need for stamps was not therefore particularly vital (in absolute terms), and so their non-appearance outside Athens is not necessarily at all surprising.

## 1. Lists and subdivision into types

The problem of inadequate publication is more serious for stamps than for the symbols on Attic weights. Even recent publication with photographs (by Lang, but more carefully done by Kroll) has failed to reproduce the stamps in a way that enables assertions made by the writers to be either checked or followed up.[33] A different difficulty lies in Pernice's earlier description: whether "ein viereckiger Stempel" invariably implies a stamp (as is clear on P.412) or just an incuse type (as one must wonder on P.808). As the majority of stamps are small, badly impressed, or worn, only a broad classification of types is generally possible.

The following lists of stamps are divided by subject matter into six main categories - human figures, animals, other objects and plants, stamps consisting of legends only and finally uncertain stamps and weights with more than one stamp. I suggest some subdivisions of the pictorial types but have not attempted to subdivide the largest group, of OWLS. Variations in this group appear more considerable than elsewhere, but in Pernice this is often for literary effect and in several cases incomplete descriptions are uncertainly supplemented elsewhere, and other scholars have tried to see more detail in the stamps than is often apparent in attempts to identify coin types (see elsewhere). Similarly, it is hardly worthwhile (as impossible in all cases) to describe the shape of the stamp; this appears to have been incuse circle, oval as well as square or rectangular (and the CORNUCOPIA on LW.28 is described as in a quarter-oval stamp). The position of the stamp, normally on the upper face of the weight, occasionally varies (the majority are underneath on Kroll's first two weights); the possible significance of this is discussed below. I have not included provenances in the lists for the sake of clarity; these may be significant however and are also discussed below where I have set them out more clearly as seemed relevant. Throughout I shall observe the convention of referring to stamps in capital letters [OWL] with weight relief types underlined [owl].

(a) Human figures

ATHENA I. head with legend metronomon - P.271, 405 (both Wheel(?) DEMO).
see title page to Pernice GG and Michon fig.5729.

II. no legend - P.415 (DHMOS[IO]N only).
on the other side of this weight is also an OWL AΘE stamp.

III. helmeted head (? Athena) - LW.46 (½-tortoise DHMO).

DIONYSOS seated with sceptre, thyrsos and cup; legend metronomon - P.6 (Astragalos STATHP) and LW.17 (Amphora TPITH).
Both stamps are illustrated Lang pl.V and dated to 1st cent BC.

MALE BEARDED HEAD I. no legend - under P.548 (lead cylinder 4.04gm)

II. ? head - on handle of P.666 (relief knotted club ?Attic)

ARTEMIS with two spears and hound - P.546 (plain 4.21gm)

(b) Animals

OWL P.512 (plain 13.49gm: ? 3dr)
P.557 (plain 2.72gm: ? 4ob)
LW.61 (plain 218gm: ? 4ob) owl facing front illegible letters to L.
Pnyx 3 (Tortoise DEMO) owl facing front: plus another stamp uncertain [? repeat].
P.399 (DEMO 60.166gm) owl plus A.
P.416 (D.MO wt.lost) owl plus AΘE.
Kroll A (½-tortoise DHMO) sitting owl, AΘE, two olive sprays: [6 repeats].
Kroll B (½-crescent D...) similar. [3 repeats]
P.182 (½-tortoise DEMO) sitting owl.
P.410 (DEMO 54.93gm) sitting owl plus DH.
P.400 (DEMO 58.77gm) owl with olive branch.
P.370 (Crescent DEMO) owl with two olive branches.
P.381 (Crescent DEMO) "Eule in zwei Hälften geteilt".
P.445 (incised 8drs) "Doppeleule".
P.411 (DEMO 54.27gm) double owl plus ΛA.
LW.26 (½-amphora HMITPITON) double owl (elsewhere on wt. mark EV) [? repeats].
P.415 (DHMOS[IO]N no wt.) double owl plus AΘE; also ATHENA II stamp.
P.32 (Amphora DEMO) owl plus ?cicada and ?kalathos.

CICADA I. no legend and type doubtful - P.99 (Amphora TPITH)

II. (with owl and kalathos on P.32)

BOAR'S HEAD with letters DH - P.185 (½-tortoise HMITE)

STRIDING PIG no legend - P.120 (Tortoise), 397 (DEMO 63.21gm)

HORNED HORSE HEAD no legend - P.158 (½-tortoise [H]MIT[ETAPTON] (?))
- P.272 (plain 453.3gm, but with other stamps).
The type is Seleucid, and of the other stamps on P.272 one is read as [βασι]λε[ως] Σελ[ευκου] by Pernice (see below).

DOLPHIN two dolphins round club(?) - P.681 (plain 64.2gm).
The type closely resembles Argive coinage .

(c) Other objects and plants

AMPHORA I. pointed - P.377 (Crescent DEMO), 742 (plain 43.51gm).
This type of amphora may possibly be Chiot (?).

II. Late Panth. inside circle - LW.33 (½-amphora TE[TAPTO]N).
This weight is of Amphora Gp.B.IV that Lang suspects of defacement.

PLEMOCHOE no legend - P.396 (DEMO 65.43gm).

KALATHOS I. kalathos plus letter A - P.361 (Crescent DEMO).

II. (with owl and ?cicada on P.32)

III. kalathos within olive wreath - P.398 (plain 61.3gm); LW.27 (½-amphora DEMO) and LW.48 (½-tortoise DEMO).

IV. kalathos (?) no legend - P.428 (marked D (?); 70.35gm).

TRIPOD I. tripod no legend - P.125 (Tortoise DEMO)

II. tripod with letters DH and small cup - P.175 (½-tortoise DEMO)

OLIVE I. olive branch plus E (? [AΘ]E) - P.316 (½-crescent)

II. olive branch only - P.349 (Crescent DEMO).

III. (olive wreath round kalathos.qv).

THYRSOS ?? thyrsos in circle - LW.56 (HMISYHMITET in relief; 55.5gm).

SHIPS PROW no legend - P.77 (1/4-amphora [DH]MO[SION]).

CORNUCOPIA no legend - LW.28 (½-amphora HMIT).
Also on this weight is a ROSETTE stamp. The cornucopia twixt two branches described as on a stamp on P.648 is clearly Roman.

ROSETTE/STAR LW.28 (½-amphora HMIT) rosette; also CORNUCOPIA stamp on wt.
LW.45 (½-tortoise HMITE) different sized rosette.
P.814 (plain 13.28gm) rosette (?).

P.30 (Amphora TPITH) six-pointed star.
P.783 (plain 144.01gm) eight-pointed star.
P.791 (plain 74.34gm) similar (but wt. a truncated lead pyrmd).

(d) Legend only

ΜΕΤΡΟ[ΝΟΜΟΝ] retr. in square stamp - P.323 (½-crescent)
Illustrated Michon fig.5727.

(?) relief - P.805 (plain 28.51gm) . [?provenance ; ? Romano-Egyptian]

(??) round stamp - P.676 (relief 9 0 R 4.1gm; ??Attic).

(?) square stamp - P.673 (plain 14.81gm) plus another uncertain stamp

[ΒΑΣΙ]ΛΕ[ΩΣ] ΣΕΛ[ΕΥΚΟΥ] - P.272 (plain 453.3gm) also with HORNED HORSE HEAD.

(e) Uncertain (so omitted)

P.408 (DEMO 55.66gm); 412 (DEMO 53.21gm);
P.823 (plain 5.68gm); 830 (plain 1.09gm); 561 (plain 0.665gm);
P.808 (incised III over stamp; 21.91gm);

P.Supp.12 (incised ΜΝ(Α) over stamp; provenance Asia Minor; 409.75gm);

P.104 (Amphora in wreath [?Attic] DEMO);

BB.2233 (Amphora ΗΜΙ ΜΕΤΡΟ; see Michon fig.5742)

LW.26 (½-Amphora ΗΜΙΤΡΙΤΟΝ; also with OWL stamp, and Lang thinks uncertain stamp to be an unsuccessfull first attempt).

Pnyx.3 (Tortoise DEMO; also with OWL stamp; ? explain as last weight).

P.272 (plain 453.3gm; Pernice notes 4 stamps in all - HORNED HORSE HEAD, Seleucid king, plus two others doubtful).

(f) Summary of weights with more than one stamp

uncertain with other stamp (? repeat) - LW.26 (OWL); Pnyx.3 (OWL); P.673 (Γ); P.272 (? of HORNED HORSE HEAD or of BASILEWS SELEYKOY).

clearly different stamps - P.415 (ATHENA II and OWL); P.272 (at least HORNED HORSE HEAD and BASILEWS SELEYKOY); LW.28 (CORNUCOPIA and ROSETTE).

clearly repeated stamps - Kroll A and B (both with OWL AΘE etc).

## 2. Chronological arrangement

The relationship of a stamp to the weight on which it appears is very much the subject of this whole discussion of stamps. As a result the chronological ordering of stamp types can only proceed from the internal dating of the stamps themselves and from indirect application of the sequence for weights established earlier. Some circularity is inevitable, but it can be restricted to the less important groups of stamps.

One method Pernice used to date stamps was by their style; and in this way he placed ATHENA METRONOMON I around 400BC and the BEARDED HEAD stamp in the fifth century.[34] Both these dates are very much earlier than anything else to be encountered, and although the latter stamp is unique (doubtfully Attic and on an untypical weight) the early date for the former could be disquieting. All other weight references to the metronomoi[35] are late second, or early first century, certainly they need not be earlier, and if the weights in question (P.271 and 405) are correctly identified as Wheel again a latish date is suggested by the analysis of these weights above. The lack of proper illustration of these stamps is unfortunate (Pernice only gives a line drawing of the former stamp on his title page), but for the reasons given I am sceptical about the date of c.400BC for an Athena who appears to lack the olive leaves of the early Attic helmet. I suspect (to judge from the OWL stamps in Kroll) that the impressions of these stamps are inadequately clear for dating by minor elements of style.

Another approach, that is rather more fruitful, is to seek parallels for stamps in Attic coinage. A number of symbols are, as with the weight relief symbols, too general to be any guide to date (AMPHORA, TRIPOD, ROSETTE/STAR for examples), but several have been used in this way. Most recently Kroll has argued that the OWL stamps on his two bronze weights compare with the Attic 3ob coin of the early, rather than late, 4th century.[36] Earlier Lang compared other OWL stamps to those appearing on measures and resembling Attic 2ob coins of a more generous 4th century date; and Pernice was somewhat less precise but no less enthusiastic in citing other coin parallels. Again however I feel it reasonable to express some doubts about these comparisons: it does not seem that they are close enough to rule out bronze coin versions of somewhat later dates than the silver coin types cited. Furthermore the full range of possible coin parallels does support the likelihood of bronze, rather than silver coins being the source of the stamp types. This I infer from the fact that

several types seem to have appeared first on non-Attic silver coin, and only subsequently on third-century Attic bronze: thus the SHIP'S PROW of Demetrius Poliorketes and Antigonos Gonatas; the Eleusinian PIG; or Delian ARTEMIS.[37] If this inference is correct for the less common stamps, perhaps it can be more seriously considered for the apparently straightforward Attic obol types involving the OWL. Rather less uncertain however are parallels with the New Style coinage where possible confusion and conservatism no longer blur comparisons: thus the AMPHORA and DIONYSOS stamps can be placed within this period to the 2nd/1st and early 1st centuries BC respectively (the last, note, with the legend 'metronomoi' read by Lang).

Proper use of coin parallels ought therefore to give at least some terminus post quem dates for stamps so identified: briefly "3ob" and "2ob" OWLS should extend from the fourth century but are more likely to be third century, as also PIG (2), SHIP, and ARTEMIS; the AMPHORA stamp extends, as said, from the second century; and DIONYSOS from the first century BC. On the other hand a terminus ante quem for a stamp's earliest appearance can in addition be derived from the context of the earliest weight on which it is found. Thus the earliest stamp, THYRSOS (?), is known to have been used by the late fifth, or early fourth century; the frontal OWL (on Pnyx 3) perhaps unhelpfully by the fifth-fourth century (Davidson); ATHENA III and some double OWLS by the fourth century; ROSETTE by the third century; CORNUCOPIA by the second; DIONYSOS and KALATHOS III by the first century BC. From these pointers a conjectural table for the use of stamps can be constructed (see following page). This should be correlated with those reached earlier for the weights themselves; and gaps have been supplied by using in some cases the weight-group date as a base to be confirmed or emended from independent indication of stamp date.

TABLE

Chronology of stamps correlated with weights (the basic chronology is of the weights; the few shifts demanded by stamp dating are indicated by arrows)

| | | |
|---|---|---|
| Early 4th.cent: | Stater fraction | - THYRSOS (?) [late 5th/early 4th context] |
| 4th-3rd cent: | ½Tortoise BIIa | - BOAR'S HEAD [but could be later]<br>HORSE PROTOME [early 3rd. c. Seleucid]<br>ROSETTE [3rd.cent. context] |
| | ½Tortoise BIId | - ATHENA III [4th.cent. context]<br>OWL [4th.cent. coin type: Kroll] |
| | Amphora AIa | - ROSETTE |
| | | - DION.METRON. [Late hellen. context] |
| | Amphora AId | - OWL [but could be later ?] |
| | ½Amphora BIa | - OWL [4th.cent.coin type; late 4th.cent. context] |
| | ½Amphora BIb | - CORNUCOPIA [mid 2nd.cent. context] |
| | ½Crescent BIc | - OWL [4th.cent. coin type: Kroll] |
| 4th-2nd cent: | Tortoise AIIb | - STRIDING PIG [probably 3rd.cent.coin] |
| | Tortoise AIIc | - TRIPOD I with OWL [Davidson ?] |
| | ½Tortoise BIId | - TRIPOD II<br>KALATHOS III [or later as ½Amph.BIc ?] |
| | ½Amphora BIc | - KALATHOS III [late hellen. context] |
| | ¼Amphora CI | - SHIP'S PROW [prob. 3rd.cent. coin] |
| | ½Crescent BId | - OLIVE I [or later as Cresc.AIIIc ?]<br>METRO [2nd.cent. or later] |
| 2nd-1st cent: | | |
| 100dr mina ..... ? | Wheel CI,II | - ATHENA METRO I |
| | ½Amphora BIV | - AMPHORA [Late Panath. type] |
| | Crescent AIIIc | - OWL<br>AMPHORA [Late Panath. type]<br>KALATHOS I<br>OLIVE I |
| 138dr mina ..... ? | Amphora AIIIa | - CICADA (?) I |
| 150dr mina ..... | Astragalos AI | - DIONYSOS METRO [early 1st.c. coin type] |

3. Inferences from the chronology

At this point I shall examine some detailed evidence for when stamps were placed on weights that arises from the chronological sequence proposed. It will be argued that a considerable time can have elapsed between a weight's first manufacture and its being stamped, but equally the two operations could have occured at the same time. Both phenomena can moreover be illustrated by a single stamp type (in fact the important DIONYSOS METRO stamp). The general rule however would seem to be that stamps were placed on weights not long after their manufacture.

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The interpretation of stamping in general is not much assisted by the small class of what appear to be late stamps on earlier weights. This is composed mainly of Amphora weights, with stamps apparently belonging to the second or first centuries BC; but unfortunately these Amphora weights are the most uncertain part of my attempted reconstruction of the Attic weight systems of this period.

Clearest, and most interesting, is the early, fourth century TPITH (1/3rd stater) Amphora weight LW.17 (Amphora AIa, 325gm). Its stamp, DIONYSOS METRO, is dated to the first century BC by coin types; and its context is late hellenistic. The same stamp occurs also on an Astragalos AI weight of the 150gm standard (dated late second/first century BC). As there are Amphora weights of this standard, it seems reasonable to conclude that this weight (LW.17) was stamped for inclusion in the contemporary weight series. Its actual weight would indicate a corrected coin mina of 433gm, which is acceptable though slightly lower than the other half-mina Amphora weights of this high standard.

A rather lighter Amphora weight of the same group (P.30 at 298.25gm) was stamped with the ROSETTE that appears also on another early ½Amphora weight (Gp.BIb, LW.28 HMIT, at 150gm) in conjunction with another stamp, CORNUCOPIA, in a mid second century context. It is of course not clear which stamp on the latter weight (LW.28) was the last to be struck upon it. Attractive is the association of the Cornucopia relief type on weights of the 150gm standard. The ½Amphora groups on this standard (Gps.BII-III) are however rather high in weight compared with the 150gm LW.28, the condition of which is described as good. Although stars appear on some Crescent weights of the latest first-century group (Gp.AIII), the ROSETTE

stamp itself should not be later than the third century (or is not likely to be later than the third century) as appearing on the ½Tortoise LW.45 in a third century context.

Of the uncertain Amphora weights of the second century at least two classes bear stamps that may relate to the fluctuating values of the period before IG.ii$^{2}$.1013. Lang's "thin" or "false weight" ½Amphora LW.33 (my Gp.BIV) bears a stamp, AMPHORA, that is also found on the later, first-century Crescent AIIIc group. P.99 (one of the two weights of Amphora AIIIa tentatively attributed to the 138dr standard) is also stamped, though the stamp, CICADA, is uncertain and unique.

KALATHOS III (with an olive wreath) may also belong to the late hellenistic period. This would explain how what otherwise would be thought an early ½Amphora weight (LW.27) was found in a context of this late date. The weight, 155gm, presents the same problem of attribution as already encountered for LW.28, stamped with CORNUCOPIA (ROSETTE). A further KALATHOS III stamp occurs on the ½Tortoise LW.48 (Gp.BIId); the condition of the weight is poor as a corner is broken off (95gm as opposed to a possible 114gm on Lang's estimate of the weight loss); may this not be related to the stamping ? Unfortunately it is not possible to decide what the resultant weight was meant to represent. A ½Crescent weight P.316 may be closer to the later Crescent weights in view of its OLIVE I stamp; by weight however on my analysis it should not be later than the early second century.

Only the DIONYSOS METRO stamp can therefore be said to be certain evidence of "re-validation" at a later date of an earlier weight; it does not support any general interpretation for other, less specific, stamps.[38]

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If some stamps were placed on weights long after their manufacture, it is possible also, but more difficult to prove, that some were placed at the time weights were made, or soon afterwards. This is much less straightforward a problem than the unwarranted series of "assumptions" made by Kroll[36] would suggest. It is strongly indicated by the parallel of clay capacity measures bearing stamps: these at least can only have been made before the clay was hard, before the manufacturing process was

in fact completed. On the other hand there is a greater practical distinction between the mould process used for the relief symbol on weights and the subsequent stamping of the weights when the metal was hard.[39] If coins could be made without a subsequent validationary process why not also weights ? Moreover as not all weights bear stamps, not even all weights of any particular type, stamping, and the reason for stamping, are clearly dissociated from the manufacture of weights.

The general looseness of the establishable chronology for weights and stamps makes it very difficult to show on this basis whether stamps were significantly close in date to the weights themselves. On some occasions this may however be likely: LW.26 is a ½Amphora weight of a group placed in the relatively narrow context of 340-310BC (Gp.BIa), its OWL stamp is comparable to fourth-century 2ob coin; again the Astragalos "stater" P.6, on the 150dr standard, could tentatively be argued close to the early first-century date of its DIONYSOS METRO stamp.[40]

It will clearly be more profitable to abandon further attempts to stretch the limitations of simple analysis of weights and stamp series. The evidence for official involvement and for the use of stamps will next be considered; for this some indications are given in outside sources.

## 4. Official involvement

There appears to be no direct evidence for stamped weights in literary or epigraphic sources. IG.ii$^2$.1013.64-67 is cited in this context,[41] but must surely refer only directly to capacity measures as only metron (or metra) is mentioned (and not also stathma).[42] Nevertheless it may be possible to derive some idea of the use of stamped weights from that described here of stamped measures. First, only officials are here required to use them; the lines 64-67 are part of a miscellaneous appendage to the main decree and are directed explicitly to hoi archontes and hai archai. Secondly, these stamped measures are to be used when buyers and sellers are not using stamped measures; the implication therefore is that the officials are to check unstamped measures with their specially stamped ones.[43]

A third inference can de drawn. The officials are required to use a stamped measure identical to that in the Skias; the way this is expressed makes it possible that stamping guarantees or reflects this equivalence. The Skias was but one of several places where this decree elsewhere shows that standard weights and measures were kept - further sets were in Eleusis, the Peiraeus, and on the Acropolis (quite apart from the Mint weights).[44] I shall presume that measures, and so weights by inference, might be stamped as a result of having been checked against the official standards in these various places as well as in the Skias. It would not be unreasonable then to suppose that the stamps used in these various places were distinguished from each other.

This position is admittedly hypothetical and based on the very late second-century organisation indicated by IG.ii$^2$.1013, a decree in itself concerned to reorganise in part such organisation. Suitable officials from these various areas do however considerably antedate the inscription as also do the metronomoi themselves.[45] It could be argued that the decree is mainly concerned to introduce only a superficial change: the 150dr standard in place of the 138dr,[46] and that other details reflect the need to underline the continuation of existing administration of weights and measures: thus the same man continues in charge of making these measures,[47] and no new officials are to be appointed. Secondly, both the Peiraeus and Eleusis have obvious connections with commercial activity: the former as the main port, the latter a major building area, with officials who could weigh and supervise contracts based on weight unit pricing.[48] Thirdly, the correlation of measure stamping with weight stamping is fairly secure: similar stamps occur on both. The double-bodied OWL is found on the Agora dry measures (DM.44,45,48 and 51) and liquid measures (LM.21-24) in the fourth century; the important DIONYSOS METRO stamp of the early first century also appears on a dry measure (DM.66, the notorious"nut measure"). I feel it is fair therefore to examine stamp types firstly for direct reflection of official involvement, and secondly for indications of possible subdivision between such (geographically separated) offices as suggested by the above hypothesis.

Only two groups of stamps can immediately be recognised as official. (1) The OWL types, frequently with AΘE and also found on measures; they belong mainly to the 4th-3rd century and an OWL in a hellenistic context (on LM.61) is rather isolated. (2) The stamps marked with a reference to the metronomoi (ATHENA I, DIONYSOS METRO, and other METRO groups); all these I have suggested are late 2nd to 1st century.[49]

Further groups are less explicitly official. (3) Stamps that incorporate the letters ΔH; these letters most plausibly stand for demosion and so indicate an official source; they appear on TRIPOD II (P.175), BOAR'S HEAD (P.185), as well as OWL (P.410). Associated are therefore other stamps incorporating other letters: (4)"ΛA"on an OWL stamp on P.411; (5) "E"on an OLIVE stamp on P.316; (6) "A" on KALATHOS I on P.361.

The provenance of stamped weights strongly assists the interpretation of some of these groups and enables further associations. Although the majority are from Athens (in general, and only with Lang's weights from a specific area of Athens, the Agora), several are only doubtfully called Attic,[50] and others, most interestingly, were found in the Peiraeus. Thus:

Attic (? Athens): BEARDED HEAD P.548 (sole weight with this stamp).
: Certain OWL stamps (P.321, 381) although others are mainly from Athens (with the Peiraeus exception below).
: One HORSE PROTOME though the other is certainly from Athens.
: One AMPHORA in the same position.
: PLEMOCHOE P.396 (sole weight).
: KALATHOS I (with "A") P.361 (sole weight).
: OLIVE I (with "E") P.316 (only weight with known context).
: One STAR though the other ROSETTE stamps are on Agora wts.

and Peiraeus: ATHENA I (with legend "metronomon") (whole group).
: One sitting OWL (P.182) though others are Athens or ? Athens.
: CICADA I P.99 (sole weight).
: BOAR'S HEAD (with "ΔH") P.185 (sole weight).
: STRIDING PIG (whole group)
: One KALATHOS III (within olive wreath) though the two others are from the Agora [Lang does not however compare the Peiraeus stamp].
: KALATHOS IV P.428 (sole weight).

It may now be possible to attribute stamps to the various offices where I am suggesting they were made. Athenian, and so struck in the Skias,[51] are likely to be OWL (especially with AΘE), DIONYSOS METRON., and the simple METRO- stamps. To the Peiraeus authority belong the ATHENA I (with legend "metronomoi") stamp; the two stamps with pigs, namely BOAR'S HEAD with legend "ΔH" and STRIDING PIG; possibly also CICADA (both types) and KALATHOS I and IV. This leaves for Eleusis (out of the Attic but ? Athens group) most happily OLIVE I (with "E"), but more tentatively BEARDED HEAD and PLEMOCHOE.

Identification of the source or authority for stamps outside these groups is even more hypothetical. In view of the practice of official stamping, it would seem more likely that these other stamps were also struck by officials though they are not now identifiable. That "ΛA" on

an OWL stamp might stand for Laureion is an attractive, but unsupportable, hypothesis.[52] Possibilities other than the official stamping by the authorities mentioned in IG.ii$^2$.1013 cannot be ruled out. I feel unhappy about their being marks of ownership however, as this sort of marking would more likely be simple scratches;[53] or even manufacturers' marks,[54] as they are the exception rather than the rule on manufactured weights. A more valid alternative would be shop- or trader- marking.[55] Nevertheless, the stamps do carry the impression of official control, and this cannot be doubted in certain cases; as commercial control was spread through the deme Agorai of Attica (as well as the centres mentioned above), there are quite insufficient stamped weights for official use, let alone the possibility of private enterprise also being involved. The hypothesis of official stamping is reasonable and sufficient.

## 5. The purpose of stamping

Given that stamps (the majority if not all of them) were struck by officials of various authorities, the purpose of such stamping can now finally be reviewed. A start on this question was made above in considering measures, stamped and unstamped, mentioned on IG.ii$^2$.1013. I inferred that stamped measures, and so also stamped weights, were not obligatory in normal commerce; though they could be used, it was only the officials who had to use them. This point is supported by the fact that the majority of weights bear no stamps. Here I shall continue by considering further the weights that were stamped. I should add, by way of introduction, that it may not prove possible, indeed it should not be assumed, that a single explanation suffice for all stamped weights; but certainly the likelihood of single explanation follows from the probability that most stamps were issued by similar official authorities (as argued in the last section).

The weights on which stamps appear have very little in common beyond their being stamped. Most, but not all, are lead weights. This fact led Kroll to seek special status for his two stamped bronze weights.[56] However lead weights are by far the most usual weights in any case, indeed the proportion stamped is probably much less than of bronze weights. Secondly, most, but not all, stamped weights are also marked demosion

in some way or other.[57] I shall argue below that the point of such a legend is obscure (carrying hardly more official guarantee than the relief symbol, where this occurs); in any case it cannot be equivalent to stamping for the very lack of correlation just mentioned.

A third observation about stamped weights is that certain weight types were more frequently stamped than others. This is indicated in the following table, and is most noticeable if subgroups are compared rather than generic types. To an extent the figures should be corrected against the size of each group although different factors must be allowed as determining the number of weights stamped and those made at all. It is not necessarily significant that the whole of a group is stamped, and especially where (as is invariably the case) the group is composed of a single stamped weight. In general however I feel that the weights stamped are too variable in types, in dates, and in weight,[58] for stamping to be associated with any one of these features.

TABLE

Numbers of Attic weights on which stamps are found (arranged by types, in descending order of total number of stamps; the figures in brackets after each number refer to the total number of weights in the class involved)

| | | |
|---|---|---|
| Miscellaneous .. | unmarked 10; just ΔΕΜΟ etc. 12; stater frs. 1 .... | 23 |
| Tortoise ..... | AIIb - 1 (16); AIIc - 2 (13) [not counting twice the uncertain stamp on Pnyx.3]; BIIa - 3 (18); BIId - 5 (25) ..... | 11 |
| Amphora ..... | AIa - 2 (19); AId - 1 (4); AIIIa - 1 (2); BIa - 1 (14); BIb - 1 (4) [not counting as two stamps LW.28]; BIc - 1 (7); BIV - 1 (1); CI - 1 (?10) ..... | 9 |
| Crescent ..... | AIIIc - 5 (15); BId - 2 (28) ..... | 7 |
| Wheel (?) ..... | CI - 1 (1); CII - 1 (1) ..... | 2 |
| Astragalos .... | AI - 1 (4) ..... | 1 |

[As Lang's assertion (p.22) that Pernice's weights included a stamped Dolphin is refuted by Pernice (GG p.21 "auf den Delphingewichten fand sich kein Stempel"), no Dolphin weight is listed here]

Although stamps are represented on a fairly wide range of weight denominations they are undoubtedly commoner on those between a third and a sixth of the normal (100dr standard) mina. They are not found on the mina itself, and the only stater to be stamped is very late (first century Astragalos P.6). This fact should imply that stamps did not have any

theoretical application (such as regularisation of weight standard). A practical interpretation is moreover made more likely by the fact that these lower weights are also the more numerous surviving (and so presumably those most used in practice).[59] It is therefore probably significant that no relief drachma weights are stamped.[60] I shall argue in later chapters that drachma weights would be most unlikely to be used in general commerce. The correct interpretation of stamping would seem to lie in the commercial context. Before this conclusion can be settled however it is necessary to consider what possible claims could be being made by the stamps on these weights. Some recent theories must be discounted.

Lang has suggested that stamps were used "to validate changes from one standard to another" (Agora X.21-2). This may possibly have been the case with LW.17 in the early first century BC as I have already allowed above. However her reluctant comment that "the variety of stamps may be considered excessive" is clearly an understatement. LW.17 is the only weight for which change of standard can be reasonably suggested; other weights, with later stamps, need not be supposed to have changed standards; and no weights, stamped in the earlier period (especially the fourth to third centuries), can have changed standards as, in my view, there was only one standard in operation through this period.[61] As a general explanation of stamping, moreover, Lang's theory is ruled out by comparison with the appearance of similar stamps on measures of capacity. These always belonged to the same "standard" and were (where as usual of clay) stamped on manufacture rather than subsequently. Further, the regulation at IG.ii$^2$.1013.64-7 becomes grotesque if stamping was only to validate changes of standard: officials would appear to be required to use only out of date weights and measures that have been converted to the new standard. Finally, it seems reasonable to cite against this hypothesis the fact that several weights were altered, or remarked in equivalent or changed denominations, without this fact having to be registered (or "validated") by a stamp.[62]

Chronological gaps, changes in standard, and adjustment of weight appear to have no necessary relation to the reason for stamping. It would seem therefore that an explanation should be sought in terms of those who used the weights. Thus, yet again Lang, "the most likely explanation ... is that it represents official inspection and certification of the weight",[63] or, more strongly on the next page, "periodic inspections of weights when all weights in use had to be certified by the metronomoi".

Kroll made the not very different assumption that a stamp bore witness to an official check carried out upon the weight so marked.[64] These explanations as they stand are unstaisfactory. There is no evidence of law or ruling to the effect that checks on weights (or measures) had to be validated by stamps; periodic inspection of all weights is clearly ruled out by the fact that not all, indeed only very few, are stamped; and even fewer weights are stamped more than once although the useable life of many may have been considerable.[65] This point should be expanded. On Lang's view of multifarious changes of standard from earliest times, it is extraordinary that, given her explanation of stamping, only two Attic weights bear certainly different stamps: LW.28 (which had a long life from the third into the second century) and P.415 (which is inadequately known).[66] Other weights with more than one stamp seem to bear repeated impressions of the same stamp with all but one of these impressions blurred. Lang was surely right to suggest that the reason for repetition of these stamps was the failure of the earlier attempts.[67] This explanation applies in particular to the stamps on Kroll's weights, which, being bronze, were considerably harder to impress clearly.[68] The only permissable inference from these multiple stampings is that clarity was felt to be important.

For none of the explanations considered so far is there any supporting evidence; the explanation I shall here propose is derived from the late second-century decree IG.ii$^2$.1013 and follows the line of inference I developed above; it is further confirmed by the considerations raised in the course of the preceding discussion. To take the last first, I suggest clarity was important in that the stamps were necessary on weights used by officials in the course of their duties. Whether these duties were wider than the checking of weights used by general commerce (as is the context of IG.ii$^2$.1013) cannot be proven; the distribution of stamps is however similar to the general distribution of denominations of weights in general, and would therefore suggest stamping was needed in more general rather than specialised contexts. Stamped weights are not properly official standards, as these were kept locked away in the various centres; stamping, I should argue, reflected the checking of a weight against such standards. The importance of the difference between this position and that held by, for example, Lang lies in the closed context in which such checking (on my view) took place.[69] From the fact that stamped weights begin in the fourth century, when the existence of metronomoi is also first attested, it is not necessary to suppose many changes except in details ocurred in their use of stamping until beyond IG.ii$^2$.1013.[70]

## IV. The manufacture of Attic weights

Beyond a reference to Diodoros, son of Theophilos of Halieis, as the person "in charge of the preparation of measures and weights" in IG.ii$^2$.1013.38-9 the people involved in the manufacture of Attic weights are entirely unknown. Pernice seems to have thought that several firms were involved as he identifies some stamps as "Fabrikzeichen".[71] There are, as has been argued in the last section, no grounds for any such identification. Despite the general lack of any further positive evidence, I feel there is some justification for the suggestion to be put forward here that the Athenian mint was itself responsible also for the manufacture of weights.

It is an undoubted fact that, whatever the confusion caused by the attempt to analyse surviving Attic weights, they formed at any time a clear and acceptable system in ancient Athens. The weight symbols apparently were sufficiently understood to be haphazardly omitted. Such omission, perhaps more regular, is most characteristic of ancient Greek (certainly Athenian) coinage. Further, the consistency of symbol that such understanding presupposes cannot have been ensured simply by practice or the demands of independent traders. A unifying factor is required to cover all the weights of the main Attic series, and this is more likely to have been the manufacturing source than state control (which is nowhere recorded as concerned with the form weights took).[72] This argument for a single manufacturing source is further reinforced by consideration of technique. Weights were made in a very similar manner over a long period of time (separating the early bronze weights with rivetted symbol as a special phase). In so far as moulds were required and some awareness of weighing, weight manufacture can be regarded as a specialist process; in many respects it is very similar to the making of coins.[73] Another general relation to coins is the stylistic: independent artists could well have paid less careful attention to coin-style changes than did those responsible for the weight moulds.[74]

Several rather more detailed arguments can be added. First, Attic weight standards were expressed in antiquity in terms of coin weights and their relation to larger units. I cite here simply Arist. Ath.Pol.10 and the various formulations of IG.ii$^2$.1013.[75] Whatever the early alteration, the 100dr mina held for a considerable period and then, when changed, was supplemented,[76] not supplanted, to form the higher commercial standards of the second and first centuries. I should admit however two qualifications to this arising from later chapters of this study: coin weights were naturally used as weights as coins were used as weights and as there were no alternative small weight units; further the metrological connection of coin with other weights is hardly surprising since, as I hold, the higher weight systems were only started as a result of (and on the basis of) the coin systems. This last point will be found to retrieve the argument I am making here about the common manufacture of these various weights.[77]

Secondly an observation on the legend demosion to be pursued in the next section in particular. The inclusion or omission of this legend is apparently haphazard; it can hardly be thought to be sanctioned except for a state controlled manufacturer; as there is no visible, measurable, or theoretical way of distinguishing the production of these demosion weights from the others, the inference must be allowed that all weights were produced by the same state manufacturer.

Thirdly the production of weights is compatible with that of coins even apart from the similarity of techniques mentioned above. The material most commonly used for weights, lead, occurs most naturally in conjunction with silver extraction. Athenian silver was mined, and so extracted locally. If by the fourth or third centuries available bronze was being used for coinage, the choice of lead for weights could be said to show a satisfactory deployment of resources. As lead however was probably also cheaper it would be wrong to press for any more far-reaching implications.

The difficulties of this mint manufacture hypothesis are not decisive. There are no records of weights being sold or let out to the public who used them; but there are equally no records of the release of the other, main product of the mint, namely coinage. It may be noted that the drachma weights (and those closest to the sorts of weights handled in coin production) lack the symbols in relief so typical of the stater and mina weights (and their fractions); however in all other

respects the technique of manufacture is consistent, and the distinction mentioned may more plausibly be thought to have been fostered on purpose to clarfy the difference in weight systems. Mint weights proper (the weights used for standardising and checking coin) are mentioned in IG.ii$^2$. 1013.30 and may possibly be what the particularly precise and untypical (as incised design) Owl weights were; such special standard weights however need not be confused with the mass-produced commercial weights. A final difficulty lies in the fact that Diodoros of IG.ii$^2$.1013.38-9 was in charge not only of the preparation of weights but also of measures; the clay liquid and dry measures would seem to have called for very different manufacturing techniques. This objection is not necessarily significant if we can think of Diodoros as a skilled metal worker and the measures involved as special bronze sekomata; alternatively an extension to the operation of the mint would have to be supposed to include the firing at least of clay measures.

Alternatives to the mint hypothesis are not easily framed. A certain amount of metal working went on at Laureion, and weights could have been manufactured there as easily (as far as supposed technique is concerned) as in the mint itself. On the other hand the evidence of Laureion work is that it was private enterprise and uneven, and neither of these conditions is particularly suitable for the supply of weights to the Athenian state. There is no helpful parallel from states other than Athens, except that in most places the weight types reflect (or their legends directly indicate) state involvement. I should add that I am not particularly concerned to prove or deny that the mint manufactured weights rather than another state-run factory. The importance of either source being responsible for the practical side of the operation is less than that the state is the ultimate controller; the implications are roughly the same.

These implications arise from coinage. It may be possible to understand rather more about weights in decrees (starting with the mid fifth-century Attic decree) that only spell out in detail requirements for coinage.[78] One of the significant features of these requirements is, as will be emphasised in later chapters, that accurate weight is omitted; I shall argue that such state-produced tokens as coins were literally accepted, more often than not, at their face value;[79] this would further explain (or excuse) the variation in coin weights. This conclusion if applicable also to weights would be one way of explaining their (much more considerable) variation.[80] Before discussing this problem of the inaccuracy of Attic weights I wish briefly to consider other evidence for official involvement.

## V. Explicit marks of official involvement

I have argued above that stamps on weights refer to their having been checked for use by Athenian market officials. Here I wish to consider explicit marks of similar involvement by officials. These fall into two groups: the most common is some variant of "demosion", the other, which is also evidenced in the stamps, comprises references to the officials themselves, the Agoranomoi and the Metronomoi. It will be shown in the next section that, despite the apparent claims made by these references, no greater precision is to be found in the weights upon which they are made.

### 1. "Demosion"

These weights are too numerous to be listed here, but can be found in the preceding type analyses with the additional collection of weights with no type other than the legend "demosion" or a variant of it. More usually this legend is part of the relief mould on weights with symbols; exceptionally it is found incised on the earliest bronze weights (with the symbol rivetted on in relief); it is unclear in every one of the lead mina-fractions without symbol but with "demosion" whether this legend is in relief or incised. The early bronze weights are also unique in that their legends also refer explicitly to Athens;[81] the city is only otherwise named on the Owl weights[82] and in certain stamps, also involving owls; the connection with coinage can however be restricted to these latter classes (the owl being decisive).

Apart from the drachma weights,[83] all types of Attic (stater- and mina-) weights include examples marked with "demosion" except Boukranion (which is however marked "AΓO": see below) and Cornucopia. Both these types are late and belong to the heavy 150dr standard. Although I am hesitant about recognising anywhere the 138dr standard (still less any

others), it would seem that "demosion"is restricted in use to the 100dr mina weights. With the single exception of some scattered (and hardly identifiable) Amphora weights,[84] the heavier standards appear, if marked, to carry reference to some expressly commercial authority as follows.

2. "Agoranomoi" (?)

Several weights carry the incomplete legend AΓO or AΓOP; a more lengthened form may be the way to interpret the legend ΑΓΟΡ.ΑΟ.ΝΟ.ΗΜΙ (on the Amphora weight P.97).[85] The legend was interpreted by Pernice as a reference to the 150dr standard that he believed was called μνᾶ ἀγορεία.[86] There was however no such mina. Pernice appears seriously to have misunderstood IG.ii$^2$.1013 in thinking that a mina was being proposed to supersede the μνᾶ ἐμπορική. Besides, the adjective ἀγόραιος ought to mean "belonging to the Agora" rather than "commercial" (for which ἐμπορικός was used).[87] Two possible interpretations of the incomplete legend ΑΓΟΡ- should be more seriously considered: ἀγορ[αίων σταθμῶν] or [Ἀγορ[ας ..], both signifying that the weight belonged to the Agora;[88] or, alternatively, ἀγορ[ανομῶν] signifying the officials in charge of commercial activity in the Agora. The latter interpretation can be preferred on the grounds (1) that there is a simple parallel in the indubitable reference to the Metronomoi (see following); (2) that Agoranomoi are frequently mentioned in the legends of non-Attic weights; (3) that the second "O" in the legend of P.97 might be a stamp and therefore the letters should read ΑΓΟΡΑΝΟ-ΗΜΙ.[89]

The difficulties in thus reading "Agoranomoi" should however be recognised. First, the parallel with Metronomoi also involves an overlap; how should the activities of these two groups of officials be sufficiently distinguished for each to have weights made with their names upon them ? Second, is the fact that the Agoranomoi at Athens do not appear in the fourth century at least to have been closely concerned with absolute weights. Aristotle distinguished the activities of the Agoranomoi ("to ensure that merchandise was in good condition and genuine" Ath.Pol.51.1) from those of Metronomoi ("to ensure that traders used proper weights and measures" ibid 51.2) and Sitophylakes (whose job included "ensuring that loaves sold were of the weight that they by law had stipulated" ibid.51.3); the Agoranomoi had according to this view a very general supervisory function while the more specialist areas of commercial regulation, including the regulation of weights, were the concern of other specialist officials.

It could be supposed that Aristotle was being over-precise in the distinctions he made between these groups of officials. Earlier in the fourth century Xenophon assigned to the Agoranomoi the function of weighing loaves in the market place (Symp.II.20). However in this passage the weighing involved the comparison of loaves from on top of a pile with those from below; it did not require weights, and should best be seen as a check on the freshness of the loaves.[90] The Agoranomoi in Xenophon are therefore keeping within their duties as laid down later by Aristotle "to ensure merchandise was in good condition..."; although it is interesting to note that they can have weighed in the course of these duties, the form such weighing took does not explain the AΓOP- weights.

A better explanation of the difficulty is required. Aristotle and Xenophon were referring to the Agoranomoi of Athens-city and port;[91] but is it possible that in other parts of Attica the Agoranomoi had wider duties This was certainly the case in other states; for example Delos, where even weights and scales are known to have been kept in the office of the Agoranomoi.[92] More decisive, though the point can only be made tentatively, is the fact that the Attic weights marked AΓOP- are all much later in date than those marked "Metronomoi"; the lettering on P.97 for example could belong to the Roman period; as there are no late references to the Metronomoi it could be the case that this body was removed in the Roman period and its duties transferred to the Agoranomoi as in other states under Roman administration.

## 3. "Metronomoi"

No problems surround the identification of the Metronomoi in legends on Attic weight relief types and also several stamps.[93] Their close involvement with weights and measures has been already indicated by citing Aristotle Ath.Pol.51.2 above, and an inscription from the late third century confirms that they actually handled special weights.[94] It is interesting that the weights bearing reference to the Metronomoi are nearly all on the heavy 150dr-mina standard, and this clearly reflects their close interest in trade practices.

## VI. Precision

Some means of assessing the precision of Attic weights would naturally be desirable, and for this the weight ranges as shown by the graphs in Appendix F are clearly important evidence. There are however several major variables, other than weight, that should be taken into account.

First is variation in standard. No specific evidence exists for other than the three standards mentioned in IG II$^2$ 1013 (of 100, 138 and 150 coin drs. to the mina), and probably the higher two of these belong to the second century and later. Furthermore the analysis I have proposed for Attic weights has shown that it is possible to accommodate all extant weights to only two of these standards (that of 100 and that of 150drs) and that the identification of weights on the third standard (of 138drs) can only be made, and that tentatively, in very few cases. Certainly the attribution of extant weights to these known standards is very much more justifiable than the postulation of further standards to account for the few deviations, and in the majority of cases other considerations (of chronology or type) are themselves sufficient to support the analysis. Similar confirmation (if not proof) derives from the more general arguments against the principle of multiple standards (and a fortiori of their manipulation) before the new and changed circumstances of the second century.[95] Properly the identification of variant standards should only be made after some estimate of the precision of the weights has been reached.

A second variable is the condition of extant weights. Several factors however are at work here. First could be noted the contemporary adjustment of weights after moulding. This need not be as obvious as on the cut-down Crescent weight LW.58 which carries its new weight (12dr)

incised; several weights are described as hollowed:[96] others have survived that were apparently wrongly made;[97] and many of those not so extraordinary may presumably have been corrected towards their proper weight. Adjustment (as I feel was the case), or tampering to produce false weights (as Lang), accounts for the unusually thin weights that I have incorporated hypothetically in my final synopsis (Amphora A IIIb and B.IV: it surely would be odd that this can be seen only with Amphora weights if Lang's interpretation were correct).

Other factors affecting the condition of these weights are natural ones: damage and chemical change. Of the latter much has been made both by Pernice, who commented on the gain in weight of lead, and by Lang, who suggests that gain and loss might both occur and would therefore conclude that for large groups of weights the effect can be ignored.[98] I very much doubt if it is right to overlook this factor given that the vast majority of our weights are lead. However it can perhaps be controlled to a certain extent by reference to the few bronze, stone and clay weights that supplement the lead series. These I have noted on the graphs in Appendix F that will be considered presently; it will be seen that generally they lie below or in the lower part of the weight ranges of lead weights. They can invariably be connected to a lead series at least as closely as the variation within that series itself and within the classes of bronze, stone or clay weights.[99] In fact it will be shown that these supposedly stable weights vary almost as much as the "unstable" lead ones. The implication of the figures I have collected is that the lead weights have however generally gained in value (as Pernice suspected). The consistency of this gain is less clear, and the greater ranges of lead weights may well simply be the result of the larger numbers of weights in these ranges. A further control is I believe the fact that several lead groups have survived much more closely bunched than others.[100] This can be taken as showing that accuracy was possible and that chemical variation has not distorted precision.[101] Where absolute values are at issue, obviously this chemical factor should be taken into account; but for purposes of precision, as here, it need not be significant.

Damage is a more serious factor. As noted already, damage in antiquity is difficult to distinguish from weight adjustment. However wear and tear must have occurred in the working life of these weights just as damage has occurred in the course of time since they were used. This is perhaps a more significant distinction than it may appear, as the

question of how worn a weight was still acceptable directly reflects the degree of imprecision allowed in practice; for this even a damaged weight is evidence. It would appear fair to contrast the approach to coinage, where a worn coin could well be accepted at face value and without recourse to weighing (as indeed I argue elsewhere to have been largely the case). Weights on the other hand can only have been used for their actual weight. Two distinct questions are in fact being asked of the precision of these weights: firstly, how accurately were they made (for which only weights in good condition are acceptable evidence), and, secondly, how precise did they have to be in order to remain in use. This latter question, as is clear, is the one I am most interested here to pursue (and shall maintain that it is only removed from the former in the artificially restricted circles where specialist weighing took place). Worn weights will therefore be included in the calculations that follow.

A caveat must be introduced here as it is obviously essential to distinguish wear and tear from damage sufficiently extensive to have led to a weight's being immediately discarded. This can only be subjective (for example a broken corner as opposed to bent or worn corners, or worn relief type) and in the greater number of cases has not been checked by me for reasons of time and the accessibility of actual weights.

The third and final variable to mention before moving on to discuss precision arises from the problem, noted for the general analysis of the weights, of uncertaintly of date and, in some cases, of attribution to the (Attic) system. Without supposing multiplicity of standards, it is still very possible that the basic coin mina should vary gradually over time; to correlate groups from different periods might well give then an erroneous indication of variation, tending, one would imagine, to exaggerate the variation. Similarly the inclusion of non-Attic weights would be likely to distort the picture. As both these dangers are inherent in any attempt to sort out these Attic weights (and despite the confidence I have in the general conclusions I have reached on the Attic series), examination of variation should proceed as far as is possible within the specific weight/type groups analysed, and should be based on only those major groups that can with certainty be placed within the main Attic series.

If the difficulties presented by these variables are recognised, there should be no real objection to examining the problem of extracting some indication of variation or precision from the Attic weight series. As already said, there are three aspects to consider. Firstly, to override or allay suspicions of chemical variation, the stable weights (in bronze, stone or clay) should be isolated.[102] This presents no difficulty, but is really preparatory to the two main aspects of the problem: to extract the official and optimum precision, and to assess the degree of variation permitted in practice .

A means of expressing variation must therefore be established. Both Pernice and Lang[103] have made use of <u>projection</u> (of fractions) and <u>reduction</u> (of multiples) to the single mina or stater base. This method is most deceptive and could easily lead to the confusing of absolute with theoretical values. While a Greek balance might not easily distinguish small differences between low fractions, it does not follow that the proportional differences at mina (or stater) level would not be detectable.[104] What might be a negligible obol or so in a twelfth becomes something over two drachmae in the higher unit, and the graphs (Appendix F) indeed show most proportional variation in the smaller weights (especially in the dr. class) and least in the very high weights. In determining absolute variation, the actual weights should be considered neither projected nor reduced.

Nevertheless this method of projection and reduction (to which I have added further in the graphs of Appendix F that of <u>correction to standard</u>) is undoubtedly a most convenient way of <u>comparing</u> the many different groups of weight denominations. As long as the method remains a theoretical procedure there are only two dangers: first, all weights should not be reduced <u>en masse</u>[105] to a single scale (for reasons already given variations might well exist between chronological periods that would be concealed by such a manoeuvre); and, second, percentages should be avoided in so far as they presuppose that a specific (absolute) standard is established (the percentage of which is represented by any given range of weights). No such standard is in fact known, and we can be fairly certain that it was not as precise as that postulated by Hultsch and generally followed by Pernice and Lang.[106] Both difficulties (or mistaken implications) are I hope avoided by the method to be adopted below of expressing variation as the <u>extent of each group range, adjusted to a comparable mina</u> (but without specifying where within the 500-400gm range this might fall).

To avoid any residual confusion I shall express this variation in millimetres measured directly from the ranges on the graphs in Appendix F.

As a result of this procedure the weights can be arranged in groups and averages calculated as follows.

TABLE

Ranges of Attic lead weights arranged by group and type, projected where necessary and averaged (1mm equals 5gm)

| | | | | | |
|---|---|---|---|---|---|
| overall | 15.25mm | 10.4mm | 14.4mm | 14.3mm | 13.5 - 14mm |
| 100dr standard | 15.5 | 10.4 | 13.9 | 15 | 13.7 |
| 150 and 138dr | 15 | - | 16 | 5 | 14.3 |
| late 6th/ 5th cent. | [low BWs] | ? | [low BWs] | ? | ? |
| 4th/3rd cent. | 15.5 | 6 | 16.8 | 15 | 13.2 |
| 2nd/1st cent. | - | 14.2 | 11.1 | 16.3 | 14 |
| | official relief denom. | no denom. | denom.only | no legend | all types |

The last three entries are derived from the chronological classification that I suggested above as the result of the analysis of weights by group and type. Unfortunately entries for the sixth-fifth-century period are too scanty for comparison here. The final average, in the top right-hand corner of the Table, can be calculated either from individual groups (giving 13.5mm), or from the two standards (giving 14mm), or from the chronological periods (which would lie between the two). However the significant point arising from these figures, and from the Table as a whole, is that variation appears fairly even over all classes of weights.

It may be interesting to note that the most accurate weights nevertheless tend to be those officially marked (demosion etc), though they are not those that bear the denomination as well as the official mark. Thus Astragalos (A II - III); Dolphin (all the 100dr standard weights in Gps.AI and B); Amphora (most groups); Turtle/Tortoise (100dr standard but not 150dr). Remarkably the types mentioning the Metronomoi in relief are hardly more accurate than the others - with the exception of the heavy mina AΓΟΡ (Dolphin A II a) to which I shall return. The Crescent weights

however give a totally different pattern: greatest variation occurs in unmarked sixths (A III.b with variation of 5mm) and eighths (B I.d of 6mm), there is less variation in officially marked sixths (A III.c of 4mm) and eighths (B I.c again of 4mm), but least in those fractions marked as sixths (A III.a of 2mm) and eighths (B I.b again of 2mm). Certain weight groups are noticeably more accurate than others (without this being simply the result of fewer surviving examples), most accurate being the Wheel groups of 4 minai weight which show a variation of only 6.7% on 1750gm. To this I shall return below, it should however allay suspicions that lead weights have been variably distorted through chemical change.

Comparison can now be made with the "stable", non-lead weights. These are listed separately in the Table on the following page and have been combined for interest in the two columns at the end of the other weight graphs (Appendix F). All belong to the 100dr standard, and most are in sufficiently good condition to be seriously regarded as representative.[107] Their numbers are however too small to allow useful averaging over types, but it is possible to separate two chronological groups (the earlier coinciding unfortunately with the one gap in the Table for lead weights on the preceding page), and so to take an average between them.

TABLE

Ranges of Attic non-lead weights (variation expressed in mm of 5gm; weights projected to the mina in gm)

| | official relief denom. gm | official relief no denom. gm | denom. only gm | no legend gm | all types variation mm |
|---|---|---|---|---|---|
| 5th cent. group | 397.5<br>380<br>378 | | [443.8]<br>434.3<br>426.6 | 446<br>437 | 14 |
| later groups | | 438.4<br>417.6 | 438<br>429<br>426<br>418<br>409<br>398<br>[348 ?] | [425 ?]<br>370<br>[336 ?] | 14 |
| average variation | | | | | 16.5mm |

Thus the variation in these "stable" weights is virtually the same as in the lead weights. Certainly it seems to be no better, but the later groups cannot be sufficiently subdivided to check this. With

TABLE

List of non-lead weights (all weights are restorations of inferred minas)
(all bronze unless specified as stone or clay)
(provenance Attic unless noted as other)

A convenient group of these can be placed early 5th cent (by context or letter) where there are virtually no other lead parallels:-

| | | | |
|---|---|---|---|
| BW.1 | Astragalos A.IIa | giving mina of 397.5gm | condition good |
| P.1 | Dolphin A.Ia | 426.6gm | fair |
| BW.3 | Turtle A.Ia | 378gm | good |
| BW.2 | Shield A.I | 380gm | good |
| SW.16 | incised "dista" [stone] | 434.3gm | polished |
| P.4;BW.5 | Owl A.I; assuming to be 16drs .... | 446-437gm (?) | good |
| P.2 | marked "dekastatero";assuming 40drs... | 443.8gm (?) | good |

Scattered or uncertain are the following:-

| | | | |
|---|---|---|---|
| [Kroll C] | [Boukranion A.III (? PHOCIS wt)] | [414.5gm] | [good] |
| [P.762] | [Boukranion A.VI (? "CORFU")] | [484.96gm] | [ ? ] |
| [P.772] | [Astragalos-shape Gp.C (? prov)] | [332.24gm (?)] | [fair] |
| P.261 | Dolphin A.III [marble] | 425gm (?) | fair |
| BW.4 | Amphora B.Ie | 336gm | poor |
| P.731 | Tortoise A.Ib [from Euboea] | c.440gm (?) | est. |
| | Pernice estimates the weight lost from a deep hole to be c.1/8 and from this estimate my figure is derived; Pernice's guess may however be derived from an inference from the mina wt.! | | |
| Kroll A | Tortoise B.IId | 417.6gm | good |
| P.227 | Tortoise B.Ib | 370.2gm | fair |
| [P.209] | [Tortoise A.III? apparently not of the Attic weight system] | | |
| P.321 | Crescent B.Ic | 438.4gm | good |
| [P.686] | [Owl A.II (from Sicyon; ?? Attic)] | [418.71gm] | [good] |
| [P.779] | [Owl A.IV (? prov; ?? Attic)] | [ ?? ] | [ ? ] |
| BW.6 | marking obscure (see also below) | -- | good |
| P.283 | marked "mn(a)" (odd shape) (?) Illustrated Michon fig.5728 [clay] | 429gm | worn |

From drachmae incised on bronze (and one relief) come finally:-

| | | | |
|---|---|---|---|
| P.563 | relief drachma..... | giving mina of 348gm | good |
| P.515 | incised 3drs. | 409gm | good |
| P.478 | punched 4drs. | 426gm | good |

Similarly the reweighed weights (my drachma class IIA):-

| | | | |
|---|---|---|---|
| Kroll A | marked 26drs1½ob... | giving mina of 398gm | good |
| Kroll B | marked 13drs3/4ob... | 418gm | good |
| BW.6 | incised 6drs1ob1ch... | 436gm | good |

these weights it is however at last possible to move on to consider absolute values. The 100dr standard mina to which they are here projected lies under 450gm and extends to 370gm in weights nevertheless in good condition. This projected range of 80gm around the lower 400gms can be compared with the slightly larger lead weight projected mina ranges of between 500 and 400gm, and suggests that the lead weights as a very general rule have gained about 10% of their original weight over time. My impression is that the gain should if anything be less than this; but it is certainly clear that the lead weights bunch sufficiently within the projected (and corrected) mina for their variation within and outside this range to be attributed to an initial weight variation, and therefore to be taken as evidence of imprecision, rather than be attributed to chemical change. The extent of this variation can now therefore be examined in absolute terms. Unfortunately the bronze weights are too scattered themselves, but, for the reasons just advanced, there should be no obstacle to examining the lead series in detail (while bearing in mind the caveat mentioned above about the use of projected weights in such a context).

Given the conclusions of the last paragraph that lead weights can be examined absolutely, and since there is no significant, or constant, difference in precision between the types of weights (unmarked or plain), a rather simpler table can be constructed to show <u>in absolute terms</u> the variation of these weights.[108] These ranges are again derived for simplicity from my graphs in Appendix F and are correct to 5gm. They are the <u>outside</u> ranges.

The Table and notes will be found on the following page.

These figures certainly vindicate the method adopted here as they show an increasing overall precision with heavier weights. This might be explained away as the natural result of wear and tear or of chemical change (both of which might be less significant on heavier weights); but the lead groups are themselves sufficiently large to remove the latter objection (and comparison with bronze weights has suggested that no less a degree of variation is to be expected there), and anyway wear and tear must be included within the working life of the weights concerned as I have already pointed out. These absolute figures serve therefore two central purposes in this survey: first the variation in precision is evidence for the performance of contemporary Greek weighing devices (see Ch.I); and second the extremes of imprecision are direct evidence of the

TABLE

Actual variations in Attic lead weight groups, and percentage variation at set weights (or denominations)

| weight range | individual gp. variation | overall varia. of denomination | percentage gp. variation | percentage overall denom. |
|---|---|---|---|---|
| over 1000gm | from 115gm to 325gm | | 6.7% of 1750gm - 25% of 1300 | |
| c.900gm | 45-90gm | overall 115gm | 5 - 10% | overall 12.7% |
| c.700gm | 80-115gm | overall 125gm | 11.4 - 16.4% | 17.8% |
| 500-400gm | 20/30-55gm | overall 60gm | 4.4 - 12.2% | 13.3% (of 450) |
| c.350gm | 45gm | so 45gm | 12.8% | so 12.8% |
| c.300gm | 25-65gm | overall 65gm | 8.3 - 21.6% | 21.6% |
| 250-200gm [a,b] | 10-60gm | overall 10-60gm | 4.4 - 26.6% | up to 26.6%(225) |
| 200-150gm [a] | 20-55gm | overall 45-55gm | 11.4 - 31.4% | up to 31.4%(175) |
| 150-100gm | 10-35gm | overall 40gm | 8 - 28% | 32% (of 125) |
| 100-50gm [a] | 5 [c] -25gm | overall 10 [d] 25gm | 6.7 [c] - 33.3% | up to 33.3%(75) |
| under 50gm [a] | less than 5gm to 10gm | overall 5-15gm | up to 40% | |

Notes

a. Down to 250-200gm only one type of fraction falls in the ranges tabulated, whereas below there are several: for example 100-50gm range includes twelfth-stater and sixth-mina, eighth-mina (138 and 150dr), sixteenth-stater and eighth-mina (100dr), and also 20-, 16-, and 12drs. For this reason a range is given even for the overall groupings (taking the smallest single denomination group and also the largest). Minai and staters are not however distinguished (ie. eighth-mina is grouped with sixteenth-stater etc.). Calculation of percentages on these individual groups has not been attempted and only the highest variation in given in the final column of these weight ranges.

b. In the 250-200gm range occurs the Tortoise group A II.a, all of which lies within a range of 60gm (260 - 208.5gm) with the exception of the heavy LW.34 at 302gm. Inclusion of this weight would alter the overall percentage to 44.4%, but I have felt it reasonable, in view of the size and cohesion of the rest of the group, to treat this weight as extraordinary and so to ignore it in this table.

c. Within the 100-50gm range two weights, Cornucopia (?) Gp. C.II give these figures of 5gm and 6.7%.

d. This 10gm variation is derived from marked 12drs; the Cornucopia (both marked and unmarked) weights are only within 20gm of each other.

sort of accuracy that could be tolerated in ancient Greece (see Chapter VIII). The extent of variation and the degree of imprecision that is immediately obvious from the last table is also shown by the graphs that have been used for its construction (see Appendix F - each mm square represents more than a drachma). It is further confirmation of my general point that accuracy in weighing was not felt by the Greeks to be at all important.

---

The present investigation into the precision of Attic weights must now be extended to consider what attempts at greater than acceptable accuracy were made. This can be briefly done as none of the specially marked weights (whether marked demosion, metronomoi or stamped) show significantly greater tendency to accuracy than the general series.

Officially marked weights have already been analysed as a whole in the last section where it was noted that those without denomination seemed to be amongst the most accurate (of groups) whereas those with denomination markings were virtually undistinguishable (in accuracy) from others not officially marked.[109] Far too few relief "Metronomoi" or "Agor-" weights survive for proper checks. The heavy Dolphin minas marked "Metronomoi" are separated by 74gm around 650gm, which is a variation of 11.3%; the later "Agor-" weights lie between these, with only 0.23% variation (or about 1½gm difference); the two ½Amphora "Metronomoi" weights, separated by 12.5gm around 190gm (both in good condition), do not approach this with a variation between them of 6.5%. Perhaps this confirms the late precision of the "Agor-" weights; it does not however really establish an accuracy for the "Metronomoi" weights much better than that of other Greek weights of the late Hellenistic period (end 2nd - 1st century). The weights with METRONOMOI stamps on the other hand cannot be expected to show any particular accuracy as they are all isolated and (as was argued above) were probably taken out of their original context.

A class of weights remains to be considered as evidence of the degree of precision attainable when it was really required. This has been already assembled, and comprises those weights that were weighed specially, and remarked or corrected in drachmae (Drachma Class II ABC). In cases where the revised weight is expressed in drachmai, obols and chalkoi the attempt at accuracy, and the degree to which it was felt possible to go, is obvious (especially true of P.449, 321; Kroll A; and

BW.6). That three weights are damaged (P.449, 685, and 503) and another considerably cut down (LW.58) need not affect the validity of the subsequently incised weight (indeed the damage may well have been the reason for the reweighing). It is significant that in one of these cases (P.685), as well as in the bronze weight Kroll A, the revised drachma weight is above the theoretical value of the relief type itself.[110] Although in the case of the bronze weight stamping could have been to confirm the new weight marking (as argued by Kroll), this cannot have been the general purpose of stamping. The Astragalos weight P.685 was found in Corinth, although an Attic weight by origin, and the reason for reinscription might well therefore be check-weighing by individual merchants.

It is not easy to quantify the accuracy of these weights in a way that does justice to the precision implied by the low fractional units involved while at the same time allowing comparison to be made with the figures already derived for the accuracy of the other weights discussed in this section. A temporary obstacle is the variant weight published for P.471 (Pernice 18.18gm and Murray (no.30) 17.36gm), although this is not particularly critical and will make no difference to the percentage calculations below. Another difficulty is the likelihood of chronological variations between weights of this class: the lack of properly controlled standards might over time introduce an inaccuracy that conceals the possibility of much greater accuracy at any given moment. Thus the minas reconstructed from these incised weights range from 458gm (P.391) to 383gm (P.503), a variation that is of c.16mm and precisely similar to the sort of variation derived for the general groups of bronze and lead weights earlier in this section.

However the marked weights of the class under consideration show that weighing was attempted to recognisable limits:

1dr.....P.685, 391, 503; LW.58; P.451, 617.
½dr or 1ob..P.471.[111]
1ob.....P.449.
1½ob or ½ob...Kroll A.[111]
3/4ob or 1/4ob...Kroll B (P.321).[111]
1ch (ie 1/8ob) or, more cautiously, 1ob (see below)...BW.6

It would appear justifiable therefore to take the opportunity of estimating in these individual cases how accurate the Greeks hoped to be when they really were trying to be accurate. A significant and dramatic contrast results with the figures derived from earlier discussion of how wide a variation they were on most occasions prepared to accept.

Without adjustments these weights can be set out as in the following table.

TABLE

Selected weights to show maximum precision attempted.

| ref. | weight | marked as weighed to within – | percentage of actual weight represented by this limit |
|---|---|---|---|
| P.685 | 858.92gm | one drachma | 0.5% |
| Kroll A | 104.4gm | quarter drachma<br>half obol | 1% or less<br>0.3% |
| P.391 | 73.3gm | one drachma | 6.2% |
| P.321 | 54.8gm | three quarter ob.<br>quarter obol | 1% or less<br>0.3% |
| LW.58 | 53gm | one drachma | 8.3% |
| P.449 | 30.5gm | one obol | 2.16% |
| BW.6 | 27gm | one chalkous (1/8ob)<br>one obol | 0.3%<br>2.66% |
| P.451 | 25.44gm | one drachma | 17% |
| P.471 | 18.18 or<br>17.36gm | half drachma<br>one obol | 11%<br>3.66% |
| P.503 | 15.33gm | drachma | 25% |
| P.617 | 12.15gm | one drachma | 33.8% |

This table gives only the sort of accuracy these weights purport to reproduce. There is no way of recovering their actual accuracy (lack of dating criteria and also lack of certain drachma standard). It should however be noted that something approaching the above accuracy should be indicated (for example an obol more or less appeared to make a difference in the weighing of P.449), even though the possibility of an overambitious claim to accuracy must always be allowed.[112] If this argument be permitted then in all cases[113] the higher unit should be taken. With these provisos comparison with the more general figures for Attic weights can finally be made. The contrast between possible (attempted or achieved) accuracy and accepted variation can then be set out in the following table.

TABLE

Contrast between possible accuracy and accepted variations in Attic weights

| | 900-700gm | 150-100gm | 100-50gm | under 50gm |
|---|---|---|---|---|
| Possible accuracy | 0.5% | better than 1% | better than 1% | up to 2.16% |
| Max. accepted variation | 12.7 - 17.8% | up to 32% | up to 33.3% | up to 40% |

Some contrast between these two situations could only be expected as the better examples of the one are here compared with the worst of the other. However the contrast is nevertheless striking. Two factors are I suggest largely responsible for this. Firstly, the size of the machine used for weighing is critical; in the case of the majority of the variable stater- and mina-based weights it will have been a relatively large commercial balance, whereas the drachmae and smaller fractions will probably have been weighed on more sensitive smaller balances.[114] Secondly, it seems that the Greeks were only concerned to weigh accurately in very special circumstances. Only three of the many relief type weights can be included in the number of those showing highest possible accuracy from being precisely marked. Their weights thus marked are not equivalent to what they should theoretically (in view of these relief types) have been. This is a further argument against the existence of theoretical weight standards, but the question of concern for accurate weighing, as opposed to precise weighing, is complex and will be discussed in detail in Chapter VIII below.

## VII. Selected conclusions on Attic weights

The importance of Attic weights arises from the detailed analysis their number makes possible. As a result several general matters have been considered which will be pursued in later parts of this study of Greek weighing. One such is the extent of official involvement with weights. Official control of weights is only indirectly reflected (and hypothetically) in stamps on Attic weights; a more direct connection is made by the explicit mention of Metronomoi (less clearly of Agoranomoi) on certain weights, although the use such officials made of the weights can only be derived from other evidence; and further a general indication of officialness is given by the systematisation of the weights as a corpus (their types, and the fact that they are all Attic weights, as well as the great number of those marked "demosion"). It has been suggested that the production of these weights was under state control, possibly as part of the work done by the Attic mint. The close connection between these weights and Attic coins, apparent in types, more problematic in absolute weights and systematisation, will be developed in later chapters.

The significance of such official involvement in weights must however be qualified in terms of chronology and of the direction such official interest took. The distribution of the bulk of weights is uneven. An early and peculiarly compact group (of bronze weights) can be dated to around 500BC; few weights belong to the fifth century, and the main series does not start until well into the fourth; the greater number of surviving weights date from even later than this. There is no good reason for not regarding such survival variation as indicative of an increasing availability (and so use) of weights in ancient Greece. The majority of

weights belong to the stater/mina systems; it is not easy to correlate the independent series of drachma weights, which in general appear to be late in date rather than early; remarkably few weights reflect the variation in standard defined in terms of drachmae to the mina in the late second century decree IG.ii$^2$.1013. This last must I believe indicate that these changes in standard were relatively short-lived. Lack of explicit indication in the typology of weights is good reason to reject the hypothesis of even further standard variations, certainly the weight-imprecision of even small subgroups of closely similar weights prevents the identification of any such further variations. Finally, the apparent lack of concern for precision, the lack of consistent designation of weight denomination, the lack of any substantial number of weights until after the classical period (and total lack before the fifth century) fit well the general Greek attitude to weighing advanced in later chapters: this did not usually involve weights and was not usually to measure weight with particular attention to absolute accuracy.

I shall not repeat here the problems of inadequate publication, variable condition, ambiguous or non-existent denomination etc., that impeded the analysis in detail of the various weight types. Many matters should be considered still uncertain (especially the chronology of particular types). Despite these difficulties however an overall picture has been reconstructed that shows that it is not necessary to postulate other than the attested standards of 100dr-, 138dr-, and 150dr-minas in order to account for all the evidence at present available. Furthermore, estimates made of the variations in weights (both of individual groups and over wide periods) show that it is not possible to use the weights to establish the existence of any additional standards.

Permitted variation was exceedingly high, and does not appear to have been seriously distorted by the condition of extant weights or the possibili of chemical change. Without recourse to the hazarding of absolute values for weight standards, it has been shown that "demosion"-marked weights were marginally more carefully made, while those on the heavy (commercial) standards varied most of all, even where marked "Metronomoi" or "Agor[anomoi On the other hand a small group of weights, marked out in drachmae, appears to have been weighed to a very much higher degree of accuracy.

The clear difference between weight systems has been already noted. The "commercial" (on all standards) consisted of fractions and multiples

of staters (in the earlier period) and minai (from some time in the latter part of the third century); this is represented usually by weights with a symbol (with or without further explanatory legend) indicating the relevant value of the weight. Drachmai on the other hand for the most part do have denomination marks, but no symbol. The two systems are incompatible: the term "stater" can apply either to the higher unit or a much lower 4-drachma unit, and the fractions of the higher units cannot be expressed in round numbers of the lower.

All the weights so far reviewed belong to well-defined series, and all can probably be regarded as official Attic weights; some comment should however be made of the largely unidentifiable private and unofficial weights. Only one such can be dated (SW.16 - dated by letter forms on a fortuitous inscription) but its appearance, a polished boulder, is revealing. The extent to which such weights, with or without any set or measured value, were used by the ancient Greeks will be considered more seriously in the chapters that follow. The present analysis however has shown that the earliest marked official weights from Athens are hardly earlier than 500BC - thus after the start of coinage at Athens (on any hypothesis of when this was), and well after Solon's supposed sophisticated reforms.[116]

## 1.(2). Weights other than Attic

### I. General survey

The extension of this review of Greek weights to those which fall outside the Attic series is presented in full in the following sections largely for the sake of completeness. No other series is represented in comparable detail as yet and the identification of a high proportion of non-Attic weights remains uncertain. Considerable importance, however, attaches to general points of contrast with the Attic series and to several significant variations in detail (weight shapes, standards, and fractions for example) that I shall discuss in this section. There follow brief analyses of one or two of the more interesting non-Attic series (Corcyra and West Greek, Corinth, Olympia, Olynthus, Syria - Seleucid and Ptolemaic) and then an overall summary of other possible series (set out in the order of IG but with Asia Minor arranged as in Head HN$^2$). I have seen no reason to include further lists of the many totally unidentified legends and types on marked weights; a large number of these are somewhere noted under possible sites but in all they do not amount (on my notes) to more than 150 weights in all.

Identification has been possible from explicit mention of the states on their weights (in the majority of cases) and from close parallels with coin types; occasionally both criteria apply; only rarely however have sufficient numbers of weights been found to justify an identification from provenance alone, though this is frequently a useful confirmation (see further general discussion of the identification of Attic weights above). These criteria clearly only identify particularly official weights, but this is also mainly true of the Attic weights assembled above by type and legend. That so many weight types can be related to coin might indicate that the joint production of both was generally controlled by state mints and this must surely remain the most likely hypothesis. By this same token however there appear noteable exceptions in the list of states that can be seen to have produced weights although their coinage is well-known and widely scattered (eg. Aegina, Syracuse and also Corinth, for although certain weights can be argued to be Corinthian none bear a consistent type or one that is in any way connected with the well-known Corinthian coin type). Such states as did produce their own weights

were surprisingly not always the more significant in economic or political terms (thus Chaleion in W.Locris and Proconnesos, but not Megara or Delos). Any such statement is of course provisional (and weights of Delos are certainly indicated in contemporary documents eg. Pleket 10) but the absence of weights in certain states is too well established to be entirely due to inadequate excavation.[116]

A total of 35 independent Greek city-states can be identified that produced their own weights (plus the Seleucid and Ptolemaic dynasties). Only about 30 types remain to be placed, the greater number of which are minor variations on other types and may well belong to series already established. More than half of the identified states produced weights which can be dated entirely within the Hellenistic period: the dating being possible from general historical considerations (Seleucid, Ptolemaic, or late foundations as Lysimacheia [309BC] or Alexandria in Troad [so named from c.300BC]), from close parallels with coin types or by inference from periods of coining activity (Tomis and Priene for example), or from lettering (more difficult where reliance must be placed on published legends; however, Cos, Heracleia and Cyzicus [in one weight at least] use alpha Λ ; and the lettering on the Thermae weight IG.ix.1$^2$.83 is said to be end third cent. BC). This late date is I believe of some significance (see further below) although the weight series in question are as a result beyond the chronological limits of this survey. A similar date may moreover apply to the greater part of the remaining weights where these cannot be specifically dated before 300BC. (thus the form of the monogram Μ on Miletus weights is found on coinage 350-190BC). On the other hand, only 6 states produced weights that can for certain be dated within the classical period (Corinth, Chaleion, Cyzicus, Chios, Samos and Agrigento [if the objects in question are weights]) and of these only the weights of Cyzicus and Chios could be said to form a recognisable series, in both cases running into the Hellenistic period most probably though in this also comparable to the Attic (single weights only from Samos and Chaleion; individualistic weights from Corinth; small and doubtful coin weights from Agrigento).

The number of weights involved in all these non-Attic series, of any date, is dramatically less than that of the Attic series itself. Of Seleucid and Ptolemaic cities only about 30 weights survive that can be identified; of other places the only significant groups are Corinth (an uneasy 6 weights), Tomis (5 clearly systematic weights), Cyzicus (an inconsistent series of 8 weights), Alexandria in Troad (5 weights from which however no system can be recovered) and Chios (possibly 10 weights, but dividing into three different standards: see below). The large Olympia series of almost 250 bronze weights is an important exception, although the dating is as yet most uncertain.

The circumstances for this contrast must be investigated. It is not simply that the non-Attic weight series still remain to be excavated and identified. Several sites, and most noteably that of Corinth, have already been sufficiently excavated to reveal any weights that might by chance have not earlier appeared or have been overlooked.[117] It may be that nineteenth-century collectors only noted the more accessible and recognisable Attic series, but the proportion of Attic to non-Attic weights has not appreciably altered since Pernice listed those known to him in 1894 (roughly 640 Attic as against under 100 others, omitting Roman and later weights). Moreover there remain a relatively small number of weights to be identified, of about 30 types and under 100 with only legends (in all not more than 150 marked weights). However these should be allocated, the numbers are too small to modify the contrast in question.

It could be suggested that the Attic series included weights made and used in states other than Athens. The evidence from Olynthus supports this in that the few relief types found there are all closely comparable to the Attic (indeed might be suspected of being actual Attic weights) whereas no other type appears to relate to Olynthus itself (the majority of the probably local weights being marked, if at all, simply with legend indicating weight value). Doubts could moreover be raised concerning the Attic provenance of the many weights collected by Pernice; the greater part derived from the modern purchase of weights in Athens (comparison with the Woodhouse collection "from Corfu" could here be made: see below) with extremely few weights given an excavated provenance. While recognising that certain weights are explicitly Athenian, it could further be pointed out that these form a very small proportion of the weights that have been classified as "Attic". The implications of this suggestion are of course remarkable: it would indicate the existence, with state backing, of an inter-state weight system, sufficiently established to require on many occasions not even explicit weight value legends and sufficiently standardised to require no qualification of "demosion" appearing on a large number of these weights.

Thus stated, it is clear that this suggestion cannot stand. All the evidence of contemporary documents indicates a variation of weight systems and standards (see following sections), and above all a variation of coin standards (to which the weights seem on other occasions to be closely related) at least in the classical period. Moreover the evidence of recent excavation (for example the Athenian Agora) plus the number of incontrovertible Attic provenances for earlier weights (P. 1-4 for example from the Persian sack),

makes it impossible to doubt seriously the majority of provenances recorded for the Attic series. If the contrast Attic/non-Attic remains, it can, however, be modified from the chronological reconstruction that I have suggested. The great majority of Attic weights, and in particular those areas of most doubt, are, or can be, late and Hellenistic; Attic weights which need be earlier than 300BC from the Agora (taking this as a fairly representative sample, and particularly well dated) number 11 against 37 post 300BC (with 6 uncertainly dated from late 4th to 2nd century). This sort of figure makes comparison of the Attic series with, say, the 5th/4th century Olynthus weights more reasonable, and with the Corinthian weights at least possible within the same chronological period (for Olynthus was destroyed around the middle of the fourth century, and Corinth never again an independent centre after the Macedonian occupation of 338 BC.). Moreover, the possibility of a centralised, standard weight system is reasonable for the Hellenistic period, where Macedonian coinage also shows that the Athenian weight standard was generally recognised. A significant numerical increase in Attic weights from the end of the fourth century calls anyway for some explanation in itself ~~(see above)~~; this was not a result of the multiplication of weight standards (as these are represented on only a small proportion of the later weights); the few firm dates moreover would allow my whole chronology to be shifted down even further than suggested above (in particular the 4th/3rd century groups could be later rather than earlier in this period).

This hypothesis cannot be firmly established on the present evidence, though it should be seriously stressed as a modification of the contrast in amounts of Attic and non-Attic weights. The administrative implications will be considered further in later chapters below, and these in turn are relevant to an assessment of the contrast which still remains (indeed the evidence is largely Attic for official interest in weight standards even in the classical period; similarly the acceptance of Attic coin appears to have been fairly general by the end of that period).

The weight standards and systems of non-Attic weight series are as perplexing as their small number. Given the problems of identification and the inadequate size of virtually all weight groups, it is very difficult to recover even isolated standard units still less whole systems. Nevertheless the evidence is sufficient to indicate that non-Attic weight systems are in general far too complex to be even tentatively reconstructed from what is at present available. This conclusion is of some importance where modern attempts at identification continue to appear[118]. For examples of the

complexity see the undateable variations in standard shown by weights of Cyzicus, Chios, and Thera. The once popular use of coin standards to identify weights has been undermined by the doubts cast on the identification of the coin standards themselves, as also by the existence in many Greek cities of a multiplicity of such coin standards.[119] This approach is especially unjustified where used at the same time to resolve doubts about published weight (as with Barron's interpretation of the early Samos bronze weight).[120] By contrast I shall simply note here one or two points of relevance to the classical period with which I am primarily concerned and further speculative interpretations will be reserved for the brief lists that follow below.

Apart from the paucity of weights from Corinth, emphasis has been placed on the possible identification of dual standards there by Davidson. Though possible, the identification is entirely unsupported and rests only on an incised "B" (numeral 2) on one weight.[121] A slightly reduced standard does appear to have been used in the Hellenistic period, but this is not as significant as a dual standard (two different weights in use at a single time) and itself is a very tentative reconstruction of three doubtfully Corinthian weights.[122] I have found no evidence for the existence of dual, or multiple, standards in any Greek state of the Classical period;[123] such variation as appears is attributable either to simple weight variation (inaccuracy), or to weights from different periods, or to the complex situation of the latest Greek period when local and international standards were recognised together by many states.[124]

The weight systems in use in these other parts of the Greek world are broadly speaking comparable to the Attic. Scholars have sought to identify "fifths" at both Corinth and Olynthus, but there is no reason to suppose the fraction at all usual even if it can be correctly read from two or three incised legends.[125] The table on the following page lists those standards and systems that seem to have been used in these states down to the end of the Classical period; though the following analyses continue the evidence to the Roman period, this later evidence is not yet properly classifiable for the reasons given.

Major series are the bronze weights from Olympia (often explicitly marked as temple property),[126] and Olynthus (where the mid-fourth-century destruction provides a useful chronological terminus). It is further interesting to note the distinction between systems based on a low unit and those on higher (stater or mina) units. I do not see that it is

necessary to assume that the former are therefore coin weights (used to weigh, or produce, coin). This does not however mean that they must not correspond, perhaps exactly, with the weights of coins.[127] I am most doubtful about the so-called Sybarite mint weight discussed by Zancani-Montuoro,[128] yet I think it is reasonable to consider that the variation in Cyzicus staters may reflect variation in the constituent metals of that city's electrum coinage. Of the higher unit systems, only the weights of Tomis stand out as clearly comparable in standard to the contemporary (second-century) local coinage.[129]

TABLE

Summary lists of weight systems and standards in non-Attic states (down to the end of the fourth century; the weights given are approximations only; for date and identification of weight value see further the analyses in the following two sections)

| | | |
|---|---|---|
| Corinth | - 412gm mina | 3x, 2x, third, (fifth) |
| Corcyra | - ? 466gm mina | mina, (? third), quarter, (? sixth) |
| | - 17 - 20gm | 8x, 5x, 4x, 3x |
| | - and others | |
| S.Italy | - 2.6gm | 75x, 30x |
| Olympia | - 450gm mina | 4x, 2x, mina, half, quarter, sixth |
| Olynthus | - 415gm mina | 3x, 2x, mina, half, third, quarter, eighth |
| Cythium | - ? 575gm mina | 8x |
| Phocis | - ? 414gm mina | (mina), (quarter) |
| Locris | - ? 402gm mina | half, third |
| Euboea | - ? 450gm mina | mina |
| Thera | - (420gm mina) | $8\frac{1}{2}$ staters of 843.3gm |
| Cyzicus | - ? 15 - 27gm st. | 3x, 2x, stater |
| | - ? wt. mina | mina |
| Proconnesos | - 427gm mina | mina |
| Magnesia | - ? 472gm mina | 2x |
| Miletus | - ? 492gm mina | half, (? quarter) |
| Samos | - (792/900gm mn.) | twelfth (stater) of 1584-1800gm |

The marking of these weights is probably as variable as Attic although a rather higher degree of explicitness has had to be required to identify the weights. "Official" legends occur, but are not invariably present; nor are city-names. Named officials become increasingly common in the Hellenistic and then Roman periods, but do not occur in the Classical. To be noted are several series of weights produced by (and probably used in) certain religious establishments: Olympia is the most important such source, but also Ephesian Artemision, Thermae Apollo, possibly Apollo Agyieus in Ambracia, and Amphiaraos at either Athens or Thebes. Most of these weights are unique, and so could be for temple use only; a wider commercial context must however be supposed for the large series from Olympia.[130]

It is interesting to note the trend towards standardisation in the technique and material of these weights. Those of the earlier periods exhibit more variety of shape, and are more frequently of bronze than the later weights. These are almost invariably of lead, square or rectangular in shape. A noteable exception is the triangular series from Tomis (in the second or first century), though the shape is found on earlier odd Corinthian weights, and can be paralleled by some from other places later.[131] The use of fairly explicit relief types (often matching local coinage) also becomes general in the Hellenistic period.[132] There are however a number of unclassifiable weights, belonging to no official series, that conform to no such general pattern of development; they may perhaps be said to come from the more backward areas of later Greece (thus from Gythium and Thera). The practice of stamping seems restricted to the Attic series of weights and is most rarely found on other weights before the Roman period, when it was generally applied;[133] this I take as some confirmation for the interpretation of stamping advanced above as related to Attic administration rather than the accuracy of particular weights. In terms of accuracy, it is possible to note technical changes of the Hellenistic period and later possibly designed to prevent defacement: two-sided relief, carefully raised or defined edges, lettering round the edge.[134] The overall impression of the non-Attic weight series is, however, that their development into recognisable series was greatly influenced by the larger Attic series. Attic weights moreover clearly travelled much more widely than those of any other state.

I should conclude this survey by noting the possibility of its including as weights the series of stone balls, many marked, that are at present identified as artillery shot from in particular Rhodes and Cypriot Salamis.[135] Until these objects are more fully published, and indeed further series found, I do not feel it necessary to more than mention them here.

## II. More detailed survey of certain non-Attic weight series

CORINTH
CORCYRA (and a small South Italian group)
OLYMPIA
OLYNTHUS
SYRIA (Seleucid and Ptolemaic included)

CORINTH

The number of weights from Corinth (both as place of origin and as present provenance) is significantly small, eliciting comment from both Davidson Corinth XII (1952) 203f and Robinson Olynthus X (1941) 450 n.15. Only four Greek weights have been unearthed by the American excavations on the site. This may be explained by the decline in importance suffered by the city in the period when weights became more usual; from its Macedonian occupation in 338BC to its destruction in 146 and beyond, Corinth was far from being an independent administrative centre. The coinage should be also borne in mind: the output was greatly reduced from 338 to 223, but then the mint closed completely (Head HN$^2$ 403). Corinth in effect lacked a flourishing Hellenistic period, which is the date of the greater number of Attic weights

Although Davidson (loc.cit) assembled the whole corpus of Corinthian weights, and I shall not reproduce it here, there are grounds for suspecting the certain identification of any standards from the small number of ambiguously-marked weights. Clearest is a mina around 412gm in the late classical period (from D.1580 incised "2 minai" at 825gm; D.1582 incised "one third" at 137.45gm; and the discoid bronze weight incised "one fifth" [preferable to Hultsch's "five"] at 85.52gm). Other weights indicate if anything a lowered standard, which can possibly be accounted for by weight loss through condition or ancient modifications; there is little conviction to Davidson's attempted reading of a much higher mina (597.5gm) from incised on a weight of 1195gm (D.1581): this weight might equally be taken as three minas (of 398.3gm and so reasonably close to the 412gm examples); such an interpretation is clearly preferable in the present state of the evidence to the implications (naturally drawn by Davidson) of dual standards in the classical period.

The Corinthian series could possibly be extended to include other weights bearing incised "ΔAMO" (for example with P.687 incised "ΔAMOY" and found in Corinth, though with relief "ΣΙ" it probably originated in Sicyon, weight 379.52gm; and with P.388 legend [? incised, but surely likely as the type appears to be Attic] "ΔAMO", "from Corfu" Woodhouse, relief Crescent, weight 63.21gm). However "ΔAMO" is also found elsewhere: see below Cos (?), Phocis, and possibly in fact Corcyra.

Corinthian provenance has been suggested for two further weights: Walters (BM.Cat.Bronzes) no.3006, a bronze weight 45.75gm with relief Lion and the letters "ΔΣ" (no date); and a second-century lead weight with relief incision "Νικομαχος Ποσμιατας" said to be"trouvé à Corinthe ? vers 1876", however Robert while noting this prefers to assign the weight to a deme in Cos (Rev.Phil. 13(1939)185-7 Pl.III).

To note of the Corinthian weights is the absence of any symbol, least of all reference to the well-known Corinthian coin Pegasos; most Corinthian weights are incised, and many in fact originated from outside Corinth (Sicyon and Athens seem certain here). The system if it normally included fifths was unique, but the fraction could have been generated simply by the adoption of a weight from outside (originally on a different standard). A final irony lies in the fact that the most clearly-identified Corinthian weight (the "fifth" already noted and incised on the other side "[K]OPINΘION" in Corinthian script) was found in Attica (Hultsch Jnl.Int. d'Arch.Num. 8(1905)5-6; Davidson Corinth XII (1952) 204 pl.147c).

CORCYRA

Although significantly placed on the trade routes of the Greek world, the island of Corcyra has so far produced little positive evidence of weight systems in use there. A major obstacle is the collection formed by Woodhouse on the island and since incorporated into the British Museum in London (with the noteable exception of P.756, now in Athens, on which see further below). While the Corcyrean provenance of the bulk of this collection cannot be doubted, it is not possible in any single case to rule out relatively modern conveyance to the island by Greeks eager to sell their finds to a known, and generous collector; caution has therefore characterised all inferences from the weights in this collection (thus Murray NC 1868 p.57; Pernice GG pp.64-5; Walters BM.Cat. 1899 p.xvi; Michon DS sv.pondus p.553; and also in a coin context Head HN$^2$ p.326). The identification of weights as particularly Corcyrean is made peculiarly difficult by the absence of any explicitly-marked weights (ie. naming the island or with a distinctive type), by the extent and variety of Woodhouse's collection itself, and by the equally baffling weight-variation on local coins.

A start on the analysis of these "Corcyra" weights can be made by isolating the fairly significant number that seem to have originated elsewhere (for the reason given above the presence of these foreign weights in a Corcyra collection cannot be used to illustrate the extent to which weights might have travelled in antiquity). The groups so identified can be then discussed under their original provenances. All the weights of this category are lead, except the last:

Athens Crescent P.344(M.70); P.383(M.78); P.385(M.79); P.382(M.89)
Tortoise P.148(M.108)
Amphora P.85(M.94); P.72(M.97); P.44(M.145)
Dolphin P.255(M.126)

Lampsakos ½Pegasos P.768(M.50)

Cyzikos Torch M.54 (not in Pernice GG) KYΣI TPO?OC
Dolphin M.55 ( .. .. .. ) KYΣI ΔICTA

Chois (?) Amphora P.109(M.37); P.108(M.48)

S.Italy (?) ΓΔΔΓ P.758(M.138) bronze weight.

Also probably not from Corcyra, because of its triangular shape, is the unmarked lead weight M.143 (not in Pernice GG) at 390.15gm; the provenance of this weights is obscure. Two further weights are related to Attic: 63.21gm P.388(M.80) Crescent but marked (? incised) "ΔAMO" (see above under Corinth, a possible intermediary place of use); P.83(M.93) Amphora (? - Pernice describes it as ½Amphora) marked "Δ.MO" at 192.76gm. The Doric dialect was however in use on Corcyra, so local use cannot here be ruled out. Finally can be noted a plain Boukranion weight, bronze, at 121.24gm - P.762(M.133); the type is found in at least two areas (Phocis as well as Athens).

The distinctive Cow and Calf coin type of Corcyra (Head HN$^2$ 325-8) does not appear on any of the weights of the Woodhouse collection. The last mentioned Boukranion is different. A more likely reference to Corcyra is the "K" incised on P.770(M.28), as the initial was found on coins from the middle of the fourth century (Head HN$^2$ 327). However the letter is only incised, and is furthermore found on an Athenian weight P.810 the weight of which is different (20.20gm as opposed to 15.86gm on P.770). A relief "K" is found on P.809 (bronze hemisphere of 21.4gm), but the provenance of the weight is unknown. The majority of "Corcyra" weights have legends very briefly indicating value. Even this means of identification is of doubtful value as no specific weight-system is

clearly indicated in that an ambiguity arises over whether letters as "T" on P.766(M.40), "Γ" on P.764(M.62), "E" on P.769(M.49) are fractions or initial letters of proper names. There is also considerable doubt over what should be regarded as a peculiarly Corcyrean weight standard.

Although the coinage has been relatively clearly analysed (Head HN[2] 325-8), the basic unit appears uncertain, at least for the earliest period. Head describes the decline from c.11.66gm to c.10.37gm [converted from grs.] from the sixth to the fourth century of a "stater" dividing into halves (that he calls "drachmae"), quarters, and eighths. Around 300BC these "staters" ceased, and, Head argues, the "drachma" became equivalent to the Corinthian. Apart from the double incuse stamp on the reverse of the earliest staters (that might equally imply two "didrachms" as two "drachmae"), I can see nothing to support this halving of the "drachma". If the mina was based on the coin weight, an assumption which in general cannot be supported although likely as an inference from Attic, it is important to decide whether we should seek a heavy, early mina in the weights from the island. Such a tentative procedure however is blocked by the impossibility of dating (to early or late periods) the weights themselves.

The following list comprises the more noteable Corcyra weights. Interpretation is minimal. Unmarked, undistinctive, and so omitted are:- M.24, 35, 43, 47, 51-2, 66-7, 139 (P.755), 140-2, 144, 146 (P.757).

Relief types -Dolphin P.268(M.130) 110.36gm ΓΙΤΞΓΑΝ legend.
-Battle scene Walters (BM.Cat.Bronzes) no.3003 54.95gm.

Circular -P.392(M.112) 116.58gm. marked "AE TET" [if an official "quarter" the mina of 466.32gm could be Attic, though the shape is not].
-P.761(M.136) 139.9gm. marked "ΓΙΙ\" [ie. seven units of 19.98gm]
-M.137 (not in Pernice GG) 136.78gm. no legend [close to the preceding, possibly seven units of 19.54gm ?]

Marked and indicating a low unit
-P.756(M.131 a copy) bronze 226.53 (Pernice; the weight in Murray of 234.06gm might, I wonder, be of the BM copy); incised "AΓOPANOMON M(NA)" (Pernice; Hultsch read the final "M" as the numeral 40, ie. 40 units of 56.64gm, but this fits nowhere and "M(NA)" is not unusual on weights).
-P.763(M.68 and Walters BM.Cat. no.3001) bronze 91.70gm; legend obv. $\frac{EV}{\Delta H}$ (Pernice/Murray) $\frac{E}{\Delta H}$ (Walters) rev. H (which is read as 8 units (of 11.46gm) by Pernice, but could equally be half a unit (of 183.4gm).
-P.769(M.49) 40.41gm legend "E" [? one sixth of 242.46gm; other Corcyra weights of the same order are M.51, which is blank, and the Lampsakos ½Pegasos P.768(M.50), mentioned above]
-P.766(M.40) 58.29gm. marked on both sides "T" [? one third of 174.87gm, or, more likely in view of the preceeding weight, one quarter of 233.16gm].

Marked but without further useful implication
-P.771(M.21) 9.32gm incised "/"
-P.770(M.28) 15.86gm incised "K"
-P.767(M.41) 55.95gm marked "\\\ " [3 units of 18.63gm]
-P.764(M.62) 85.49gm marked "Γ" [5 units of 17.098gm]
-P.765(M.65) 80.95gm marked "\\\\" [four units of 20.24gm]
-P.759(M.134) 144.56gm marked "H" [? half of 289.12gm or eight units of 18.07gm]
-P.760(M.135) 140.54gm marked "Δ" [? ten units of 14.054gm or just an abbreviated "demosion", or four units of 35.14gm]

Also note Walters (BM.Cat.Bronzes) 3009, bronze 248.83gm inscribed ΣΩ/K [Walters suggested this was a monogram of "Sokrat(es)"; alternatively the sigma could be a mu, and "M(ina)" be meant; the weight is not impossible for this in the context].

To note of the Corcyra weights is the fact that, just as with Corinth, there are no specific weight-symbols. No definitely Corcyrean series can be identified, and the presence of non-Corcyrean weights (positively identified) in the Woodhouse collection carries no implication of these weights necessarily having travelled in antiquity and been used on the island. Nevertheless there is a certain number of weights indicating that a very low (upper) unit was in use on the island in Greek times (c.240-250gm), and also some evidence of another (lower) unit of 17-20gm. Neither unit can be identified; neither can be dated.

Additional note on a small South Italian weight group

In the lists of non-Corcyrean weights above I included P.758 as possibly from South Italy. This and a further weight form a clearly identified group: both are bronze, both deeply incised with acrophonic numerals including a distinctive delta with an internal oblique stroke, both furthermore indicate precisely the same low weight unit. As far as I know the group has not been assembled before.

1. Bronze weight in the BM incised "ΠΔΔΓ" 193gm [Murray and Pernice, the former supported also by the grain equivalent given as 2980grs; Walters gives 2230grs, which converts to 144.50gm: this I take to be an error although the figure should be checked]. See P.758, M.138, Walters BM.Cat.Bronzes no.3002, Tod BSA 18(1911-12)112 (printed as ΠΔΔΓ ie. obscuring the oblique stroke delta). The legend indicates 75 units of 2.573gm. "From Corfu" Woodhouse.

2. Bronze weight incised "ΔΔΔ" 80.55gm. See P.Zancani-Montuoro Annali 12-14(1965-7)21-30 with Tav.XVIII fig.1 (the weight is shown upside down). The legend indicates 30 units of 2.685gm. From Francavilla Marittima, Cosenza.

Zancani-Montuora, not noticing the first weight, believed the incised deltas to be retrograde and dated her piece "per la forma e la direzione dei segni" to the last quarter of the sixth century on analogy with similar, but later, letter forms on terracotta building fragments from near Caulonia (p.22). This dating was further raised to 560/50-511/10BC on the argument that the only monetary context for the weight was in the Sybaris system (Sybaris being destroyed at the latter date). Though recognising that identification of "peso monetale" was conditional (p.24), the major part of her article was devoted to the analysis of the Sybaris coin weights into which this piece was assumed to fit. This assumption should be questioned. The letter form is neither peculiar nor (once read the right way round) early: Zancani-Montuoro herself cited the early third century Locri bronze tablet (p.22), and Thespiae inscriptions of the same date have a very similar delta (printed ⊳ by Jeffery Local Scripts 258 n.5 and Tod BSA 37(1936-7) sv.Thespiae). In the Thespiae case the sign stands for 10 staters; it is interesting that the two weights collected here from the West are marked multiples of a weight one third of what is usually said to be the local "stater". The connection with Sybaris, to resume Zancani-Montuoro's thesis, is weak: the weight can only indirectly be related - it was found in a "colonial" area of Sybaris and its weight can be compared to that of the lower Sybaris thirds; but with a later date likely rather than an earlier, and with absolutely no explicit mark of provenance (the "colony" cannot be named), there is no reason to suppose it to be Sybarite rather than any other of the several Greek cities in the South of Italy using the so-called "Achaean" standard, and continuing with this standard even into the fourth century. Finally I cannot understand why the weight(s) should be thought mint- or coin-weights even though they relate to the same weight standard as local coins; there are no coins of these weights. I have commented upon the use of the lower unit in the weights; it may be relevant to note that both are equivalent to round numbers of the higher units, 25 and 10 respectively.

OLYMPIA with graph in Appendix F.

There can be no doubt about the identification of the considerable series of weights from Olympia and marked (for the most part) "ΔΙΟΣ". These weights belonged to, and were used in, the Olympia sanctuary. Of their use there is no written testimony however; they are not found elsewhere (nor are any other weights found at Olympia); their dating is problematical; and none bear any indication of their (weight) value. The series was published by W.Dittenberger and K.Purgold in Olympia V (1896) 801-24 but the analysis by Dörpfeld (advertised by Furtwängler in Olympia IV (1890) 190 and Pernice GG 63 n.1) appears not to have materialised. General comments only will be found in Michon DS sv.pondus p.552.

The weights I have transferred from Olympia V to a single graph: App F. They suggest the following (relative) identification of values: 4(minai), 2(minai), 1(mina), half(mina), but the lower groups cannot easily be divided between quarters, sixths, and eighths. The range of the "mina" (or one unit weight) is from 497.2gm (no.153) to 419.2 and 367.4gm (nos.160, 161), but these last are well below a definite peak in the region of 445-430gm. The upper weight units display wider ranges, but reduce to "minai" of c.482-434gm (for the 4 "mina"), and 486-417.9gm (for the 2 "mina"). The "half-mina" weights project a "mina" of as much as 547.6gm (no.162 at 273.8gm) to 420.6gm; but the peak would seem to lie around 440gm. Lower units are, as said, difficult to separate and projections are impossible.

The system, the standard, and even the impressive inaccuracy of the series are therefore easily comparable to the Attic weight series. The Olympia weights however are all (or almost all: Michon) bronze.

The weights collected by Robinson in Olynthus X (1941) 447ff provide a good example of the difficulties in analysing a small corpus. Excluding loom-weights, suspension-weights, and net-weights (which can be simply done from shape) leaves 97 weights. Of the identification of several of these Robinson was rightly sceptical, yet it is interesting to note the cynicism with which he presents such "puddles of lead" as nos.2466-8 and remarks: "they are probably not weights at all but it seemed appropriate to include them here, as other scholars may be able to draw conclusions from their weights" (p.470; no-one, to my knowledge, has taken up the "invitation" of n.1 p.447). I have argued above against metrological analysis of uncertainly identified weights; Robinson was tempted (see the "fifth-mina" nos.2401 and 2415) but I doubt if seriously. Taking the criterion of relief-marking only nine of the 97 weights of Olynthus were clearly made as weights: such marking was more usually by letter indicating value than by symbol at Olynthus. This basis can be extended by including the roughly incised weights (22 in number), only one of which bears an incised symbol and several of the others are doubtful. The remainder must be discounted, as they are uncertain weights. Lists follow this general summary analysis.

Immediately apparent is the fact that no weights allude explicitly to Olynthus, though all were found there none can be identified as Olynthus official weights. The most unusual item, argued by Robinson to be a peculiarly Olynthian weight, is no.2382 incised "ΠΕΛΕΚΥΣ" but I shall show below in the lists that there is little reason for accepting Robinson's association of this weight term with Bronze Age weights: neither are, in my opinion, related to absolute weight values. The marking of weights with an "O" is probably a more relevant peculiarity of the Olynthus weights, though the fraction it seems to represent (one eighth - ogdoon) is also common in the Attic series.

Secondly can be noted the absence of clearly foreign weights on the site, though on the other hand several weight types clearly are closely related to the types of other states (especially the Astragalos compared with Attic; the Dolphin is incised at Olynthus).

The corpus of Olynthus weights is very small, the relief class forming less than a third of it. There is no contrast here with Athens if it be accepted that the majority of the Attic weights date from the late fourth century or (mainly) much later: Olynthus was abandoned in the middle of the fourth century. This fact acts as a useful check on the chronology advanced above for the Attic series, and it also confirms the general implications for weighing in practice that I am concerned to establish in this study.

The weight system itself apparently was simple and straightforward. Based on a mina of between 419.5gm and 412.5gm, it is possible to identify multiples of 2- and 3-minai, and fractions of half-, third-, quarter-, and eighth-mina. There is no reason to suppose fifth-mina or other fractions from the evidence at present available. No other (alternative) weight systems are indicated; and no other standard than c.420gm is involved. The range of mina,projected and reduced included,is as follows (dotted weights are relief marked; "*" denotes actual mina weights):-

460.455.450.445.440.435.430.425.420.415.410.405.400.395.390.385.380gm

x? x· x x x· x x· x x· * x· x· (x)

The inaccuracies therefore lie mainly in multiple and fractional weights, and hardly less in the relief than the incised (the two extremes are poor and rather isolated incised weights: the incised Dolphin no.2420 which bears no explicit weight legend, and the incised quarter-mina no.2394 which has a hole in it).

- - -

A:Weights with relief legend

2389 relief "M(NA)" 419gm lead square (5th or early 4th cent.)
2390 .. .. 418.5gm bronze square (late 5th or early 4th cent.)
2399 .. "T(ETAPTH)" 107.5gm bronze square (5th-early 4th cent.)
2400 .. .. 106gm lead square ( .. .. .. )
(?)2402 .. (?)"O(ΓΔOON)" 50gm lead square (no date)
(?)2416 .. "A" 375gm lead broken half-cylinder, flat on bottom [Robinson queries whether a weight or a metal bar. This implies that the end towards which the "A" lies is broken; the letters "MN-" could therefore be lost on the broken portion which might have made up the full weight of the piece. Of course its present weight is meaningless].

Doubtful, and best omitted, is no.2407, lead mushroom with a relief lump that could be either "O" or "⊙". The weight of 145.5gm rules out the most natural interpretation of "O" as one eighth.

AA:Weights with incised legend

(?)2383 incised "TPMN|AON" 1255.6gm [but see further below]
2384, 2386-8 incised "MN" or just "M"; all lead rectangular; from late fifth or fourth century contexts; weights 412.5gm, 419.5gm, 419gm, 417gm [for no.2385 see below]
2391-2 incised "H" (half-mina); all lead circular; 212gm and 209gm (late 5th-4th cent.)
2393 incised "Ꟶ" (third ?); lead circular; 142gm (late 5th-4th cent)
2394-8 incised "TE", "TET", "TETA" (quarters); all lead; 95gm (with hole), 106.2, 108, 107, 100.5gm. (5th or early 4th cent).
2403, 2406-9 incised "O"; one (2403) bronze, rest lead rectangular; 55gm, 53.5, 53.7, 56, 55.5gm (fifth or fourth cent.) [for nos. 2404-5 see below]

The following however are unlikely to have been meant as weights (except perhaps at a final stage the first):-

2385 incised "M" in lead with the remains of iron bars imbedded (for handle ?); 417gm [it is possible, as the weight is right, that this piece was used as a weight after it had broken]
2401 deeply cut letters "ΠE" filling whole face; bronze; 104gm [Robinson read this as for fifth; the resultant 520gm mina would however be unique for Olynthus, and the letters seem to full and well-formed. I suggest the piece is broken from a bronze inscription]
2413-4 incised "X" on lead sheeting [scrap ? Robinson gives no wts]
2415 incised "Π" on lead wt.111.65gm [which is even higher than 2401]
2410 incised "Ⅎ" on lead wt.42.45gm [Robinson suggests four "staters" of 10.6gm, but with what support ?]
2411 incised "⅄" on lead wt.37.2gm [Robinson's lldrs should be ⅄⊦ ]
2412 incised "Ⅿ" (ligature of T and M) on lead wt.28.1gm [Robinson makes no conjecture here]

Four weights bear traces of tubular drill cuts, the placing of which on at least one weight appear haphazard enough to suggest the marking was incidental. Though the drill may have been used to cut the letter "O", which is found on bona fide weights, the possibility that the lead in question was used as a pressure pad (or practice plate) in drilling cannot be ruled out:-

2382 roughly incised "ΠΕΛ|ΕΚΥΣ" on squarish lead wt.1302.5gm, both sides covered with tubular drill marks and smaller pitting [Robinson argues, p.447f, that "pelekus" was a weight term derived from bronze-age axe-head weights and the equivalent of 3 minai at Olynthus. There is no other evidence to support the use of the word as a weight term at Olynthus, and where the term is found (in 5th.cent. Cyprus and Hesychius) it is the equivalent of 10 minai. Olynthus was repopulated in the fifth century, and there is little reason to suspect the retention of out-of-date bronze-age terminology there. The interpretation of the term remains obscure: ? the weight for casting axe heads ? even more informal. The tubular drill marks show that the piece of lead was heavily used by some artisan].

2383 roughly incised "ΤΡΜΝ|ΑΟΝ" on one side [Robinson], and "ΤΡΙ|ΙΙ" on the other; squarish lead wt.1255.6gm. From Robinson's illustration however it is clear that both the "O" and the circular part of the "P" on the first side are cut with a tubular drill; the first legend should therefore be read as "ΤΙΜΝ|ΑΝ" (even though this makes little sense) and indeed the other legend is relatively satisfactory for the correct three-mina weight [I should presume that the piece was put to more than one use, as a weight and as a drill pad etc].

2404 legend "O" cut with a circular chisel [Robinson] on square bronze weight 52gm [the technique contrasts with other incised "O" for "O(ΓΔΟΟΝ)" although the weight is suitable; there is no sense in denying the possibility that mechanical means might have been employed to make this circular mark on a piece meant to serve as a weight]

(?)2405 legend "O" deeply cut with a compass [Robinson] on square lead weight 53.5gm [another variant technique, or is the central dot a fault ? The weight again is suitable for the eighth-mina]

B:Weights with relief symbol

2417 Astragalos no legend on rectangular lead wt.896gm (5th/early 4th.)
2418 Astragalos (? plus incised marks) on square lead wt.812.5gm.
2419 uncertain Astragalos on square lead wt.415gm

BB:Weights with incised symbol

2420 poorly engraved Dolphin on square lead wt.58gm (5th/early 4th.c.)

C:Weights without legend or symbol

Of Robinson's weights 2421-78 the following of his comments are worth including here; none of these can I believe be usefully regarded as weights

2461 circular lead "evidently the weight as first cast was not heavy enough, and a bit more lead was added; a part of this has again chipped off" (p.469)

2478 conical lead "...formed by pouring molten lead into a depression. This would be a natural way of making exact measures. But perhaps it was a base for a wooden or stone column" (p.471)

2444 circular lead; Robinson mentions stamps on both sides of this otherwise blank sheet (p.466), but no details are given.

SYRIA

The Greek weights from this area are naturally Hellenistic or later in date. Neither coinage, nor weights, before the Macedonian conquest can be considered here (but for Hebrew, Canaanite, and Phoenician see the general reviews in ch.IX.1 below). The later coinage is summarised by Head HN[2] 773-4; it closely followed the political history of the area, dividing into three main periods: (1) Alexander-coinage from the late 4th. century down to 266BC all on the "Attic" standard; (2) Ptolemaic, using what has been labelled the"Phoenician"standard (14.5gm shekel stater, with a 3.63gm quarter-shekel or drachma) from 266 into the 2nd century; (3) Seleucid, early 2nd century into the first. The interesting changes in the course of this last period are the inauguration of municipal coinage under Antiochus IV Epiphanios (175-164BC from Head's lists p.763), and the incorporation of coins on the"Phoenician"standard alongside the Attic standard used for the earlier Seleucid period. This"Phoenician"standard was used in the Phoenician city mints under Alexander (150-145BC). Even later, complete autonomy seems to have been accorded several of these cities and weights, legends, and dates begin to vary locally.

While some aspects of the history of coinage in Syria are reflected in weights from the area, the correlation is generally weaker than has been found elsewhere. Thus it is not possible yet to identify either coin weight standard (Attic or "Phoenician") in the surviving weights. Only four fit the Attic standard (the "Trident" weight from Tanagra; one "¼" from Seleuceia and another from Antiocheia; and an unmarked Anchor possibly from Antiocheia also); I do not feel confident to hazard a guess about those fitting the"Phoenician"standard. A major problem is of course the small number of weights collected from such a vast area, and the even smaller number that can be accurately placed within that area (only the late 2nd/1st century city-states are clearly distinguishable from their legends; and the variable dating systems impede a chronology that does not itself also rest upon identification of origins).

Nevertheless it is possible to pick out a range of different weight standards from those weights that are clearly marked. This is too wide to enable any further attempts at identification or attribution of the not so explicitly marked weights to be made at this stage, but is also good evidence of the lack of standardisation in the area as a whole. Thus "Seleucid" minai weigh 614gm and 519gm; "Ptolemaic" 1070gm, 703.92gm, 340.5gm, 55.8gm; Seleuceia weights (a fairly compact series) vary as much as 571.5gm, 504.9gm, 455.4gm (apparently all for the same mina); and although the heavy Antiocheia minai are close (1069gm, 1057gm), the earlier Anchor/zébu minai also vary greatly (498.6gm, 522.12gm, 496gm, 488gm, 439.84gm, 402.4gm). It is therefore difficult to follow Head (HN[2] 774) in believing that the Seleucid minting of coinage on the"Phoenician"standard showed that "the commercial susceptibilities of the Phoenician cities were carefully considered", at least as far as weights were concerned. There is, it is true, a close connection between coin and weight types, but this need be little more than style and common manufacture; there is no evidence of far-reaching official weight-standardisation and so neither of any recognition that such would be of great service to the commercial community.

I add for completeness a list of the weights from this area. They are grouped by city (or symbol) where sufficiently distinctive. The general Seleucid and Ptolemaic types are included also both from within and without the precise geographical limits of this area.

Antiocheia (Seleucid - second century BC)

- Relief Anchor and legend "ANTIOXEIA MNA" with date 194BC on lead (?) wt. 498.6gm. In Berlin. Lang ANSMN Michon DS sv.pondus 555 n.15.
- Relief Anchor, no legend on lead (?) wt.261.06gm. P.775.
- Relief Anchor, no legend on lead wt.248gm. Lang ANSMN no.4.
- Relief zébu and legend "ANTIOXEION TETAPTON" (with lattice reverse) on bronze weight 122gm. Babelon and Blanchet Cat.Bronz. 2237; Michon fig.5736.
- Relief Anchor and legend "ANTIOXEION TETAPTON" on lead (?) wt.109.96gm. Michon 555 n.18.
- Relief Anchor, no legend on lead wt.100.6gm (prov. Asia Minor). P.Supp.10.

Antiocheia (autonomous - first century BC)

- Relief each side Elephant and bell, legends (a) naming city and Agoranomoi (b) "DHMOSIA MNA" on lead (?) wt.1069gm [Michon] or 1068.2gm[Pernice]. Babelon and Blanchet BN.Cat.Bronz. 2246; Michon 555 fig.5737; Pernice GG p.73; Lang ANSMN reads the date as 57BC.
- Relief Elephant and legend "MNA" (reverse blank) on lead wt.1057gm (prov. unknown). Lang ANSMN no.5.***.

Gaza (Imperial ?)

- Legend "KOΛΩNIAC ΓAZHC" plus magistrate's name and year 15 (or is this a metrological number: Michon) on lead (?) wt.178.5gm of mid. first cent.BC. Babelon and Blanchet BN.Cat.Bronz. 2255; Michon 556 n.11.
- Agoranomos and year 164 on lead (?) wt.144gm (? prov. Gaza). Michon 556 n.13.

Laodiceia (Seleucid and autonomous - Head HN$^2$ 781)

- Relief Crescent and star, Agoranomos named, and city, also "MNA" and year 207 [so 105BC if Seleucid] on lead (?) wt.643. Babelon and Blanchet 2256.
- Agoranomos, city, also "HMIMNAION" on lead (?) wt. (?). Michon 556 n.5 (Coll.Rouvier).

Seleuceia (second century)

- Relief Elephant (to left), legend "ΣEΛEYKEION DIMNOYN" and date year 126 [186BC] on lead (?) wt.1143gm. Michon 556. Louvre.
- Relief Cornucopia, legend "ΣEΛEYKEION HMIMNAION" and year 150 [162BC] on lead (?) wt.252.45gm. Michon 556. Louvre.
- Relief zébu (to left), legend "ΣEΛEYKEIΩN TETAPTON" on lead (?) wt.113.85gm. Michon 556.

Seleucid types on other weights

- Relief Anchor "DHMO" on bronze wt.124.42gm [but with small suspension hole] from Sidon. Walters BM.Cat.Bronz. no.3010. [AA.11(1896)143; not included with the Antiocheia Anchors as the legend "demosion" does not appear there; Seleucid Sidon is more likely].

- Relief Anchor, legend that a mina of Antiochos X Philopator , year 220 [92BC] on lead (?) wt.614gm. Louvre. Michon 555 [placing under Antiocheia].

- Relief Victory with palm, legend that a mina of Antiochos IV Epiphanios, on lead (?) wt.519gm. Babelon and Blanchet BN.Cat.Bronz. 2245; Michon 555 fig.5738.

- HORNED HORSE HEAD stamp on Attic ½Tortoise lead wt.118.30gm. P.158

- HORNED HORSE HEAD stamp, [BASI]ΛE[WS] SEΛ[EYKOY] stamp on otherwise plain lead (?) wt.453.3gm from Athens. P.272. [see above ch.VII 1(1) III]

Ptolemaic types on unlocated weights

- Relief Double cornucopiae "DHMOSIA DIMNA" on lead (?) wt.681gm from Syria. Babelon and Blanchet 2261.

- Relief Double cornucopiae "ETOYΣ ΔΔΣ- ΔHMOΣIA MNA" on lead (?) wt.703.92gm (? prov.). Smith AA 26(1911)459 no.25 argues the date to be 78BC (Seleucid).

- Relief Cornucopia and named Agoranomos on BN wt. Michon 558 n.26.

- Relief Cornucopia "TETAPTON" mould for lead weight (? prov). Michon 556.

- Relief (a) Cornucopia and Fortuna (b) Star and ram "DHMOSION HMIMNAION" and year 2, on lead (?) wt.535gm [Michon] or 535.15gm [Pernice]. Babelon and Blanchet 2248; Michon 555; Pernice GG p.73 [Michon places also under Antiocheia, but the type would seem to be better here separate].

- Relief Justice (named) with cornucopia and a balance, named Agoranomos and year 86 [? first cent. AD] on lead (?) wt. with ring 313.9gm. Michon 556. [See above ch.I.1(2) Rep.U.VII (1)].

- Relief Dolphin around trident, dated to the 7th month of year 161, on lead (?) wt. 273gm. Babelon and Blanchet 2250.

- Relief Dolphin around trident, no legend, on lead (?) wt.267.80gm. From Berytus. Pernice GG p.73.

- Relief Trident, named Agoranomos, "M(NA)", and year 184, on lead (?) wt. 55.80gm. Michon 556 n.7 (Coll. Rouvier).

? - Relief Trident, and legend "$\Delta_{\Lambda}^{H}$" [query for "de(mosion)"] on bronze wt. 34.165gm. From Peiraeus. P.670.

? - Relief Upper part of trident [or is it a large "E" ?] on lead wt.460.74. From Tanagra. P.695.

? - Lang suspected that Pernice was unaware of the distinction between Crescent and Cornucopia in the Attic series (Agora X p.13). The following weights described by him as Crescents, but suspect on other grounds, may possibly be Ptolemaic:-

P.728 legend "ETOYΣ MH MH" 59.70gm (from Aegina)
P.583 with also relief "Δ" 16.07gm (from Athens)
P.389 opposed crescents, 59.84gm (? from Athens)

## III. General lists of weights from minor sites

ARGOLID
LACONIA
SICYON
METHANA
BOEOTIA
PHOCIS
LOCRIS
AETOLIA
EPIRUS
THRACIAN AREA
AEGINA
EUBOEA
CRETE
DELOS
MELOS
NAXOS
THERA
BITHYNIA
MYSIA Cyzicus
Lampsacus
Pergamon
Proconnesos
TROAS Alexandria in Troad
Ilium Novum
TENEDOS
LESBOS
IONIA Ephesus
Magnesia
Miletus
Priene
Smyrna
CHIOS
SAMOS
COS
WESTERN GREEKS

ARGOLID

Pernice ascribes three weights to Argos (P.681-3) but none have either Argive provenance or explicit legend. Only P.681 can be compared to Argive coin types (Quiver between two dolphins - though Head $HN^2$ identifies this as a fountain pump), but the type occurs on a stamp on P.681 (not noticed by Michon DS sv.pondus 552), and the weight carries no other indication of its value (64.2gm). The type on the lead disk P.682 seems more likely to be Elean (Eagle with branch in beak).

LACONIA

Two odd weights from Gythium seem to belong to the Greek period. Neither bears any legend indicating official or city, and there are no types. Their attribution to Gythium is therefore hypothetical:

- Inscribed $\overline{\text{H}}$ on a fragment of a marble sphere. IG v (1) 1213 Kolbe disputes Forster's identification (in BSA 10(1904)182-5) of "H" as 100 minai, on the grounds that the restored sphere should have weighed 4,600gm and so 7 [sic] minai of 655gm. This seems oddly mistaken as "H" should be 8 (if a number) and a mina of 575gm is not implausible.

? - Lead weight with handle, no legend, wt.535.23gm. P.680. Pernice finds the low weight disconcerting (is the handle intact ?).

SICYON

Sicyonian weights can be identified by legend (ΣΙ or ?ΣΙΚ) or by type (Dove in wreath). Coin parallels would indicate dating between 4th/2nd c.

- Relief "ΣΙ" on bronze wt.379.52gm, later incised "ΔAMOY" and found in Corinth (see above). P.687.

? - Relief Dove in wreath on circular weight with an official's name. Cab.Méd. Michon DS sv.pondus 552 n.57 [but is this necessarily a weight ?]

? - Incised sitting owl and "ANΘ" on bronze wt.418.71gm found Sicyon. P.686.

? - Relief Crescent and legend "ΣΙΚ" on lead wt.122.6gm. P.335; the heaviest of the Crescents in Pernice, and suspected as non-Attic by Lang Agora X 12 n.26.

METHANA

Pernice notes two round bronze "weights" P.691,692 as from Methana, incised "N" and a monogram ΛΕ. These legends are obscure. The weights (4.16 and 4.06gm) may be drachmae but the identification of the pieces as weights is best for the present left uncertain.

BOEOTIA

Most weights from the area belong to the series of other states. The only local piece definitely is the bronze weight (Walters BM Cat.Bronz. 2999) with the legend Νικόλκος Μαρκου ἀγορανομων Λεβαδευ[σι] ie. Lebadeia (L.Robert Rev.Phil. 13(1939)186-7, correcting earlier editors who read an ethnic here). It is square, with a ring, and weighs 296.15gm.

Otherwise "from Thebes":-

- [? Attic] Relief lump (? Astragalos) lead wt.840.18gm. P.694.
- [Attic] Relief ½Tortoise [Gp.BIIc] lead wt.110.7gm. P.696.
- [??] Incised Winged Sphinx on bronze wt. described AA 28(1913)18 (e) Munich.

From Tanagra:-

- [Attic] Relief ½Crescent lead wt.68.27gm. P.697.
- [? Attic] Relief "ΔΕ ΟΓΔΟ" lead wt.57.36gm. P.699.
- [Ptolemaic] Relief Upper part of trident [or ? large "E"] lead wt.460.74gm. P.695 (and also listed above).

From Acraiphnion:-

- [??] Round lead wt.63.36gm, marked (? stamp) " Δ ". P.698.

PHOCIS

The following group of two weights was assembled by Kroll Hanfmann Studies 87ff. Though giving a restored mina range of 414.5-424.56gm their shapes are too variable to suppose a similar origin (either in date or place). Surprisingly no weights seem to have been found at Delphi.

- Relief Boukranion square bronze wt.414.5gm incised with Agoranomos name and possibly (by implication) the value (mna). Kroll Weight C.
- Relief Boukranion hemispherical lead weight, no legend, from Phocis. Wt.106.14gm. P.701.

LOCRIS

- Relief Fish (with letter ?) and legend "ΦΥΣΚΕΩΝ Η" on good condition bronze weight 304.91gm. No provenance. P.751. Pernice prefers Rhodian Physkos to the Locrian, but comparison with the next weight makes Locris possible if "H" means 100(drs).
- Relief legend "ΧΑΛ | ΕΩΝ" with "T" between, on bronze wt.100.51gm. P.700 and IG ix (1²) 738, dating the letters to the fifth century. Of the two possibilities "T(ETARTON)" gives a mina of 402.04gm which is low; and "T(PITON)" gives one of 301.53gm which is lower, but comparable to the mina read from the "H" of the preceeding weight.

The low local Locrian standard (of just over 300gm) could be interesting, but badly needs confirmation.

AETOLIA

- No doubts surround the identification of a mina weight from Thermae. The legend reads "Ἀπολλώνιος Θερμεύς" and also "M(NA)" on a bronze weight possibly from the site, wt.500gm. Ἐφ. Ἀρχ. 1905 p.81; IG ix ($1^2$) 83, dating the weight to the end of the third century.

EPIRUS

- From Phoenike has come one lead weight, incised simply "M" at 442.86gm [P.702]. Phoenike was the capital of the Epirot federacy, coining in the later third century (Head HN$^2$ 321-2), which may then be the date of this weight.

- From Dodona a much higher mina is indicated by a lead weight marked in relief "ΗΜΙΣΥ | ΜΝΗ | ΣΥΓΟΡΓ" at 253gm [P.703]. This would give a mina of 506gm. Head notes no coinage from Dodona until the Imperial period.

Ambracia. Two bronze weights, relief Pointed column of Apollo Agyieus (found also on the coins of Ambracia 238-168BC Head HN$^2$ 319-20), legend "AMBP", 254gm and 125gm [AA 28(1913)18 (f) and (g)]. Comparing Dodona above, these could be half- and quarter minai of 508gm and 500gm.

THRACIAN AREA (N.Aegean Islands, N.Coast, Chersonese, W.Black Sea)

A fair number of weights seem rightly assigned to cities of this area: Pernice GG nos.705-26; Michon DS sv.pondus 553; Soutzo "Poids et monn. de Tomi" Congrès de Num. (1900) 115-45. The greater part of these weights however are blank or belong to the Roman period (identified by Roman names of officials, and also by the Roman weight system, thus "δεκαλιτρον Ἰταλικον" on P.705). Of the weights that appear to be Greek, none can be precisely dated, though in general they seem late (second to first century BC).

- Attributed to Aegospotami or Aenus is the BM (? lead) weight P.726, with relief goat and "ΔΗ(μοσιον)" 51.062gm. The weight is unique and without provenance, the attribution being simply from coin type (Michon p.553 "sans grande vraisemblence").

- Bisanthe certainly made its own weights. For example see the bronze (presumed from Michon p.553) weight P.706 with relief Caduceus and legend "ΒΙΣΑΝ ΜΝΑ" (and further unidentifiable marks that may belong to traders) at 556.13gm (provenance also Bisanthe).

- Byzantium. Two further weights are attributed to Bisanthe by Michon which must rather belong to Byzantium. Both are cited from sales catalogues, and the peculiar form of "B" in the second surely relates to the "ℿ" uniquely found on Byzantium coin (see Head HN$^2$ 267). Further if the "M" on the first weight is correctly read as "M[NA]" the weight is roughly half that of Bisanthe:
  (1) Relief Dolphin and "BYZ M", lead wt.260gm.
  (2) Relief Dolphin and "ℿYZAN", lead wt.228gm.

- Heracleia (Thracian according to Michon, though Robert calls Propontic). Two weights are collected by Michon p.553, their actual weights are only roughly compatible and their shapes are entirely different. The identity of the group should be regarded as most uncertain:
  (1) Relief Crowned Dionysos and "HPA TETAP[TON]" on triangular lead weight from Tomis P.711, wt.129.5gm (giving a mina of 518gm).
  (2) Relief Heracles and "HMI ΔH[MOΣION]" on round lead weight from Tomis or Mangalia P.708, wt.240.8gm (giving a mina of 481.6gm).

- Lysimacheia (in Thracian Chersonese) was independent for only a short period in the third century BC. This gives a clear date for the one weight which can be assigned to the city (by legend and coin type): P.Supp.7, a square lead weight with relief Lion protome and "ΛΥΣΙ" and "H[MI ?]", wt.246.3gm. The provenance is given simply as from Asia Minor. Pernice AA 1904 p.45 argues that the type is ½Lion and indicates ½-mina; however the protome occurs on all the coins of the city without any such metrological implication.

- Tomis, a Milesian settlement, appears to have issued the series of distinctive triangular lead weights, several of which with explicit mention of the city name. As the autonomous coinage is placed in the second to first centuries BC (Head HN² 275-6, though Soutzo p.120 thinks this could be slightly earlier), the triangular series, which appears to be Greek, should be dated in the same period. Other Tomis weights are clearly Roman and so much later. The weights of the Greek series are quarter-, third-, half-, and 1-minas; though the condition is in general poor (nos.1 and 3 of the following list are best preserved), the standard appears to be as high as 640gm mina. Soutzo points out that this is precisely 100 times the weight of the earliest autonomous silver drachma of Tomis (6.39gm); Michon's suggestion (p.553) that it represents the "μνᾶ ἀγορᾶϊκ" should therefore be ignored. The following list revises Soutzo's numbering; all weights are lead and triangular in shape:
  (1) Relief Hermes in petasos and "TEHP°" wt.160.70gm (P.710; Soutzo no.1).
  (2) .. .. .. and "TO" above "TETAPTH" wt.143gm (Soutzo no.4)
  (3) .. .. .. and "TPITH" wt.212.2gm (P.709; Soutzo no.2).
  (4) Relief Dioscuri and "TO" above "HM[IMNAION]" wt.191.8gm but with a substantial loss due to a hole in the weight (Soutzo no.3).
  (5) Relief Hermes in petasos and traces of "M" wt.625gm (Soutzo no.5).

AEGINA

No specifically Aeginetan weights can be identified. The turtle/tortoise type of Aeginetan coinage occurs on weights, and in the correct sequence, but these weights have been shown conclusively to belong to the Attic series entirely (see especially the legend on BW.3 above Turtle Gp.A.1a). A variation, with the tortoise in a laurel wreath, has been suggested as Aeginetan (Michon DS sv.pondus p.553 and n.4), but no weight or provenance supports this view. The wreath is not found on Aeginetan coins. Attic weights found on Aegina are P.727 (Amphora Gp.A.1a) and the odd P.728 (½Crescent Gp.B.1d) which seems to bear a Seleucid date.

EUBOEA

The association of Euboea with two Gorgoneion weights (P.730, 735: see both Pernice and Michon) should now be dropped that the coins justifying the association have been recognised as Attic, but the weights cannot be otherwise identified. Attic weights found on Euboea are P.731 (bronze, Tortoise Gp.A.1b) and P.733 (½Crescent Gp.B.1c). Possibly local however are two square bronze weights with relief legends and Euboean provenance:
(1) Relief "ΓΟ | ΔΗ | Μ[ΝΑ]" wt.450.82gm (P.729); from Euboea in general.
(2) Relief "ΔΗ" wt.64.82gm (P.732); from Carystos. It is obscure what value this weight represents. Like the first it is in good condition.

CRETE

The lead weight P.14, with relief Astragalos and "HMIMN", wt.255.6gm, was described as of Cretan provenance. Neither the weight (giving a heavy mina of 511.2gm) nor the type used with ½-mina value fits the main Attic series of Astragalos weights. Though the weight has been listed provisionally above as Astragalos Gp.A.IV, it may in fact be Cretan. No further Cretan weights have yet been assembled to confirm the location of this heavy mina standard on the island; the two mastoids listed by Pernice as from Crete (P.748-9) must be Roman (compare the Agora mastoids).

DELOS

The weights of Delos excavated by the French are somewhat unsatisfactorily described by Deonna Delos XVII (1938) 139ff. Although the weights of the "pesons" of lead (rightly not regarded as actual weights) are given in detail, the weights of the proper lead and stone weights are not recorded (though the bronze it is true are). This inadequacy is perhaps not immediately significant as the greater number of the weights are plain (unmarked or with letters unrelated to their value or provenance). The five marked lead weights include one that can be assigned to Alexandria in Troad (qv) (B.608-7821), but are otherwise unplaceable. A further weight, P.745, is variously described by Deonna (bronze, relief "M", wt. 111.33gm) and Pernice (lead, relief "ΓM", wt.111.23gm), and its origin is equally obscure. That Delos should thus fall into the same category as Corinth and Aegina, with neither local weights nor evidence of substantial use of Attic weights, is to be noted: see further sv.Delos in ch.III.

MELOS

Uncertain. Michon DS sv.pondus p.553 suggested that the relief lump on P.773 might be an apple and so indicate Melos; associated by legend would then be P.774; but the identification is not satisfactory. Pernice lists a further three circular lead disks with provenance Melos or Kythnos (P.752-4); but they seem unlikely to be weights.

NAXOS

Even the provenance of Naxos is doubtful for the Attic Tortoise P.746.

THERA

A number of weights have been identified from Thera: IG XII (3) 1638-40 and 977-81 see Hiller von Gaert. Suppl. IG XII p.90; Viedebantt Forsch. (1916) 53-6; Mamet Thera (1879) 27 and Thera III p.41: also Hiller von Gaert. Hermes 36(1901) 113ff; a clearer description of no.981 is given by Pernice (P.747). Of these weights only three seem possible to be included here, and none are certainly Theran. The first, if correctly dated, could be most significant:

(1) Black stone, incised "ἡμι[στατ]ηρος ; ηεναιον" in what is said to be sixth-century lettering; a second incised legend "IC" is very late however. Wt.7168gm (which would give 8½ staters of 843.3gm, or a mina of 421.7gm). IG XII (3) 1638.

(2) Red stone, incised "TPHCMN". Wt.3200gm (3 minai of 1066gm). Late. IG XII (3) 1640.

(3) Round lead weight, with relief "M" (plus more modern graffiti, and in a depression a relief symbol of a vessel); wt.484gm. P.747 and IG XII (3) 981.

BITHYNIA

A Roman province from 74BC, to which period appear to belong the following weights:

- Heracleia Pontica (distinct from Propontic by both provenance and type)
  (1) Square bronze weight, with relief Heracles and legends of agoranomoi and Roman Empire, wt.2686.4gm. Walters BM Cat.Bronzes 2997. [Is this perhaps a steelyard weight ?].
  (2) Square lead weight, with relief Heracles on both sides and legend "MHΔOY" (?), wt.155gm. Louvre MNC 1908; Michon DS sv.pondus p.554.
- Nicaea. Circular lead weight, with relief Flower/cornucopia on both sides and legend "NIK", wt.172gm. Coll.Hoffmann; Michon p.554.

MYSIA

- Cyzicus is explicitly marked on a small series of Greek weights; these seem to be mainly (no.5 being an exception) coin weights as the stater involved is the small coin weight rather than the higher 2-mina stater. Despite the careful marking of value the weights vary surprisingly; this could be an interesting indication of the varying valuation put upon the coin in question (which was electrum: see further Bogaert Ant.Class.32, 33 and Guepin ibid. 34. The loss of the mina weight (no.5) is unfortunate. Though several of these weights are possibly of the later Roman period (especially with the later "Z" form for earlier "Ξ"), I have included them here as the borderline is not distinct.
  (1) Bronze weight, relief Dolphin (or better, Head HN$^2$, Tunny) and legend (probably also relief) "KYΠ | ΔICTA"; wt.45.07gm (two staters of 22.535gm). Walters BM Cat.Bronzes 3000; Murray NC (1868)55; (Coll. Woodhouse "from Corfu" and see above on Corcyra).

(2) Bronze weight, similar, but no details. Michon DS sv.pondus 554 n.18.
(3) Bronze weight, relief Dolphin and "KYZI|ΔIC"; wt.29.85 gm (two staters of 14.925gm). Babelon and Blanchet BN Cat.Bronz. 2242; Michon fig.5735.
(4) Bronze (? as Michon p.554, although the weight is not mentioned by Walters), relief Torch and "KYZI TP[I ?]C"; wt.44.43gm (three staters of 14.81gm). Murray 54 (see p.71), also from the Woodhouse Collection.
(5) Lead weight, relief Torch and "KYZI MNA" (Michon); no further details as the weight has since been lost. Michon p.554 n.15.
(6) Bronze weight, relief Lighted torch and "KYZI CTA" (Michon); wt. 18.70gm. Babelon and Blanchet BN Cat.Bronz. 2243.
(7) Lead weight, relief Torch (Pernice "Kerykeion") and "CTA KYI"; wt. 30.52gm. P.Supp.5.
(8) Lead weight, relief Torch (again corrected) and "KYZI CTA"; wt.27.90gm. P.Supp.6.

- Lampsacus, like Cyzicus, minted electrum staters (generally placed at about 15.36gm, but with room for considerable variation early: Head HN² 529). From the early fourth century however electrum was abandoned for gold coins on the standard of gold "Darics" (394-350BC at about 8.488gm); but throughout the century Lampsacus also produced silver coins on the "Persic" standard (said to be 2.527gm) and these continued until the city (autonomous but under Rome) issued Attic 4drs. in the early second century. The winged forepart of a horse continues as the coin type right through these changes (although certain other types do also occur). Despite this fairly explicit coin history, it is not possible to correlate (and so date) the two identifiable Lampsacus weights:
(1) Square bronze weight, relief Forepart of Pegasos and "H" ("sans doute" "H[MIMNAION]": Michon); wt.262gm. Michon DS sv.pondus 554 n.21.
(2) Lead weight, relief Forepart of Pegasos and no legend; wt.40.41gm. Murray NC 1868 no.50; P.768 (again from the Woodhouse Collection).

- Pergamon. Michon notes one weight with legend "ΓEPΓAMHNON" (DS sv.pondus 554); but nothing further is indicated for what was a major coin centre in the later Greek world.

- Proconnesos. This island off Mysia in Propontis coined from 400-280BC (Head HN² 537-8); probably to this period therefore belongs one oval lead weight, relief Amphora on side (?) and "ΠPOK", wt.427.6gm (but poor condition; presumably however a mina): P.Supp.9.

TROAS

- Alexandria was founded as Antigoneia in 310BC, but then renamed in 300BC. Its coins typically show a horse feeding or Apollo Smintheus with bow and phiale, and the legends are "AΛEΞAN" or "AΛE" (Head HN² 540-1). The weights of Alexandria are only of interest in that they include the sole marked weight from Delos (no.1 following); no standard system can be reconstructed:
(1) Square lead weight, relief Cithara with bow each side and "AΛEΞAN" with "M/M" (MNA) below; wt. not given. From Delos, Deonna Delos XVII 147 no.B.608-7821 also pl.423.
(2) Bronze weight filled with lead, relief Horse feeding also "AΛEΞAN" and "ΔIOKΛEIOYΣ"; wt.2589.6gm. Michon DS sv.pondus 554.
(3) Square lead weight, relief Horse and "AΛE" wt.98gm. Michon 554.
(4) Similar, with "T" under ground line, but ? weight. Michon 554 n.24; Deonna p.148; BCH 7(1883)100.
(5) Similar, but bronze; wt.30gm. Michon 554.

- Ilium Novum. On the site Schlieman found a square lead weight, relief Pig's head in profile, possibly comparable to an Attic stamp (?), wt.510gm: Michon DS sv.pondus 554.

TENEDOS

A remarkably clear group can be established for this small and seemingly unimportant commercial centre; it is not however clear what value the two weights represent (whether mina or its half). The weights are similar as described by Michon DS sv.pondus 554: lead square weights, with relief Double-axe and bunch of grapes by shaft and explicit legend "ΤΕΝΕΑΙΩΝ" (plus a monogram ), wts. 272.1 and 273gm.

LESBOS

P.750 came from Methymna, a lead weight with relief "ΛΞ" at 123.21gm. Though Pernice suggested (GG. p.70) the weight was a quarter of a 492.84gm mina (and the high Attic mina is found in third- to second-century Ionia), it clearly cannot be established.

IONIA

- Ephesus. Head arranges the Ephesian coinage through a variety of weight standards (Phoenician, Rhodian, Attic, Ptolemaic, Reduced Rhodian, again Attic, and finally Cistophoric: HN 571-6). Against this sort of background it would be idle to attempt to place any of the three weights that might be attributed to the city; none of them furthermore are adequately published:
  (1) Square lead (?) weight, with symbol (?relief) Bow and quiver and legends "APTE" and "MNH"; no weight given. Michon DS sv.pondus 555 n.6
  (2) Lead (?) weight in form of an olive, relief Bee with "EΦ" and on the reverse a female head (presumably Artemis), wt.39gm. Babelon and Blanchet BN Cat.Bronz. (hence query) no.2244; Michon 555.
  (3) Lead weight, with relief "ΔΗ(μοσιον)"; wt.323.68gm. From Ephesus, Pernice GG. p.62.

- Magnesia (on Maeander). Michon notes one weight with legend "ΜΑΓΝΗΤΩΝ Κ" (DS sv.pondus 555 n.5), wt.944gm. As most coins of the city are of Attic weight (Head HN 581-2), the letter "Κ" probably relates to magistrate, rather than numeral. The weight might therefore be interpreted as two-minai (of 472gm mina).

- Miletus. Again a complex coin history prevents interpretation of a small corpus of inadequately-marked weights. The attribution to Miletus seems certain however in view of the distinctive monogram for "MI" (found on coins 350-190BC). A high mina is again indicated for Ionia if the first weight is a ½-mina.
  (1) Triangular lead weight, relief ""; wt.246gm. From Asia Minor, P.Supp.8.
  (2) Lead weight, relief ""; wt.112.49gm. From Peiraeus, P.659.

- Priene. The three clearly-marked and identifiable Priene weights are a welcome contrast to the rather vague attributions of the majority of Asia Minor weights.
(1) Square lead weight, relief Trident and "ΠΡΙΗ ΔΙ" (also a square depression which could be a monogram ?); wt.936gm. P.Supp.2.
(2) Similar, wt.982gm. P.Supp.3.
(3) Similar, relief Trident and "ΠΡΙΗ ΜΝΑ"; wt.525gm. P.Supp.4.
The provenance of all these weights is given as simply Asia Minor. Both Pernice and later Robinson (Olynthus X 451 n.19) have noted the two standards implied by these weights: interpreting the legend of nos.1-2 as "ΔΙ[ΜΝΟΥΝ]" yields minai of 468, 491 and 525gm for the series. As all the weights are of lead, and as the difference between the first two is in fact greater than that between these and the third (which is where both Pernice and Robinson distinguish standards), I am not prepared to accept that a distinction can be established. The third-second-century coinage of Priene would appear on the other hand to call for a mina considerably lower than the lowest "standard" indicated by these weights (Head HN$^2$ 590-1 gives the drachma as 56grs., or 3.628gm).

- Smyrna. Weights from Smyrna were published first as a corpus almost a hundred years ago by Papadopoulos-Kerameus Τα ἀρχ. Σμυρναϊκὰ σταθμὰ (1875) and then further in 1877 and 1878. None of this have I been able to consult; nor have I found more recent material than the general discussion by Michon DS sv. pondus 554-5 and 558, and Pernice's lists GG pp.62 and 68. On the basis of this scattered evidence however the following tentative subdivision of the corpus seems suggested: (a) third-century weights with legend "ΣΜΥΡΝΑΙΩΝ" or abbreviated forms (but "Σ" rather than "Z" or "Ξ" of the second/first century, rather than "Z" of the Imperial period, and rather than "C" post Hadrian: see the coin legends as arranged by Head HN$^2$ 592-3); these weights form the basis of the list that follows; (b) foreign weights found at Smyrna (? Chiot Amphora weight P.744; and the Attic Dolphin Gp. A.1c Pernice GG p.62 and the ½-Amphora Gp.B.1 also noted in the same place by Pernice); and finally (c) weights with named officials that clearly belong to the Roman period (see esp. Michon and add AA 14(1899)151 nos. 236-40). Neither of these two last groups need concern us here. The first however can be set out in rather more detail: 1-5 are third-century:
(1) Legend "ΣΜΥΡΝΑΙΩΝ" wt.910gm. Smyrna Cat. no.63.
(2) Legend similar, but also Agoranomos Nikomachos; wt.69gm. Michon 554 n.28 (in the BN).
(3) Legend "ΑΓΟΡΑΝ ΔΗΜΟΣ ΣΜΥΡΝΥ"; wt.133.35gm. Michon ibid. n.29 (Louvre)
(4) Similar; wt.256.5gm. Michon ibid. n.30 (Smyrna).
(5) Legend "ΣΜΥΡ ΤΒ" and named Agoranomos; ? wt. Smyrna Cat. no.87.
And probably second-century:
(6) Lead (?) weight, with relief Galloping lion and " Μ[..]"; no wt. given. Michon ibid n.31 (Louvre).
(7) Rectangular lead weight, relief Lion standing with forepaw raised, no legend; wt.653gm (but badly worn). Lang ANSMN (1968) no.3.
Lang argues this last weight to be equivalent to two Cistophoric minai. It is true that its weight seems to diverge from the "ΣΜΥΡΝΑΙΩΝ " weights nos.1-4 of the earlier period, but these do not themselves form a clearly coherent system. It would seem better here as elsewhere to leave open the identification of the values of unmarked weights, and not one of these from Smyrna itself is so marked.

CHIOS

A significant group of weights can be assigned to Chios. The weights in fabric compare closely with Attic being squarish and of lead (the marble weight no.1 is an exception); types are Sphinx on Chiot amphora and Chiot amphora alone (see Michon DS sv.pondus fig.5733 for illustration of no.2); only one weight bears the city name, but the majority are sufficiently identified by type and local provenance. The following list is derived from Pernice and Michon, but I have made one deletion (P.742, which has an AMPHORA stamp) and added tentatively the two weights (P.108-9) from the Woodhouse Collection on Corfu. The weights that are clearly marked could seem to indicate three different minai: 547-562.05gm, 474.76, and 416gm (the lower supported by taking no.6 as a quarter-mina). In view of this variation the corpus must be greatly enlarged before a valid analysis can be attempted further than these lists.

(1) Marble, relief Amphora; wt.1779.8gm. No provenance, P.737.
(2) Lead, relief Sphinx on amphora and "ΔΥΟ ΜΝΑ Α"(Michon); wt.1124.1gm. From Chios, P.738.
(3) Similar, but legend "ΜΝΑ"; wt.547gm. From Asia Minor, P.739.
(4) Lead, relief Amphora and "ΜΝΑ"; wt.474.76gm. From Chios, P.740.
(5) Lead, relief Sphinx on amphora and "ΜΝΑ"; wt.416gm (but condition said to be poor). From Chios, P.741.
(6) Lead, relief Amphora and "ΧΙΟΣ"; wt.107gm. From Chios, Michon p.553-4.
(7) Similar, but no legend; wt.38.85gm. "From Corfu" (Woodhouse), P.108.
(8) Lead, relief Sphinx on amphora but no clear legend; wt.37.75gm. From Chios, P.743.
(9) Lead, relief Amphora (the incised "Χ" is unlikely to be the city name, contra Pernice GG 63 n.2); wt.29.07gm. From Smyrna, P.744.
(10) Similar, no legend; wt.26.87gm. "From Corfu" (Woodhouse), P.109.

SAMOS

The sole weight I can mention here from Samos is of considerable interest for its early date and its weight value. It is bronze, with legend "ΗΜΙΕΚ⌊ΗΚ⌋ΤΟΝ Τ⌋Ο ΔΗΜΙΑ[ΚΟΝ]" in letters dated to the third quarter of the sixth century by Barron Silver Coins of Samos 7 and n.1. Barron cites three modern weighings of 132, 145 and 150gm. Although the most recent of these is the lowest (132gm), Barron took the middle weight to postulate a stater of 1740gm, exactly, he noted, 100-times the Samian coin (electrum) staters of 17.40gm. With the lower and higher readings, however, staters of 1584gm and 1800gm are yielded and these are not amenable to easy correlation with contemporary coin weights. Still important to note are the early date and the weight system indicated by the weight.

COS

Two weights have tentatively been assigned to Cos: neither is certain and neither is self-explanatory; neither need be an actual weight, nor are they, if weights, consistent with a common system and standard.

(1) Square lead weight, "gravée en lettres en relief" "ΝΙΚΟΜΑ⌊ΧΟΣ ΙΣΘΜ⌊ΙΩΤΑΙΣ"; wt.130gm. Robert Rev.Phil. 13(1939)185-7 explained the weight as a dedication by an Agoranomos Nikomachos to the Coan deme Isthmiotai; the stated provenance, "Corinth", he argued to be a mistaken inference from the inscription. The letters are unique for weights, their form would suggest a date in the second/first century BC.

(2) Truncated lead pyramid; relief Heracles (above), Club and Bow (under); sides stamped "HPΓA"; below relief legend "ΔAM[OΣION]"; wt.179.55gm. Lang ANSMN (1968) no.1 assigns this weight to Cos (there is no stated provenance) on grounds of Doric dialect, Heracles type, and weight, which she takes to be an underweight (as the weight is worn) Rhodian half-mina.

Clearly neither the attribution nor the interpretation of these weights can usefully be pursued here.

WESTERN GREEKS (further to Corcyra and the small South Italian group discussed in the preceding section of this chapter)

- Akrai. A single bronze weight, incised "ΣTATEP ΔIKAIO", has long been known from Palazzolo Acreide: Orsi Riv.di Stor.Ant. 5(1900)45; Brea Akrai 159f no.17; Jenkins Gela 127. The weight is now said to be 17.55gm (Jenkins, against Orsi's 17.4gm), and could easily be equivalent to the slightly heavier Sicilian tetradrachm (see the brief survey of Sicilian mints in the excursus appended to the following discussion of coinage). From letter forms and from the fact that the 4dr stater only appeared on the island towards the end of the sixth century, the weight is likely to belong to the fifth century.

- Akragas. A series of bronze "weights" are listed at the end of the BM Catalogue of coins for Akragas. Nos.1-5 are marked with pellets: 4 on 15.29gm, and 14.58gm; 3 on 12.25gm, and 12.18gm; and 2 on 6.80gm. The resultant range for the theoretical single pellet unit is rather wide, 3.4 - 4.1gm, and also rather underweight for the most likely local coin weight, the drachma or "5-litra" (both over 4.1gm). The objects are of distinctive triangular or tooth-like shape, and therefore cannot be coin; nevertheless they bear the city-emblem of Eagle and crab that appears on coin. The date is uncertain but should be no later than the end of the fifth century destruction of the site.

## 2. Coins

### 2.(1) General considerations

Any assembly of Greek weights is incomplete without some mention of coins.[136] In so far as the value of a Greek coin in silver or gold was a direct function of the weight, the coin itself was a weight, officially stamped by the state mint just as the many weights considered in the earlier part of this chapter. The possible contribution of coins to the whole study of weighing in Greece is therefore considerable. Most Greek states coined, and a large amount of research has enabled classification of a variety of weight systems on a variety of standards. With detailed analysis of coin types, die sequences, and modulations of standards, relatively precise chronological periods can be established (for the Western Colonies approaching twenty-five year periods) and possibly significant variations observed between them. Hoard evidence gives some indication of the extent to which these coins travelled outside their places of origin, and from dies estimates of the relative sizes of certain issues can be derived. The extent of coinage, the minimal weight differences suggested for fractional denominations, and the variations indicated by the studies just mentioned, could easily be manipulated to refute ostensibly even the most sceptical of those who doubt the place of weighing in ancient Greece, just as coinage has been used, from Aristotle to Lang and Breglia, to associate the Greek state with commercial enterprise.[137]

It is essential to recognise that the use of coin evidence in these contexts depends entirely upon a number of assumptions about coinage in general that in themselves depend on the first and most crucial misconception: that coinage was generated by commercial considerations. That the earliest Greek coins were suitable for trade has been conclusively refuted by Dr Kraay by pointing out that their values were very much too high.[138]

The implication that the (subsequent) lower fractional coins were any better suited ought equally to be challenged, as Dr Kraay has also shown that such coins did not travel. Secondly, endless debate has surrounded the question of the origins of coin standards without questioning that they had a common origin and without serious note being taken of the obvious ambiguity of the virtually ubiquitous "stater".[139] Thirdly, considerable ingenuity has been used to establish Greek weight standards and to express them in several decimal places of grammes. My objection is not simply that the Attic drachma, for example, has been set at 4.366gm[140] where the smallest attested Attic weight, the eighth obol (and itself a coin),[141] could only decide the first decimal place; variations might have been detectable even below the measuremental threshold, although even here the balances available to the ancient Greeks, as also their manner of using them, impose similar limits.[142] More seriously, the importance of consistency within certain contexts can be separated from absolute measurements, and the value (and manipulation) of such absolute measurements of Greek coins questioned. While modern weights are indispensible for the analysis and study of the ancient coins (and I make full use of them here), it is all too easy to tranfer them, and their conceptual framework of absolute weight measurement, to the questions that surround the interpretation of Greek coinage.

These and other basic assumptions will be questioned in later chapters where they are more immediately relevant.[143] They group more conventionally around a series of problems generally considered in the context of coinage alone, and so, as I shall not be restricting my subsequent discussion to coinage, it may be helpful to set out these issues briefly here. First, and most obstinate, is the debate about the <u>origins and development</u> of coin standards and systems. The interest here is on the weights involved, and attempts have been made[144] to derive the Greek weights from earlier near-eastern weights (Hultsch) or from those of the Greek bronze age (Seltman); modifications include bimetalism (Ridgeway) and the facilitation of exchange (rather as Lang argues for the Tortoise weights). The relation between coin and other weights belongs here, and has been seen as evidence of state attempts to combat inflation by varying the relationship (Lang) or has been used to postulate pre-coinage weight systems on the assumption that the relationship was one of identity (Breglia). All these theories presuppose <u>state interest</u> in commercial

enterprises of some kind or other; this is a second major issue in its own right, and while the involvement of the state is indisputable, the commercial function of coinage can seriously be questioned, as already has been indicated above. Marginally distinct is the problem of the use of coins, although this is of some independent importance for my thesis as raising the question of whether coins were considered to be weights in practice by ordinary Greeks. The possibility of contrast with these specialists concerned with the manufacture of coins I consider to be important, and again there is no firm agreement on how this was done. Finally I should note the problems arising in the interpretation of the accuracy of coins, for it will be clear that these problems depend largely on the issues already mentioned: was accuracy necessarily the result of accuracy in weighing ? how relevant was accuracy to use ? how can the Greeks' own estimate of their accuracy be assessed ?

My position on these matters is briefly as follows. The origins of Greek coin weights cannot usefully be recovered, but possibly they represent a combination of the survival of bronze-age units, of recent influence from the Near East (particularly in their systems), and of haphazard decisions on the part of those concerned in the making of the first coins. Bimetalism seems to be inappropriate to the vast majority of Greek mints that originally (and also subsequently) produced coins in the one metal, silver, only. Systematisation, including the unification of weight systems other than that of coins, probably followed upon the official statement of a weight standard in the coinage; the reasons should be compared with those for state coinage itself, and only approach recognition of commercial use in the later classical period. Generally such systems were maintained as standards, although second-century Athens seems to have experimented with a dissociation of standards that may, but only for this late date, have been prompted by such motives as Lang has suggested (but applied to the earliest Athenian period also).[145] With rather more caution I should divide the use of coin between: (a) silver content in bulk (certainly outside, but occasionally also within, the state of origin); (b) conventional value as individual coins (restricted to the area of acceptability, in most cases being only in the state of origin); and (c) weight value for the purpose of weighing other items. This last is only attested in inventory procedure although its use may have been wider. There is no indication that the coin weights were ever

checked (not even where used as weights); in practice the absolute weights of coins were of little importance.

Thus although coins are a special form of weights, it is clear that they offer no immediate solution to the general questions of Greek weighing; indeed I shall be concerned to qualify their relevance even as weights to such specific problems as accuracy and everyday use. There remains however the direct evidence they give of actual weight standards and systems which, although of limited value, cannot be omitted from this chapter on Greek weights.

## 2.(2) Coin weight standards and systems

The evidence for these is considerable as coins have survived in great numbers; it is also fully representative of ancient Greece as a whole in so far as most Greek states minted at one time or another. Unlike the fragmentary and largely doubtful corpus of (non-coin) weights outside the Attic series, most coins can be identified as to provenance from the types stamped upon them. Analysis has been further advanced by the keen interest of collectors and scholars (for whom the weight series have offered no comparable intrinsic attraction). Unfortunately however the greatest areas of remaining doubt are precisely those of interest here - weight standards and the systems of their subdivision. To some extent this is a necessary result of the order in which the numismatic evidence can be assembled: only after identification and ordering in sequence or in association can systems be observed. This involves three major difficulties: the making of inferences from Greek coins; clarification of what is meant by a weight standard when used of Greek coin; and thirdly practical problems in the evidence itself.

It would of course be wrong to suggest that weights do not play an essential part in the study of Greek coins. In dealing with them the frequency table technique has generally supplanted the use of averages since Hemmy first published a rigorous analysis of it under the rather elaborate name of the "homogeneous random process".[146] The theory is that given a fixed minted weight an identifiable pattern emerges from the

surviving coins (a random curve covering wear and corrosion of a number of specimens). With sufficient coins represented in the sample it is possible to pick out with a high degree of mathematical certainty the original weight on which the coins were minted. An obvious difficulty with Greek coins is the uncertainty of whether a fixed minted weight can be assumed, or if so, within what sort of limits of accuracy. In simpler cases however, where overlaps are not expected, the use of ranges on a frequency table is sufficiently sensitive. Thus the large issues of staters of the South Italian colonies have been analysed to show a decline during the fifth century in the standard upon which they were minted. Caution is necessary even here, as if the periods are chosen in a particular way this decline appears to increase suddenly at a certain moment, whereas if different chronological periods are taken the sudden dip is lost.[147] Furthermore, these staters were around 8gm in weight and their identification not in doubt; recourse to the frequency table to distinguish litrai and obols in the Chalcidian colonies in the archaic period, however, is clearly not justified: the coins are about one tenth the weight of the South Italian staters, and the sole basis for their distinction is (not type but) as far as I can see two peaks on a fairly evenly (and thinly) spread frequency table.[148]

Nevertheless the mistake made here is important if it illustrates the difficulty, in dealing with coins, of separating the precision of modern measurement (necessary and quite legitimate as a tool of analysis) from the practical weighing capabilities, and interests, of the Greeks themselves. If the Greeks could not distinguish litrai from obols by weight, and were not interested in trying to do so or to indicate the difference by other means (such as type), there is only a qualified future in seeking to argue that a distinction existed on the basis of a modern frequency table.[149]

The extraction of the weights on which Greek coins were struck should therefore be seen as a rather more delicate operation than the simple measurement of surviving coins. It should properly involve an estimate of what the ancient Greeks were trying, and were able, to achieve. Further confusion appears to surround the modern term "coin standard" outside the context of the minting of individual coins. The term might mean either the basic unit weight on which coins were struck

as units, multiples or fractions, or it could mean the most commonly minted weight (that of the tetradrachm of classical Athens for example, namely c.17.2gm). Occasionally the distinction is blurred: the c.17.2gm tetradrachm regarded as on the same standard as the unit drachma. These ambiguities may seem unduly fastidious, but I believe that they do point to an important area of uncertainty in the study of Greek coins. This arises from the lack of explicit denomination markings on the majority of the coins and from the inadequacy of the literary evidence for their contemporary names. In many cases it is impossible to identify a coin system beyond its barest structure (in terms of factors of division from high to low weights). This fact is misleadingly obscured by the habit of numismatists, perhaps desirable for purposes of identification when describing coin types, of labelling coins "drachma", "obol", "litra" etc without further evidence than the system of subdivision roughly indicated by the weight ranges of the coins. In consequence doubts about the system (3dr/dr or dr/2ob, the ratio being the same) are glossed over, and the problem of which weight represents the basic unit is totally ignored. Given the amount of discussion on the origins and transmission of weight standards, this state of uncertainty is surely remarkable.

Its correction however is far from an easy task, as I shall illustrate in the next section. I shall continue to use the term coin standard, but only for the present in its widest sense (unit and system) in order to allow for a wider possibility of interpretation than is generally felt to attend the existing classification of Greek coins.[150] The question of coin systematisation and the incorporation of coin and other weight systems and standards is pursued below in chapters IV and V.

## 2.(3) Special problems of analysis

The notes I shall conclude with here are based on an attempted analysis of archaic and fifth-century coinage in western Greek colonies.[151] The problems can be presumed fairly uniform for most independent Greek mints, and those of the west involve in addition special difficulties of local, non-Greek weights in coinage and of being a very closely related

geographical (and surely also commercial) group. A general simplification that occurs in the later classical period is the result of a tendency towards uniformity (especially with the Attic system) that was by then widespread. This tendency is in itself of considerable interest, and weight systems other than coins may have also been involved.[152] However the greater possibilities in the use of the coin evidence surround the earlier period, especially the earliest coins minted in individual states, and this is where the major problems remain.[153]

A primary obstacle is the number of independent mints: 12 in Sicily, 20 in South Italy produced coins in the sixth and fifth centuries and nearly all of these present different patterns for analysis. This in itself would suggest that there was some justification for individual analysis and some likelihood that the results would form interesting comparative material. Though nearly all these mints produced high value coins, an immediate difficulty when attempting to reconstruct their systems is that several had no further fractional coinage: early Gela, Agrigento, and many minor South Italian mints of the sixth century. Moreover, where fractions do occur, their variety is bewildering. While the high value coins have received the primary attention of numismatists, these fractional coins are furthermore very much less well understood. Because of their low weight, they were rarely hoarded and as a result present now little scope for die-study (anyway restricted because of the small size of the coins) or simple association (either with each other or with the high value series). Recent research has suggested that the minting of fractions could be extremely erratic, with large issues produced at appreciably separated intervals;[154] on the other hand the evidence could be explained by a greater conservatism in fraction types (the high value series illustrate many). Greater difficulties are presented however by the identification of the values these small coins were intended to have: their weights are small, and very variable (from wear, as those surviving have mostly been lost in circulation rather than hoarded in good condition, or more likely I believe from lack of careful minting); the coins are also extremely rarely marked. From Sicily and South Italy in the sixth-fifth century period come no less than 124 fractional types (under 1.5gm in weight) of which only 32-33 are marked in any identifiable way. Literary evidence is not helpful: the Sicilian "litra" and the Tarentine "noummos" (both of

which were mentioned by Aristotle) have provoked more problems than they have solved.[155] Even apart from the confusion that possibly accompanied the original use of these small coins in antiquity,[156] the problems of association and identification make analysis of the coin systems now largely tentative.

Despite these difficulties, systematisation is apparent in most mints even if some details and certain mints are, and probably must remain, obscure. The need is for more careful analyses of individual mints along the lines of recent monographs, paying equal, if not greater, attention to the fractions as to the high value coins. Only when these preliminary studies are available can an overall picture of the coin systems of Greek mints be properly drawn, and it is upon this overall picture that final conclusions about numismatic metrology depend. In 1910 Head expressed the hope in the introduction to his second edition of Historia Nummorum "that, when the time comes for another edition, the whole subject of numismatic metrology, with all that it involves, may have been more thoroughly investigated".[157] Such a third edition is clearly still a long way off; furthermore the general interest in coinage has switched to its role in economic history and the metrological problems rather consigned to the field of speculation.

The reason for this would appear to be that modern scholars who are not numismatists or aware of the difficulties surrounding the interpretation of the coin evidence, have been tempted to fall back on the over-simplified evidence of isolated coin groups (as the early staters at Poseidonia)[158] or of earlier works that are now properly out of date on these general questions (such as, for all its other value, T.J. Dunbabin's The Western Greeks).[159] Short of the impossible task of revising Head, smaller surveys, however provisional, can therefore serve a useful purpose in this context. One such, with regretably little precise detail, was recently published by H.A. Cahn, and covered the Greek mints in Asia Minor.[160] With rather less authority I shall include here, exempli gratia, a brief survey of the Sicilian mints.[161] Ideally I should have wished to present in full the available evidence for the coin systems of these mints, but this would have introduced much discussion of details with no relevance to my general subject of Greek weighing. I have therefore omitted all discussion, indicating only briefly published

sources and the grounds for systematisation where it can be identified explicitly. Particular areas of controversy are also noted (for example on the litra/obol distinction). I should emphasise finally that the difficulties mentioned above apply in general to the coin systems to be listed,[162] and that few of my conclusions would escape the criticism of some numismatist or other.

## Excursus: Sicilian coin systems down to the end of the fifth century

I have tried to distinguish conventional nomenclature from explicit (in inverted commas) or conjectured (queried); in the short survey that follows I argue for abandoning "drs" and "obols" throughout in favour of "litrai" and "ouggiai" (ozs). The term "stater" remains useful as it is indeterminate.

Foundation dates are conventional; further historical details are included only where essential to the interpretation (rather than simply the dating) of the coin series; bibliographies are included to indicate the sources for the analysis given, but are not complete for each mint.

In most places I have corrected weights to only 2 significant figures (and even this must surely be too precise for my purposes); the numbers in brackets after the ranges are of the coins upon which the ranges have been constructed; the presence of stray coins outside a recognisable range is noted by the formula "range on", and in more doubtful cases the number of coins inside the range given is quoted against the total (thus 28/34 for Agrigento period 1 means that 28 coins of the group of 34 fall within the 9.0-8.3gm range).

Descriptions and dates relate only to the high-value coins in each group normally; no system however is being followed.

The order in which mints are listed has proved to be as follows:

- Siracusa and related: Siracusa; Agrigento; Gela; Selinunte; Camarina; Stiela
- "Chalcidian" group: Etna-Catania; Himera; Leontini; Naxos; Messina; Reggio
- Non-Greek towns: Sicel; Elymian; Punic

A general survey of the Sicilian mints concludes the excursus.

SICILY

(Siracusa and related mints)

Siracusa founded 733 from Corinth

bibliog.: Kraay Demareteion 1969, JHS 1964 esp.77-8,86; Boehringer Münzen von Syracus 1929; Price Robinson Studies 1968; Tudeer ZfN 1913 esp.211.

explicit marking: 4dr/2dr/1dr indicated by types 4/2/1-horse though the logic collapses for the 10dr (also quadriga) and is strained for the "obol" wheel type; closeness to Attic weight supports identifica. of "drachmae"; controversy surrounds the distinction of "obol" wheels and "litra" cuttlefish but as other wheels are marked as litra fractions I do not accept a distinction; marking of 6/5/2 pellets (with associated 3/1 pellets on AE) should be identified as ouggiai (ozs) which are attested, as also litrai, at Siracusa

references: Hesych.sv. ἔγχος; Poll.9.79 (tin coinage); Diod.11.26.3 (with Poll.9.85; Hesych.sv. Δημαρέτειον showing at least 50-litra piece at Siracusa); other references to Sicilian coinage in general can probably be related to Siracusa - esp.Poll.9.81-2 (litrai and frs); also possibly Poll.4.174-5 (though properly Agrigento and Himera). Most of this evidence, with reference to litrai or Corinthian and Aeginetan equivalences, does not fit the 4/2/1 typology of the coins which is (as their weight) apparently Attic; the reconstitution by Timoleon in the late 4th century is almost certainly that to which the later literary evidence relates (HN².179).

| | | | | |
|---|---|---|---|---|
| A: | Incuse 520-500 | | stater (4dr) | 17.47-16.54gm (90) |
| | | | ½st (2dr) | 8.55-8.02 (7) |
| B: | Dolphins 485-480 plus Massive Issues 479-461 | | 4dr | 17.93-16.02 (1106) |
| | | | 2dr | 8.80-8.02 (80) |
| | | | 1dr | 4.35-4.01 (77) |
| | plus around 460's | | 50-lit.(10dr) | 43.95-42.07 (13) |
| | | | litra ?(ob) | 0.79-0.51 (41) |
| | | | "5-oz" | 0.28-0.25 (2) |
| | | | "2-oz" | 0.10 (1) |
| C: | 460-425 | 20-litra ? | stater (4dr) | 17.76-16.08 (1564) |
| | | | (2dr) | 8.58-8.03 (10) |
| | | | (1dr) | 4.26 (1) |
| | | | ? litra | 0.89-0.58 (54) |
| | | | ? ½-litra/6-oz | 0.45-0.29 (26) |
| | | | "5-oz" | 0.27-0.25 (3) |
| | | (also Æ 3/1-oz) | | |

note: all above numbers are ranges from Boehringer.

Agrigento

founded 580 from Gela with several E.Gks (and a Rhodian oikist)
bibliography: no monograph exists, so I have relied upon BMC 1876; Jenkins Gela 162ff, Himera 1971 passim; Cahn Naxos p.82; Price Robinson Studies 1968; Kraay Greek Coins p.296f.; Seltman NC.1948 p.1ff. and GC$^2$ pls.
explicit marking: ΛΙ occurs on a number of coins ranging from 0.88, 0.89gm (BMC.48-9) through 0.7-0.55gm (Cahn Naxos p.82) down to 0.45gm; although this is generally taken to indicate li[tra], the range is remarkable. ΓΕΜ, identified as 5-litrai, occurs on three coins 4.3-4.1gm, but the reverse is marked with ΥΙΙΛ as also BMC.52 at o.56gm; I am therefore unsure about the identification of the "5-litra" mark, though the equivalence with the drachma would appear implied by other evidence of Agrigento coins. Pellet marks on Æ and Æ coins of the later period need not relate to the same weight system. A small series of actual weights (Æ) is similarly marked (see above).
references: Aristotle's Akrag.Pol. is cited for local fines in litrai (30l. Poll.9.80; 50l. ibid.4.174) and Arist. apparently equated the litra in this context with the Aeginetan obol.

| | | | | |
|---|---|---|---|---|
| 1: | 520-480 Eagle plain | stater (?2dr) | | 9.0-8.3 (28/34) |
| 2: | 480-465/60 Eagle on line | | (4dr) | 17.6-17.3 (6/7) |
| | | | (2dr) | 8.8-8.7 (2) |
| 3: | 465/60-c.425 Eagle on capital | | (4dr) | 17.4-17.2 (2) |
| | | | ?(1dr) | |
| | | ?"5-litr" | (?/dr) | 4.3-4.1 (3) ΓΕΜ |
| | | "litra" | | 0.7-0.6 (20/23) ΛΙ |
| | | | ?(5oz) | |
| | | | ?(2oz) | |
| 4: | c.425-406 Quadgriga | | (?50-litr/10dr) | 43.22 (1) |
| | | | (4dr) | 17.6-17.2 (6) |
| | | | (?5-litr/1dr) | 4.1 (1) |
| | | | (?½dr) | 2.1-1.9 (9) |
| | | | (?litra/ob) | 0.7 (3) |

note: the uncertain coins in the third period are noted by Jenkins Himera p.24 n.10; the total number of fractional types is therefore at present uncertain.

Gela

founded 688 from Crete and Rhodes
bibliography: Jenkins The coinage of Gela 1970; Price Robinson Studies 1968; Kraay JHS 1964.
explicit marking: only 2 pellets for 2-oz on the lower fraction of the second period; the horse-typology is not consistent.
references: none.

| | | | |
|---|---|---|---|
| 1: 490/85-480/75 | stater | (?3dr) | 8.80-8.00gm (474/533) |
| | [2-st | (?4dr) | 17.50-17.35 (4)] |
| 2: 480/75-475/70 [Quadriga begins] | | (4dr) | 17.4-16.95 (199/279) |
| | | (1dr) | 4.15-4.00 (5) |
| | (?ob/litra) | | 0.8-0.5 (13) |
| | "2-oz" | | 0.1 (4) |
| 3: 465-425 | | (4dr) | 17.6-16.7 (range on 438) |
| | (?ob/litra) | | 0.9-0.5 (range on 196) |
| 4: 425-405 [also Æ and Æ] | | (4dr) | 17.6-16.7 (range on 295) |
| | | (2dr) | 8.8-8.4 (range on 31) |
| | (?½dr/2-litrai) | | 1.8-1.7 (2) |

note: five fractional groups in all, there being two comprising the ?ob/litra of period 3.

Selinunte — founded 628 (?651) by Megara Hyblaea

bibliography: no monograph, so I have used here Schwabacher Mit. Bay.Num.Ges. 1925; Kraay Greek Coins 297ff; Head HN² 167-9 (with caution); Seltman GC² 72, 129-30; Jenkins Gela pp.125-6; BMC Sicily 1876.

explicit marking: Two pellets on BMC.10 (8.68gm); unique both for 2dr (if that is what it implies) and for this group; otherwise the possibility of an early Corinthian (3dr) stater applies for both here and Gela (qv). Only Æ marked with 3 pellets.

references: possibly relevant is the inscription on Temple G (see Calder 1963 and Gr.Rom.Byz.Studies 5(1964)113-9; Woodward JHS 86(1966)296-7; ML 38 and commentary pp.82-3).

| | | | | |
|---|---|---|---|---|
| 1: | 550-480? | Incuse square r. celery obv. | stater (?3dr) | 8.7-8.2 (10/14) |
| | 500-480? | ..... | (?litra/obol) | 0.7-0.3 (7) !! |
| 2: | ?465-409 | obv.Apollo or quadriga | (4dr) | 17.6-16.8 (202) |
| | c.450ff. | obv.Heracles v. bull | (2dr) | 8.7-8.1 (5) |
| | .. | ... | (?1dr) | 4.0 (1) |
| | | | (?litra/obol) | 0.7 (5) |
| | ? towards 409 | | (?2-lit/½dr) | 1.94-1.69 (2) |

note: three fraction types; insufficient evidence apart from main staters of fifth century.

Camarina — founded 598 from Corinth and Siracusa; 492 from Gela (Hippocrates) and 461 again from Siracusa (Gelon); population deported 405.

bibliography: Kraay Greek Coins 294 with BMC Sicily 1876.

explicit marking: ?? Corinthian helmet indicating Cor.(3dr) stater; Æ of second period marked 6/5/3/1 (oz)

| | | | | |
|---|---|---|---|---|
| 1: | 492-485 | rev.palm tree obv.Corinth.helmet | stater (?3dr) | 8.39 (1) |
| 2: | 425-405 | Heracles head/quadriga | (4dr) | 17.2-16.9 (6/8) |
| | | | (2dr) | 8.6-8.0 (6) |
| | | | (1dr) | 3.93 (1) |
| | | | (?litra/obol) | 0.8-0.7 (9/11) |

note: late fifth-cent. possibly also Æ 1.17gm (Jenkins Gela 98-9) though both identification and interpretation are uncertain.

Stiela — Siracusan fort near Meg.Hyb. 450-415.

bibliography: BMC and HN².

| | | | |
|---|---|---|---|
| 450-415 | | (1dr) | 4.05 (1) |
| | | (½dr) | 2.04 (1) |

SICILY

("Chalcidian" group)

Etna-Catania  founded 729 from Naxos but no coinage till taken over by Siracusa.
bibliography: Kraay Greek Coins 283ff and BMC Sicily.

| | | | |
|---|---|---|---|
| 1: | 476-466 "AITNAI" | (4dr) | 17.23 (1) |
| | | (?litra/obol) | 0.9,0.7-0.6,0.5 (5) |
| 2: | 466-403 "KATANAION" | (4dr) | 17.3-16.8 (7) |
| | | (1dr) | 4.2-3.7 (8) |
| | | (?2-litr/½dr) | 1.9 (1) |
| | | (?litra/obol) | 0.9-0.8,0.8,0.8-0.7 (3⅓3) |
| | | (??) | 0.27 (1) |
| | | (??) | 0.149 (1) |

note: although an insignificant place there appear to be seven diff. fractional issues; these may be mistaken from Camarina ?? (tho' the Æ noted there could equally be from Ka[tania]).

Himera  founded mid.7th cent. from Zankle (? Siracusan exiles also).
bibliography: Cahn Naxos p.75 n.3, pp.76-7; Gutmann & Schwabacher Mitt.Bay.Num.Ges.1929.101ff; Kraay Himera 1-14; Jenkins ibid. 21-36; Parise ibid. 15-20.
explicit marking: Pellet on the back of the Himera cock is part of the design (? cf.Selinunte ?); odd signs on archaic coins (⅃V, ⅃, TV) are totally obscure; the astragalos on two coins (4.30 and under 0.1gm) cannot be mark of value (despite Parise and Jenkins); only the smaller of these two coins is explicitly marked as 2-oz with two pellets [Æ marked 6,3,2,1 pellets].
references: Aristotle's Himer.Pol. is cited twice by Pollux for the names of the Sicilian coins (litra, hexas etc) as also the equivalences obol-litra and 10-obol/10-litrai Corinthian stater (Poll.4.174-5; 9.80-81). These remarks may however apply to anywhere in Sicily (see sv.Siracusa above and Agrigento).

| | | | |
|---|---|---|---|
| 1: | 525-484/3 Incuse rev. | stater (?dr) | 5.8-5.6 (range on 98) |
| | | (?litra/obol) | 0.95-0.7 (38/43 Parise) |
| | | (??) | 0.188 (1) |
| 2: | 484/3-472 Crab rev. | stater (?2dr) | 8.7-8.2 (159/173) |
| | | ½st (?dr) | 4.2-3.8 (35/38) |
| | | "2-oz" | 0.06 (?wt) (1) |
| 3: | 472-409 Quadriga obv. | (4dr) | 17.3-16.8 (range on 100) |
| | | (2dr) | 8.4-8.2 (range on 13) |
| | | (?2-litr/½dr) | 2.1-2.0 (3/4) |
| | | (?litra/obol) | 0.9-0.7,0.7 (6/7 and 1) |

note: the 2-oz of period 2 is given as 0.06gm Jenkins citing BMC.30 which converts in fact to 0.077gm (1.2 grains); the different fractional types total six in all (the lowest of the 7 of the last entry is 0.54gm BMC.47 !).

Leontini — founded 729 from Naxos, but no coinage till taken over by Siracusa in 485 (Gelon) despite control by Gela from 495; autonomous 466-20.
bibliography: BMC Sicily (full); Kraay Greek Coins 282; Chantraine Syrakus und Leontini JNG 1957; Jenkins Himera 24 n.10; Boehringer 1929 pp.79ff; Price Studies to Robinson 1968.
explicit marking: 6,5, and 2 pellets mark ozs. in the post-Siracusan (?) period around mid.5th cent; note that the high-value coins do not follow the usual Siracusan type distinction however (both "2dr" and "dr" with single horse - compare Gela ?).

| | | | | |
|---|---|---|---|---|
| 1: | 485-466 Quadriga {Siracusan / control} | (4dr) | 17.5-16.8 (10/11) |
| | | (2dr) | 8.6, 8.4-8.3, 8.1 (4) |
| | | (1dr) | 4.3-4.2 (2) |
| | | (?2ob) | 1.1 (1) |
| | | (?1ob) | 0.6 (4) |
| ?1/2: | ? probably after 466 | (?litra) | 0.8-0.7 (7) |
| | | "6-oz" | 0.4 (1) |
| | | "5-oz" | 0.3-0.2 (2) |
| | | "2-oz" | 0.1 (1) |
| 2: | c.466-c.420 Independent issues | (4dr) | 17.5-16.8 (17) |
| | | (1dr) | 4.3-4.0 (3) |

note: seven different fractional issues of which three are marked and the obol/litra distinction possibly maintained both in weight and type.

Naxos — founded 734/5 from Chalkis (? also from Naxos, as Cahn); coined till taken over c.490 by Hippocrates of Gela, then more issues 461-403 till finally rubbed out by Siracusa.
bibliography: Cahn Naxos 1944; with Kraay Greek Coins 281f:

| | | | | | |
|---|---|---|---|---|---|
| [28] | 1: | 550-490 | [(a) earlier | stater (?dr) | 5.5-5.4 (range on 19) |
| | | | [(b) later | | 5.7-5.5 (range on 28) |
| [25] | | | | (?litra/obol) | 0.8-0.7 (range on 46) |
| [1] | 2: | 461-430 | | stater (4dr) | 17.35-17.20 (range on 49) |
| [5] | | | | 1/4st (1dr) | 4.30-4.15 (range on 105) |
| [37] | | | | (?litra/obol) | 0.75-0.66 (range on 96) |
| [-] | | | | (??) | 0.27, 0.23 (2) |
| [6] | 3: | 430-403 | | stater (4dr) | 17.3-17.0 (range on 45) |
| [8] | | | | ½st (2dr) | 8.55-8.40 (range on 49) |
| [-] | | | [(a) earlier | (?litra/obol) | 0.73 (2) |
| [17] | | | [(b) later | | 0.81-0.69 (range on 39) |
| [14] | | | | (?2litr/½dr) | 2.10-2.0 (range on 44) |

note: Cahn also gives dies for these issues (see square brackets to left, and note that the litra/obol value is apparently the commonest) With the third phase also occurred Æ 3oz and 1oz; a fourth phase, after the 403 destruction apparently included "2-litrai" (Cahn) of 1.25-0.95gm. Despite the mint's importance there are only six fractional types.

Messina — founded late 8th cent from Cumae and Chalkis; originally named Zankle, independent till 490's when controlled by Hippocrates (Gela), 493-491/489 by Samian emigrés (supported by Anaxilas of Rhegion), 491/489 by Anaxilas himself when the colony was renamed Messana and Messenians installed.

bibliography: Robinson JHS 1946; Gielow Die Silberprägung von Dankle-Messana Mitt.Bay.Num.Ges.1930 1ff; Barron Samos pp.14, 40-5; Cahn Naxos p.77; Kraay Greek Coins 285ff; Seltman GC[2] pp.71,79,100-2, 134-5, and pls.

explicit marking: only one fraction is marked, three pellets on Gielow p.47 no.91, but the weight is not given.

| | | | |
|---|---|---|---|
| 1: | 525-494/3 Incuse rev. | stater (?dr) | 5.65-5.55 (range on 68) |
| | | (?litra) | 0.80-0.75 (range on 11) |
| | | (? 2-oz) | 0.11 (1) |
| 2: | 493-491/489 Samian period | stater (4dr) | 17.3-17.0 (2) |
| | | (2ob) | 1.26 (1) |
| | | (1ob) | 0.48 (1) |
| | | "3-oz" | no wt. given |
| | | (? 2-oz) | 0.13 (1) |
| 3: | 491/489-480 Anaxilas first issue | stater (3dr) | 17.35-17.31 (2) |
| | | (?litra) | 0.91 (1) |
| 4: | 480-460 Mule cart and hare | (4dr) | 17.49 (1) |
| | | (2dr) | 8.49 (1) |
| | | (1dr) | 4.17 (1) |
| | | (?litra) | 0.86 (1) |
| | | (? 2-oz) | no wt.given |
| 5/6: | 460-430 | (4dr) | 17.4-17.1 (3) |
| | | (1dr) | 4.15-3.65 (2) |
| | | (?litra) | 0.80-0.77 (2) |
| 7: | 430-396 | (4dr) | 17.22 (1) |
| | | (1dr) | 4.09 (1) |
| | | (?½dr) | 2.00 (1) |
| | | (?litra) | 0.80-0.64 (5) |
| | | (?½litra) | 0.27 (1) |

note: this detailed analysis of Messina coins is largely based on Robinson JHS 1946; very few coins comprise most groups after the earliest period and there are as many as fourteen fractional values. AV coins (1.46gm) associated with Period 4. In general compare Reggio.

Reggio

founded possibly by Messenians and Zanklaians c.720; included in the Sicilian coinage area (hoards and wt.standard) though incuse fabric taken from S.Italy.

bibliography: Robinson JHS 1946; Herzfelder 1955 and 1957; Kraay Greek Coins 312-3 and JHS 1964 76-78.

explicit marking: 2.13gm (Period 5) marked with "two berries" and olive spray, but so also is the next coin at 0.87gm; clearly this is a type rather than value mark. Ⓗ on 0.29 (also Period 5) was explained by Robinson as ἡμιοβολιον but the ring is the coin edge, and so only "½" can be inferred. 0.17gm (Period 3) rev.marked with two pellets indicating "2-oz". 0.28gm (Period 4) marked with five pellets for "5-oz".

references: Pollux notes the hare as a Rhegion coin type (9.84).

| | | | | |
|---|---|---|---|---|
| 1: | 510-494/3 Incuse rev. | stater (?dr) | 5.64 (1) | |
| 2: | 494/3-484/0 Anaxilas first issue | stater (3dr) | 17.63 (1) | |
| | | 1/3st (1dr) | 5.57 (1) | |
| | | ?(1/18st or litra) | 0.97 (1) | |
| 3: | 484/0-462/1 Mule, cart and hare | stater (4dr) | 17.43-17.17 (3) | |
| | | ½st (2dr) | 8.61 (1) | |
| | | 1/4st (1dr) | 4.08 (1) | |
| | | (?litra) | 0.80 (1) | |
| | | "2-oz" | 0.17 (1) | |
| 4: | 462/1-420 restored democracy | stater (4dr) | 17.26-17.18 (2) | |
| | | 1/4st (1dr) | 4.17 (1) | |
| | | (?litra) | 0.73 (1) | |
| | | "5-oz" | 0.28 (1) | |
| | | (?2-oz) | 0.10 (1) | |
| | | [also Æ marked"3-oz","1-oz"now] | | |
| 5: | 420-387 under Siracusa | stater (4dr) | 17.29 (1) | |
| | | 1/4st (1dr) | 4.00 (1) | |
| | | ?1/8st (½dr) | 2.13 (1) | |
| | | (?litra) | 0.87 (1) | |
| | | "½"(?½ob or ½litra) | 0.29 (1) | |

note: compare Messina; very few coins illustrating each group identified by Robinson; in all, nine fractions.

SICILY

(Non-Greek mints operating before 400BC)

(a) Sicel towns - largely from Head $HN^2$ litrai indicated by profuse Æ marking

| | | | |
|---|---|---|---|
| Abacenum | 450-400 | (? litra) | c.0.8gm |
| | | (? ½litra) | c.0.4gm |
| Enna | c.450 | (? litra) | no wt. given |
| Galaria | c.460 | (? litra) | no wt. given |
| Longane | c.466-413 | (? litra) | no wt. given |
| Morgantina | c.460 | (? litra) | no wt. given |
| | c.420-400 | (? litra) | no wt. given |
| Piakos | c.400 | (? litra) | 0.72 (1) |
| | | [Jenkins Sch.Münzblätter 1962 17-20] | |

(b) Elymian towns - mixture Punic, Sicel, and Hellenic influences

| | | | |
|---|---|---|---|
| Entella | c.450 | (litra) | no wt. given by $HN^2$ |
| | | "6-oz"(½litra) | no wt. given by $HN^2$ |
| Erice | [$HN^2$ superseded by Kraay Greek Coins 298] | | |
| | 410-400 | (? 2dr) | no wt. given Kraay |
| | 400-390 Quadriga | (4dr) | 17.25 (1) |
| | c.400 | (? litra) | 0.56 (1) |

note: Head also mentions litrai marked Ⱥ, as well as further coins, in the periods redated by Kraay as above. At present I have not been able to identify these coins.

Segesta [$HN^2$ with Kraay Greek Coins 299f and Lederer Die 4drs von Segesta 1910]

| | | |
|---|---|---|
| 480-400 throughout | (? 2dr) | 8.68-8.52 (4) |
| 410-400 | (4dr) | 17.25-16.85 (3) |

? dating and ? weights from Head are added ½dr, 1½ob, litra, ½litra, and 2-oz (none are noted as marked).

(c). Punic towns - coinage for Greek consumption

| | | | |
|---|---|---|---|
| Carthage | from early 4th cent only | (4dr) | 17.17-16.85 (3)<br>[Kraay Gr.Coins 300ff] |
| Motya | with Gk inscriptions 450f. | (2dr)<br>(1dr) | no wt. given<br>...<br>[Kraay ibid] |
| | with Punic inscrs 410-397 | (coins called 4dr, 2dr, ob, and ½ob) | |
| Panormus | [argued to be the "ZIZ" mint after Rash Melcarth had minted 4drs: Kraay Sch.Münzblätter 1964.61-5 and Gk.Coins 298-9; Head is unclear] | | |
| | with Gk inscrs from 450 | (2dr)<br>?(4dr) | 8.69 (1) Kraay<br>no wt. (added by Head) |
| | with Punic ("ZIZ") 410-375 | (4dr)<br>?(2dr, 1dr, 5ob, and litra/ob also added) | 17.2-16.5 (15) |
| Solus | second half 5th cent | (? 2dr) | no wt. given Kraay |
| | late 5th cent (imitation of Himera) | (? litra) | 0.67-0.65 (2)<br>[Jenkins Himera 34f] |

SICILY

(general survey)

The Greek colonies in Sicily form a well-defined currency area that also included Reggio and extended perhaps to Taranto in Southern Italy [see also the Taranto fractions. Kraay JHS 1964 pp.77-8 assembles the evidence; but his hypothesis that the Crotoniate fractions are makeweights to facilitate exchange with Sicilian and Mainland coins is rather unlikely (Sch.Münzblätter 1958.99-102)]. All the mints faced the same problem of having to import its silver, possibly in bulk, from Spain [Cahn Naxos pp.78-9 attempted to detect the route this trade took in the slight variations in weight standards between Naxos, Himera and Zankle-Messina. At best only the Greek mint specialists could have operated with the small differences this theory would imply], or in the form of other coins, and especially Attic which have been found in large numbers in Sicilian hoards [Kraay JHS 1964 pp.79-80; the theory that the absence of Corinthian coinage in the West till the fourth century was to be explained in a similar way (eg. Milne Greek Coinage 31ff) has been exploded by the analysis of the silver content of Sicilian coins (which has established also that Agrigento and Siracusa drew on different sources: Kraay 1962 esp.pp.35-7) as also by more general arguments (set out by Kraay again in NC 1960 pp.71-8].(M.163) Moreover, the political cohesion of the island (with first Gela then Siracusa dominant) seems to have encouraged its commercial unity. Despite the eventual conformity of weight standard in the fifth century, the coinage shows nevertheless a variety of independent types that can also be matched in individual details of fabric (eg. incuse from S.Italy) and also in the variations of weights and systems of the earliest phase of coinage on the island.

The general development of the mints of Sicily can be divided into two main phases. First, as the practice of coining spread from the middle of the sixth century three distinct groups of mints appear: (a) those with staters around 8.5gm as Selinunte and Agrigento (with Gela later and thence Camarina's first issues); (b) starting slightly later the stater of around 17gm or higher as Siracusa (whence Leontini and Etna); and (c) a lower stater of c.5.6gm at Naxos, Himera, Zankle-Messina and Reggio. The identification of the first two staters will be discussed below, conventionally they are labelled "2dr" and "4dr" on the Attic standard although the possibility that the first began as a Corinthian "3dr" has been considered (Jenkins Gela pp.125-6 though preferring "2dr" Attic). The 5.6gm stater has more plausibly been suggested as a single unit weight and the label "Chalcidian" applied simply from the common area from which most of the colonies using this stater were founded (no evidence is available to show that this weight, any more than the similarly-named pots, was truly Chalcidian: see esp. Robinson JHS 1946).

The second phase comprises the gradual shift in the fifth century from these distinct groups towards a generally minted system of type (b) with a large coin of around or above 17gm. The general movement, and moreso the individual stages, show clearly the importance of political control as behind the changes. Thus Camarina, Leontini, and Etna all start coining on the system of those cities that controlled them, whereas Himera moves through all stages in the development (from (c) to (a) to (b)) [Valid, but of minor importance in the study of weight systems and standards, was the artistic influence exerted by the more celebrated issues of Siracusa]. Similarly the short rule of a handful of Samians at Zankle-Messina is marked by the adoption by the mint there of Samian coin types and possibly the Samian weight system. However the standard of this period was not Samian (Barron Samos p.9 etc argues for a Samian 4dr 499-415BC of around 13gm), and this calls for an explanation.

The Messina (Samian) standard of 17.3-17.0gm could be viewed simply as the equivalent of the Siracusan (ie.(b) above) were this not awkward at a period when Messina was being supported by Reggio (where the 17gm plus weight was

still divided into thirds in the subsequent period) and when Siracusa had not yet reached its first main period of coinage (the massive issues beginning only after the battle of Himera). Alternatively, as I should suggest, the 17gm weight dividing by half and quarter represented a local system that the Samians at Messina had to recognise (while Anaxilas in Reggio did not). Despite the fact that coinage was a Greek "invention"[CJ164] there is good evidence for the independent strength of a local weight system in Sicily (litra-ozs), and I propose to argue that much of the confusion about Sicilian coinage may be removed if the intrusion of this system into the Greek coinage is recognised. Instead of the traditional nomenclature "drachmae" and "obols" I believe that only "litra" and "ozs" were applied to these coins. The implications for systematisation (and also for the identification of fractions) are important.

The only ancient references[165] I have found to coins of Sicily are to litrai and ozs, their fractions; whereas only equivalences are expressed in Attic (implicitly), Corinthian, and Aeginetan coins (and therefore properly in terms of the weights of these mainland coins). For this the authority of Aristotle and early comic writers has been cited (Poll.4.174-5; 9.80ff). By the same evidence the terms "litra" and "oz" are said to be specifically Sicilian, and they can be seen moreover to have moved over into other elements of the local vocabulary (thus λιτροδόκη for purse). The singling-out of recondite names could be seen as simply antiquarianism were it not also to fit the fact that the only explicit markings on Sicilian coins are similarly of litrai (Λ and, albeit uniquely, ΓΕΛ [Agrigento]) and ozs (as must be inferred from the pellet markings on Æ as well as Æ coins). Further support lies in the simplification of the coin systems of Sicily in general and in the removal of the awkward problem of how the Sicilian Greeks distinguished "obols" from "litrai". Both these matters can now briefly be discussed.

It is interesting that Aristotle should dwell upon the 10-litrai coin amongst possible higher multiples (equivalent to the Corinthian stater: as cited above). This can however now be recognised as the c.8.5gm weight noted above as common in the south of Sicily (group (a)) and which also was most popular in the western towns, peripheral to the Greek sphere and removed from Siracusan control (Segesta, Motya, Panormos: though these mints are not yet properly understood). 5- and 50-litrai coins are attested (though rarer) and should displace the modern "dr" and "10dr" labels.[CJ166] Multiples lower than 5 are more uncertain, and especially the apparent ½dr (slightly over 2gm weight) that is scattered, albeit extremely thinly, over a number of mints (Agrigento, possibly Gela and Selinunte, Stiela, Catania, Himera, Naxos, Messina and Reggio). This value appears in all cases to belong to the latter part of the fifth century, and is very much rarer than the litrai and litra-fractions (as also than it is in the fuller mainland Greek systems). If it is not therefore some odd litra-multiple (2, 2½, or 3 could all be possible, and why not more than one of these ?), it might be indeed a "3ob" or "½dr" for the use of visiting foreigners. The coincidence of the Sicilian weight standard and system [note: the origin of the litra/oz, not discussed here, might have been in some other metal than silver and so only the system is properly of certain local provenance; it is not profitable to speculate on how the silver equivalence in this case was then assessed, although the Roman libra provides an obvious starting point were it clear that this was not as vague initially as the Greek "talant"] with the Attic cannot have escaped the notice of the ancients, nor also the ease with which accomodation of the major international mint could be achieved. Such considerations I believe motivated the large issues of 20-litrai coins that could so easily be equated with the Attic tetradrachms.[CJ167] Outstanding must probably remain the c.5.6gm "Chalcidian" staters; they did not survive long, but even in the earliest phase were accompanied by coins that can only have been litrai or their fractions (Messina, Naxos, Himera).

Litrai, the basic Sicilian unit, according to my hypothesis abound in all mints and at most periods (note especially the non-Greek mints that rarely could afford to mint larger, if at all in silver). Attempts have been made to reduce the number of litrai by distinguishing "obols" and in addition to the general reasons I have given for doubting the existence of obols at all in Sicily there are several further arguments I can usefully set here against the distinction. (1) Weight must be ruled out as a valid way of establishing either that there was a distinction or what the individual coin weights in theory were. Part of the reason for this relies on the accuracy of Greek mints and the awareness of Greeks users: see elsewhere; also, the weight ranges even of single types are obviously too large to admit any distinction (if not always as bad as the earliest Selinunte candidate: 0.7-0.3gm). If the actual weight of the litra was moreover (see note in last paragraph) not absolute, but somewhat a conventional assessment of a bronze or iron equivalence, the vagaries noticeable between litra groups need not be at all significant. (2) It seems that the Sicilian mints produced only one coin at any one time that could be so confused; again I feel there is room to support the simplification, at least in their original use, of Greek coins. (3) The litra weight is consistently present in such mints as Himera, Reggio, Messina and Naxos that subsequently changed their higher unit and also its system of subdivision. The c.5.6gm stater may probably not be Sicilian, but the presence of the litra with it surely supports its subsequent identification. (4) The explicit Sicilian fractions (6oz, 5oz, 2oz and more rarely 3oz) appear to fit with other fractions in Æ while neither associate at all naturally with supposed obols (or their eighths, to introduce Attic chalkoi as Aristotle ap. Poll.loc.cit.). (5) Finally no explicit indication, of what would have been a marginal distinction, is given on any Sicilian coin; nor any system of marking adopted that might show obols to have been intended (the obscure "H" on the unique Reggio coin at 0.29gm is the only possible exception I have noticed, and I do not feel that even it is at all convincing: ½litrai are included in Aristotle's list of Sicilian coins: Poll.9.81).[CH5163]

chapter three

# WEIGHT SYSTEMS

## Introductory

From the last chapter it is clear that in many Greek states there existed a number of weight systems. I now wish to examine these different systems and the uses made of them. This question will naturally lead on to the problems of the relationship between systems: first, whether variation is simply a matter of convention (individual or institutional) or of scale (precious metals as opposed to bulk materials); and, second, whether it is possible to detect a chronological development from ad hoc weight standards to eventual overall systematisation. Subsequent chapters will continue this last issue by considering the corelation of absolute values, the historical development of systems, and the extent to which actual weights were used. For the present however I shall continue to assemble the evidence by exploring the question of how Greeks weighed what - from gold and silver to wood and glue - and shall pay particular attention to the terminology (and the evidence it might yield of systematisation), but also to the authorities concerned (temple, state or private trader) and to the commodity weighed.

The actual weights are for these purposes entirely unhelpful. They give no indication of context, and even the possible identification of such officials as Agoranomoi and Metronomoi on certain weights does not establish how they might have used the weights in question. Moreover surviving weights seem overwhelmingly to belong to the post-classical period when there is good reason to believe that the processes of systematisation and of standardisation were well advanced. Coin weights are possibly more helpful, for the metal content of coins provides a natural context for their application as weights. It will in fact be shown that, both in terminology and in actual weights, coins do correspond to the weights of weighed amounts of the metals in which they are made. Furthermore it is clear that on occasion coins were actually used as weights, although for their more frequent use as value tokens weight seems not to have been particularly relevant[1].

The sources drawn upon for this chapter are essentially the contemporary inscriptions. Building accounts and temple inventories are the most useful of these, but other documents occasionally mention weights and are therefore included. I have tried to take some account of literary evidence; but while local writers present few problems beyond the difficulty of finding many that are other than Attic, the more general or later writers raise questions of interpretation that must be discussed in detail where they arise. Thus Herodotus on Delphi, Pausanias on Olympia, and Homer in general provoke no little speculation on whether their weights were adjusted for a particular audience, and if so its date[2].

The whole question of systematisation inevitably also involves consideration of methods of accounting. This varied greatly between Greek states in the details especially of numerical notation but also of the units used (for example whether talants and minai replace high numbers od drachmai, or how the drachma was itself subdivided). As such variations must in most cases be related to variations in the weight or coin systems of the states concerned they cannot be overlooked here even if this relation is itself extremely difficult to specify. A further reason for including the subject under the review attempted is that interpretation of texts frequently depends upon the distinction of accounte (notional) sums of money from weighed and counted actual sums. I hope to be able to show the different systems used for these two purposes. For numerical notations, largely derived from these same accounts, I am relying largely on Tod[3]. Of particular interest further is the manner in which the Greeks handled conversion of coin[4], and also the incorporation of coined sums with weighed sums in single accounts. While nicely indicating contemporary acceptance of the accuracy of coins[5], this last feature clearly underlines the relevance of simple accounting to this analy sis of weighing.

To attempt however a full analysis of all three sources of evidence for Greek weighing (weights, coins, and accounting) is far beyond the scope of this thesis. The greater part of such evidence is post-classical; and, even if the variations of these later periods might be relevant evidence for earlier development (as can for instance be argued for epichoric numerical systems), discussion of this evidence would be out of proportion to the results and to the rest of this thesis. I have therefore restricted analysis of accounting to the most important

area, Athens, and only note the situation in other states where it is particularly interesting. What follows is therefore not comprehensive but selective, and after Athens I consider essentially only such evidence as relates fairly immediately to the question of weighing. Also I cannot claim to have covered every Greek inscription for the whole of the Greek world. There are obvious gaps, especially for the Eastern and Western cities, but I do not feel that the omissions are very significant for the central classical period. The sources used are listed at the head of each section; IG has been the starting point in most cases, and the sections indeed follow the order of IG beginning with Athens.

Two general caveats must close this introduction. Firstly it is necessary to take on trust the validity of figures given for weights on these inscriptions. There are very few occasions when these figures can be subjected to any kind of check. For our immediate purposes the credibility of the figures is however not so very important, as, true or false, it is the weight system in which these figures are given that is being examined here (and also of course the fact that weights are being given). A more basic question than the accuracy of the figures is indeed whether weighing actually accompanied the operations being described. Both these questions will be discussed in Chapters VII-VIII.

Secondly the major source for this chapter, inscriptions, represents official activity virtually without exception[6]. Thus the picture derived is only an indirect reflection of the actual procedures of general commerce. One effect of this situation must be a tendency towards an artificial homogeneity in weight recording, and this in turn would seem to justify careful attention being paid to minor variations where they can be detected. Another result is to cast further doubt on the extension in practice of weight pricing to commodities, such as wood, that one might imagine were in practice more usually measured by other means, and only rarely, if at all, by weight.

1. ATHENS

Sources IG $I^2$ and $II^2$.1-1695; SEG X; $SIG^3$; AS (Attic Stelai with Pritchett's text Hesperia).

Comparative table of commodities weighed see following page

TABLE

Weighing of commodities in Athens (source inscriptions)

| | | | |
|---|---|---|---|
| - accounted silver coin | - state accounts | - talants, drs, obs, ½obs [High drs as well as talants; minai only for percentage rates; quarter obols later] | - (5 - 4th c.) |
| - weighed gold and silver | - state accounts, temple inventories, and also purchase of gold for building | - talants, drs, obols, ½obols [¼obols Ⱥ only in 4th c.; ½obols Ⱥ in 5th c., Ⱥ only in 4th c.] | - (5 - 4th c.) |
| | - outside disposal of Ⱥ (?? also purchase) | - staters, drachmai, obols, tartemorion (¼ obol) [2dr stater] | - (4th c.) |
| - δαῖς | - deme (religious) | - ??? silver drs/obols | - (mid 4th c.) |
| - ἑλεφας | - commercial | - minai | - (4th c.) |
| | - Athena purchase | - talants/drachmai | - (latter 5th) |
| - ἶξος | - Eleusis inventory | - talants/staters | - (end 5th c.) |
| - καττιτερος | - Athena building | - talants; talants/minai. | - (5th c.) |
| - κηρος | - Athena building | - talants | - (5th c.) |
| - κολλα | - Eleusis building | - staters | - (end 4th c.) |
| - μιλτος | - Eleusis building | - staters | - (end 4th c.) |
| - μολυβδος | - Athena building | - talants | - (5th c.) |
| | | - κρατευται | - ,, |
| | - Navy lists invent. | - talants/minai | - (end 4th c.) |
| | - Eleusis building | - talants | - (end 4th c.) |
| - ξυλα | - Eleusis building | - talants | - (end 4th c.) |
| - πιττα | - Eleusis building | - staters | - (end 4th c.) |
| - πορφυρα | - Religious | - drachmai | - (3rd c.) |
| - σιδηρος | - Athena inventory | - talants ?? | - (4th c.) |
| | - Navy lists invent. | - (? Talants), minai | - (end 4th c.) |
| | - Eleusis inventory | - talants/staters | - (late 5th c) |
| | - Eleusis building | - talants/staters | - (end 4th c.) |
| - σκορδον | - deme (religious) | - staters | - (mid 4th c.) |
| - τυρον | - deme (religious) | - staters | - (mid 4th c.) |
| - χαλκος | - Athena building | - talants; talants/minai | - (later 5th) |
| | - Athena inventory | - ??? τριμηνον | - (4th c.) |
| | - Eleusis building (contract) | - minai | - (end 4th c.) |
| - rope and sails | - Athena commercial | - Egyptian talants/minai | - (4th c.) |

1 (1) Summary of Attic weight systems (extant weights, coin and accounting

The terminology and absolute values of the actual weights collected in the last chapter allow the distinction of at least five different systems. The first two are related to the same weight standard and evidently result from the simple halving of the basic unit. The others may be related though not directly. Only the third system gives also an indication of special context, although the interpretation of the marking ΑΓΟΡ and ΜΕΤΡΟ is not straightforward[7]. All groups are represented by both marked and unmarked weights, but for simplicity I list here only the marked values.

I. Stater base around 860gm (late sixth to third century, although the mina based systems may have appeared before the end of this period) διστατερ, στατερ, ημιστατερον, τεταρτη, ημισυημιτεταρτη and τριτη, ημιτριτον, ημισυημιτριτον.

II. Mina base around 430gm (second to first century) τετραμνω, δημναιον, μνα, ημιμναιον, τεταρτον, ογδοον and τριτη, εξημερον (or εκτ[ημορον] ?).

III. Slightly heavier mina base (second to first century, and possibly dividing into the two known heavier standards of 138 and 150drs) δημνεον (though στατηρ also occurs), μνα, ημιμν[αιον] ?, τεταρτον, ογδοον (note variant spelling) and τριτη ?.

IV. Stater base around 17.5gm (early fifth century and possibly later in view of P.2 and the Owl weights). The only marked weight is P.2 δεκαστατερο.

V. Drachma base of 4 - 5gm (a closer approximation seems inadvisable). Weights on this system occur marked in multiples (206, 100, 25, 20, 16, 12, 10, 8 down to 1), or in combinations of units and sixths or obols (1dr3ob; 7dr4ob; 4dr3ob; 13dr$\frac{3}{4}$ob; 26dr1$\frac{1}{2}$ob)[8] or in obols alone (4,3,2, and 1ob).

To this list can be added from coinage further systems, although the second, and most normal, coin system is equivalent to the last (V) of the actual weights above. Identification of the earliest system is controversial although I am inclined to follow the substance of Head's argument for an early standard coin equivalent in weight to what was later 2drs[9]. The importance of this earliest system is however here not significant, for whether tetradrachms or didrachms were the usual denominations minted is irrelevant to the certain fact that the basic unit was the drachma. The last group to be listed (VIII) relates to the small issues of gold coin in 407/6 and c.295/4; in these issues the term stater seems to have been applied to a weight equivalent to the silver didrachm.

VI. Unnamed unit around 8.5 - 8.4gm (short period in late sixth century) Dividing into halves, and occurring in multiples (of2). Silver.

VII. Drachma around or above 4.3gm . The normal coin series was 4dr, 1dr, 5ob, 4ob, 3ob, 2ob, 1½ob, 1ob and ½ob. Further fractions occur, especially in the fourth century: τριταρτημοριον (¾ obol), τεταρτημοριον (¼ob), τριημιτεταρτημοριον (⅜ob), ἡμιτεταρτημοριον (⅛ob) (others have been identified but they are not mentioned in literature or on the actual coins). The standard denomination was of course the tetradrachm, and this at 17.2gm could bring the group into line with the 17.5gm stater of IV above. Silver.

VIII. Stater around 8.6gm. (a) in the late fifth century this divided into halves, quarters, sixths, and twelfths, all of which are confirmed by contemporary inscriptions; (b) the early third century issue, apparently with only quarters and sixths,[10] lacks contemporary evidence for any fractional values. Gold.

The accounting system used in Athens is firmly established and need not be argued here[11]. Doubt still surrounds the earlier stages of its development[12], but the classical system used a drachma unit with multiples of 100 (the mina) and of 6000 (the talant), and with fractions of one sixth (the obol) and of one forty-eighth (the chalkous). We can therefore add for completeness:

IX. Talant - mina - drachma - obol - chalkous continuous scale.

## 1 (2) Weight systems for gold and silver on Attic inscriptions

From the weighing of gold and silver on Attic inscriptions two systems seem to emerge. One is equivalent to the coin system (although figures above 5999drs are expressed in talants) and is used for both metals; the other introduces gold staters, and is found on only one inscription IG $II^2$ 1496. It can be shown that the coin system is the general rule for official weighing while the stater weight possibly relates to a commercial context.

Of the usual system there can be little doubt. On those occasions where sufficient gold is being weighed, talants rather than high drachmai occur, and this would appear to be true of weighed as opposed to accounted silver (or numbered silver coin). The only exception I have found is the Pronai inventory of 434/3 item 2 where M ( μυριαι ) is used as part of the weight of a number of φιαλαι ἀργυραι (IG $I^2$ 232.7): in subsequent years the growing total as further phialai are added appears in talants and drachmai (cf. $I^2$ 233.19-20; 236.49; 237.58-9 etc). This contrast with accounting, which did not necessarily involve talants[13], may be sufficient to indicate that an actual talant weight was used in the weighing procedure[14]. Below talants both metals are weighed in drachmai, obols and fractions of obols. The mina is a unit of account only, although as will be seen from the following section it served as a unit of weight for other commodities.

The range of contexts for the use of this system to weigh gold and silver is considerable; it is not simply restricted to inventories but occurs also in several temple accounts including the sale of surplus gold from the Parthenon (explicitly weighed in drachmai on ML 59.21ff for example) and the purchase of gold for Pheidias' statue (in talants, drachmai and one obol on ML 54A.14ff). The following Tables show the other authorities involved: apart from the Athena Treasurers these include the officials at Brauron, Delos and Eleusis and also the temples of Aesculapius and Ἥρως Ἰατρος . Although admittedly a consistently official source, these authorities vary in other ways (especially in their recording techniques and the extent to which they price and weigh other commodities) and some standardisation should be inferred from the common practice.

TABLE

(a) Contexts for the weighing of gold on Attic inscriptions

fifth century

| | | |
|---|---|---|
| drs, obols, ½obols ..... | Athena temple ..... | inventory |
| drs ..... | Athena (Parthenon) ..... | sale surplus |
| tal, drs, obols ..... | Athena (Pheidias) ..... | purchase materials |
| drachmai, (? ob) ..... | Brauron temple ..... | inventory |

fourth century

| | | |
|---|---|---|
| drs, obols, ½obols ..... | Athena temple 403/2 - 386/5 ... | inventory |
| drs, obs, ½obs and ¼ obs. | ,, 385/4 - 342/1 | ,, |
| drs, obols ..... | ,, 341 to end century | ,, |
| [drs, obols, ½obols ..... | Delos (Athens admin.) ..... | inventory] |
| drs, obs, ½obs, ¼ obs ... | Brauron temple ..... | inventory |
| drs, obs, ½obs, ¼ obs ... | Aesculapius Sanct. ..... | inventory |
| drs, obs, ½obs, (?¼ ob). | Eleusis Sanct. ($II^2$1544) ..... | inventory |
| drs, obols ..... | Athena ($II^2$1496) ..... | inventory |
| staters, drachma, 9ob, tartemorion ... | ,, ..... | commercial |
| talants, drs, obols, ½obs and ¼ obs ..... | ,, ..... | metal working and new articles |

third century

| | | |
|---|---|---|
| drs, obols, ½obols ..... | Aesculapius Sanct. ..... | inventory |

(b) Contexts for the weighing of silver on Attic inscriptions

fifth century

| | | |
|---|---|---|
| talants, drs, obs ..... | Athena temples ..... | inventory |
| drachmai ..... | Eleusis Sanct. ..... | inventory |

fourth century

| | | |
|---|---|---|
| drs, obols ..... | Athena temples ..... | inventory |
| [drs, obols ..... | Delos (Athens admin.) ..... | weighing "against silver (coin)" $II^2$1643.5 ] |
| [drs, obols ..... | ,, ..... | inventory ] |
| drs, obols ..... | Brauron temple ..... | inventory |
| drs, 3ob (ie. ½dr) ..... | Aesculapius Sanct. ..... | inventory |
| drs, obols, ½obs ..... | Eleusis Sanct. ($II^2$1542,1544).. | inventory |

third century

| | | |
|---|---|---|
| drs, 3ob ..... | Decretum Thiasotarum ($II^2$1277). | inventory |
| drs, obols ..... | Aesculapius ($II^2$1534) ..... | inventory |
| drs, 3ob ..... | Ἥρως Ἰατρός ($II^2$839) ..... | metal working |
| drachmai ..... | ,, ($II^2$840) ..... | inventory |

The staters of gold on IG II$^2$1496 are in contrast with the standard practice. Used of coins the term denoted simply the usual denomination, of weight it was applied to (a) the two-mina, or thirtieth of the talant, unit used quite commonly for weighing commodities other than gold and silver as will be shown in the next section; (b) the variant heavy standards which used this base ; (c) the unit of around 17.5gm[15]. As a coin term its weight was immaterial, but in Athens it was applied specifically, as already noted, to the gold coins of the emergency 407/6 issue[16]. These coins appear to have been based on the weights of the more usual silver currency and to have been equivalent to 2drs. Hesychios, albeit late and alone unreliable evidence, confirms this by referring to το χρυσιον sv. στατηρ , and also, sv. χρυσους by citing Polemarchos as his authority for equating this coin <u>in Athens</u> with two drachmai[17]. If Polemarchos of Cyzicus can be identified as the source here, the equation belongs to the fourth century [18] and so there is good reason to conclude that the staters of II$^2$1496 (which is late fourth century and certainly before the only other gold issue of c.295/4) are 2dr weight units of gold[19]. The alternatives, that some other (unspecified and non-Athenian) coin is meant on the inscription or that the stater of gold is here equivalent to as much as two minai or even as four drachmai (silver) weight, are far more unlikely. However the fact that <u>all</u> other weights of gold on the Attic inscriptions I have examined are in single drachmai units requires some explanation. For this it is necessary to examine the inscription in some detail.

The references to staters of gold occur on both sides of the stone. Side B is related by the editors to Lycurgus' filling-out of the Canephoria[20] for which, it is supposed, gold dedications on the Acropolis were melted down and further gold purchased to supplement this. The passage of interest to us comes from the left hand edge of this side. Following a list of the various (melted down ?) weighed objects, and on a third fragment (c), is a total weight of necklaces, bracelets and crowns:

Stoicheion

197 ζυμπαν κε]φ[αλ]αιον σταθμ[ου των
ὑποδρι]δων και των ἀμφιδεων
και] των στεφανων ⋮ ΤΤΤΧΧΧΗΗΔΔ— .
Space.
200 χρυ]σου ἐξ ἀκροπολεως ἐλαβομεν
ἀφ]ειρημενης της ἀφεψησεως
ΤΤΧ[Η] ΓΔΔΔ !!!!! CT.
χρυσου] ὁ προσεπριαμεθα
ΤΧΓΗΔΔ]ΔΓΗΗΗΤ.
Space

205 οὗτοι στατῆ]ρες γίγνονται
XXX[ΓΗΗΗΗΔΓ] ϛϛϛϛ
δραχμὴ τε ? χρ]υσίου καὶ τεταρτημο[ρίου].
[τοῦ στατῆρος ἐ]ϊκοσι καὶ τριω[ν]
[τίμη χρυσίου ϛ ] ΔΤΤΤΤXXX[ΓΗΔΔΓ]—.
210 [— — — — — — — — — — — — — —]

The restorations in lines 208 and 209, which are my own, will be justified in the following analysis. Lines 202 and 204 are restored by IG II$^2$ to equal the total, 3T 3220drs (line 199);[21] there is little doubt also that this gold is weighed in talants, drachmai, obols, and half- and quarter-obols[22]. It would appear that line 205-9 give the price paid for the additional gold purchased. The 1T 1639drs $\frac{1}{4}$ obol of line 204 are converted into staters, a simple division by two being supported by the four staters and remaining fractions that can be read on the stone. Thus this figure is restored as 3819staters 1dr $\frac{1}{4}$ obol. The high talant figure in line 209, and the relation between the two figures in lines 206 and 209, enable restoration of a conversion or price factor of 23 silver drachmai per gold stater for lines 208 and 209 as I have given in the text above. This represents a ratio of 11$\frac{1}{2}$:1 for gold:silver, which is roughly that to be expected for the late fourth century[23]. That the arithmetic should not entirely tally is not necessarily an argument against this restoration[24]. The state had its own ways of reaching bargains and the gold in question on this inscription is being purchased, not inventoried.

This last point lies surely at the heart of the matter, for here is a record of the purchase of gold on the open market. This I suggest explains why on this occasion it was necessary to depart from the usual terminology (and weight systems) of temple and treasury accounts. The record does however also show the danger of relying on the Athenian public accounts as evidence of general practice. The great majority of these obscure the fact that gold was handled in stater units of around 8.6gm on the commercial market.

The other side, A, of this same inscription carries the only other reference to gold stater weights that I have noticed on Attic inscriptions. The major part of the text (fragments a, b, c and d) forms a final column (IV) concluding the accounts of τοῦ δεκατικοῦ (dated by archons to 334/3 -

332/1). Earlier fragments refer to crowns voted in 338/7 and 333/2, an those with which we are concerned, fragments f and g, mention two crowns voted to Alexander. These two fragments are placed by IG II$^2$ at the fo of Col.III; but although the location of fragment e, with the reference to a crown in the archonship of Nikokrates (333/2), cannot be certain, i would appear that there is no chronological priority for the earlier columns over the Dermatikon accounts in the last column. Rather they seem to contain at least three disconnected accounts: (i) Coll.I and II (including fragment e) inventory the weights (in drachmai) of gold crowns voted at various times; (ii) Col.IV gives, as already said, the Dermatikon accounts; (iii) Col.III (fragments f and g) is another list of crowns but very different from that in Coll.I and II. This list in Col.III starts with the fourth of seven gold crowns ἀνθ'[ὧν τ]ο χρυσ[ιον] ἐλαβομεν (lines 62-3 with the number also). Each crown is described individually in a form that reflects this description: στεφανου (in the Genitive case) followed by a number of στατηρας (in the Accusative)[25]. The figures may be set out as follows:

- for/of crown no.4 ... we took 48 staters;
- for/of two crowns (nos.5 and 6) voted to Alexander ... we took 97 staters and 1 drachma of gold;
- for/of the crown (no.7) voted to Teisamenos ... we took 49 staters and 9 obols.

The record ends with the total weight of the seven crowns involved: σταθμον τουτων ⋮ ΓΗΔΔ[--- (a number which must be less than 650).

I have dwelt on the arrangement of this side of IG II$^2$1496 as I am not entirely happy with the interpretation of the editors who suppose that the reference is in this last part to two gold crowns voted to Alexander the Great, probably in 331[26], and that the Athena treasurers are here acquiring the gold with which to make these (and the other) crowns[27]. I have indicated that there is no way of deducing the date of these fragments f and g from other parts of the inscription (indeed as they come from the <u>foot</u> of Col.III might they not if anything be rather later than higher parts ?). Nor are crowns for Alexander easy to date at all precisely as they are known to have been voted on at least two occasions[28] and possibly also on several others[29]. That there might in fact be a ten-year gap between the crowns voted Alexander leads to my next point, which is that the phrase ἀνθ'ὧν το χρυσιον ἐλαβομεν indicates that the crowns are being <u>disposed of</u> for gold, rather than that gold is being <u>acquired</u> for their construction[30].

Certainty on this matter may not be attainable. If the fragments f and g are correctly joined, it is odd that they end with the weight expressed in drachmai[31]. This expression sounds more like an inventory entry although, as I have argued, the crowns have been disposed of. I do not know if it could be possible to reverse the order of fragments f and g, or whether the τουτων (sc. των στεφανων) was the stone-cutter's mistake for τουτου (sc. του χρυσου ). An equally reasonable explanation, that would not demand some sort of correction of the text as it has been put together, is that the number of crowns and their total weight is given here simply to fit in with other inventory entries (possibly to enable the subtraction of these seven crowns to be made from an earlier total before their disposal).

If I am right in seeing in these lines 52-64 the disposal of a number of dedications[32], the operation involved is very similar to that I have argued described on Side B of the inscription. Both reflect gold transactions on the commercial market between Athenian officials and common traders. Note in conclusion the distinction on Side B between gold from the Acropolis (in drachmai) and that bought to supplement it (in staters), and compare on Side A the transaction (ἐλαβομεν in staters) and the record (σταθμον τουτων in drachmai).

The preceding examination of the two references to weight staters of gold on IG II$^2$1496 has suggested that the term does not appear used of gold elsewhere in Attic inscriptions because the transactions on this single inscription were most unusual. Reference to the table for gold weights[33] will show that most other references are to the simple inventorying of gold in temple accounts. On these occasions gold is consistently weighed in (talants), drachmai, obols and fractions of obols. Two building accounts however mention weights of gold: the Parthenon sale of surplus gold (most conveniently ML 59) and the purchase of gold for Pheidias' statue (ML 54). Both these accounts use the normal inventory weight system for gold and not the stater/drachma system we see in IG II$^2$1496. While the difference in date might count towards an explanation, I do not feel that an explanation is necessarily called for. Standard official procedure in the most usual context for weighing and inscribing weight (inventories) obscures the practical variations that actually existed. The importance of IG II$^2$1496 is that it exceptionally has lifted the veil that the set formulae of other inscriptions cast over such practical variations[34].

While the contexts for the weighing of both gold and silver in talants-drachmai-obols (and fractions of obols) can thus be associated with Athena Treasurers and other officials, the non official contexts in which these metals were weighed, and to which the stater-drachma-obol (and fraction) system of IG II$^2$1496 belongs, cannot be securely identified from the available inscriptions. In particular, despite the suggestion of a commercial context for the transactions of IG II$^2$1496, it must be left open whether these stater weights were part of an official Athenian system (but parallel to the more usual talant-drachma-obol system) or whether they were those used by independent traders in gold. For the present we must conclude simply by noting the existence of the two systems.

## 1 (3) Weighing of commodities other than gold and silver on Attic inscriptions

Although several distinct systems (and possibly unconnected weights also) were probably used in the weighing of commodities other than gold and silver at Athens, this has yet to be established. I shall not therefore anticipate my conclusions by making any further subdivision at this stage beyond that I have already drawn between gold/silver and other commodities.

For these other commodities there exists a mass of evidence that cannot easily be presented in a palatable form. Despite the number of references to the weighing of commodities, the picture that emerges is rather inconclusive. This is due in particular to the artificially official sources (where the gulf between accounting procedure and weighing practice cannot be ignored) and to their very variable and incomplete procedures. The results have been tabulated above[35] but should not be taken without the following pages of detailed commentary. The order of the commentary is arbitrary though it is divided between the various authorities responsible for the inscriptions considered.

Athena Treasurers

(a). Though the weighing of gold together with silver may be understandable given a single weight system for the two metals, it is nevertheless a remarkable procedure given the very different values of the metals involved. More surprising is therefore the category of mixed gold and bronze (II$^2$1408. 15-6 for example). Compare the onyx (which surely had a gold or silver setting cf.IG II$^2$1388.86) weighed simply as 32drs (1388. 63), and the obscure φιάλη χαλκοκρας βαρβαρικη inventoried in the section of χρυσα και ἐπιτηκτα και ὀποχαλκα in 1424a.95f (an alloy ? the word derived from κεραννυμι rather than the explanation offered by LSJ "tipped with copper" from κορυσσης ). The explanation for mixing together these disparate materials surely derives from their context, the need to preserve a single inventory form. It does not imply that a common weight system was normally applied to all such materials.

(b). Two entries I understand as referring to actual weights rather than to the weights of the materials concerned: τελαντον σιδηρον IG II$^2$1425. 380 (cf. in third-century Delos IG XI 203.B.98) and τριμηνον χαλκουν IG II$^2$1469.100 (preferring to read this as "three mina" rather than the obscurely Homeric "lasting three months" Iliad 23.826-35).

(c). Ivory. Of the two references to sales of ivory in the Athena accounts, only the price is given in that of Pheidias' statue (ML 54) and in the second, the Parthenon sale of surplus ivory (ML 59.24-6), it is weighed in talants and drachmai (restoring 3T 60drs) rather than minai (as in the fourth-century purchase of ivory in Athens by Delphi FdD III.5. 25 II A 5-13). As already said of the commercial handling of gold in this inscription in drachmai (rather than staters), I suspect that the common silver/gold inventory weight system is used on this inscription by convention and need not indicate actual commercial practice for ivory (or gold).

(d). The accounts of the statue of Athena Promachos are the earliest Athenian documents that bear on our subject (465-455 BC see SEG X.243 and IG I$^2$338 but with considerable additions). Work on the statue covered several years, and the repetitive nature of the records of purchases makes possible much restoration of the mutilated text. From this it appears that tin, wax and bronze (κασσιτερος, κηρος and χαλκος ) are weighed and priced only in talants. There is however one highly controversial entry which might qualify this assertion: the only talant figure preserved in toto (rather than restored) is followed by a break of about 6 to 9 letters introduced by a mysterious epsilon:

[χαλκὸ ταλαντα ·] ΔΤΤΤΤ Ε [- - - - - -] (Col.II line 56).

Restorations proposed include Ε[ὐβοϊκα] (Meritt Hesperia 5(1936)370 and followed by SEG) and Ε[μπορικα] (suggested by Lewis). Either of these would be significant if established, but I find it impossible to accept any such qualification of talants here for the following reasons:

i. The terms are unparalleled in contemporary documents. Ἐμπορικος as an epithet of weight occurs for the first time in the special circumstances of IG II$^2$1013.35 (c.100BC); hardly comparable is [Dem] 35.49, which is not a reference to small change. The wide assumption amongst modern writers that commercial weight standards existed in classical Greece (cf. Lang in Agora X for example) is a total anachronism and can hardly derive much support from a solitary epsilon in this text. Euboean talants are of course mentioned by Herodotus (III.89.1, 95.1-2 to cite two texts themselves very much in need of restoration), but they are mentioned in order to explain Babylonian weights, they are in other words the normal late fifth-century Attic weights. It is therefore for Meritt to show that

they differed from the Attic, and if they did not there seems little reason to qualify talants as Euboean in this Athena Promachos account.

ii. Qualification of the type of talants involved would more naturally precede the figures, if not in fact the word talant itself (compare ἄργυρου Ἀτ[τικοῦ τάλαντα – IG II$^2$1492.131; Αἰγυπτίου τάλαντα II$^2$1479; and most relevantly ἐμπορικὴν μνᾶν II$^2$1013.34).

iii. Such qualification should appear on each occurrence of the talant unit, yet though the totals show that only one sort of talant is involved there is no room for qualification in other parts of the text.

Meritt in fact considered other possible restorations. One was the addition of a fraction (eg. τε[τάρτον] taking the last tau from the talant figure). Alternatively I should suggest the provenance of the gold involved (perhaps even ἐ[κ Εὐβοίας] !). On either restoration (both preferable to those considered earlier) the uniqueness of the inscription is lost.

(e). IG I$^2$371 combines three stones relating the expenditure on the statues of Athena and Hephaistos c.420 BC (see also Dinsmoor Hesperia 9(1940)43). Despite the loss of the left-hand column containing the amounts paid, this inscription is important in that it gives some prices per unit weight (thus tin and bronze though weighed in talants, half-talants and minai, are priced per talant, which must therefore be taken as the basic, and older ?, unit: III.5-8 and 2-4), and secondly in that it itemises lead ( μολυβδος ) as counted (and presumably priced) in "bars" of some sort: III.12-13 κρατευται δωδεκα. LSJ translate "leaden pigs of specified weight"; in Homer the term refers to metal or stone blocks supporting spits (Iliad 9.214); it is not uncommon in other Athenian inscriptions, where it is invariably numbered and in a context suggesting some sort of metal (for example IG II$^2$1541.20; 1425.388, 415). As a specific weight term it is overlooked by Pollux and other metrological writers, but I find this rather as some confirmation for the ancient use of the term (since superseded) as a weight constant.

(f). The Erectheum accounts, despite their detail and length (IG I$^2$372-4), contain only one weight: 2T of lead bought from Sostratos for 10drs (374.286-9). In the same entry gold is bought in numbered leaves (πεταλα). The people involved are private merchants and few of them sold by weight. Again, the curtain on general practice is briefly lifted (see above on IG II$^2$1496).

(g). IG II$^2$1479B details equipment handed over to the Strategoi probably (line 65f) in 313/12 BC. I include it here under Athena Treasurers as the other side of the stone contains an inventory of crowns etc passed on by these Treasurers up to 314/3. The inscription however is significant as it describes rope and a sail as weighed in Egyptian talants and minai (while being priced in normal Attic silver drs). Two questions therefore arise - what were these Egyptian talants and minai ? and why are they being used here by the Athena Treasurers rather than normal Attic weights ? I shall examine this issue in some detail here as it bears not only on the immediate investigation of variant weight systems in Athens, but also on a possible specialised use of weighing that will be considered further below in Chapter VII.2.(11).

Although Egyptian talants and minai are not mentioned in any other classical inscriptions, the later metrological writers give several possible equivalences. Pollux IX.86 says the Egyptian talant was smaller than the Attic and equalled 1500 Attic drachmai; other writers regard them as equal, explaining the 1:4 ratio in terms of coin value rather than weight (see Hultsch SM fr.95.2). Though there are several types of rope on IG II$^2$1479B, and though the total prices vary (line 54f gives 26 Eg.T 5 Eg.M as costing 40drs whereas in line 63 23 Eg.T 3 Eg.M seem to have cost 90drs), the magnitude of price involved seems more in

line with the cost of rope on other contemporary inscriptions (for example 3T for 90-100drs for στροφεις on IG II$^2$1673.19) if a considerably smaller Egyptian talant can be assumed as Pollux. We seem therefore to be faced here with an entirely different weight system, and, by virtue of the epithet, clearly Egyptian.

The identification of the absolute value of the Egyptian talant of this inscription either from later metrological writings or from actual Egyptian weights is not possible. Too many variant weight standards existed in Egypt (and even Hultsch was defeated in this respect: GRM$^2$ 645-6); nor is reconstruction possible given uncertainty as to the standardisation of Greek ship measurements (contrast the calculation based on modern rope in Morrison and Williams Greek Oared Ships p.296 with the suspicious inadequacy of Schramm's attempts at reconstructing Agesistratus' three-span catapult as described by Marsden Greek and Roman Artillery - Historical Development p.88).

The measurement of rope, and certainly of sail, by weight is not usual. The categories "light" and "heavy" for sail in the Attic Navy Lists (IG II$^2$1627.65; 1629.371; 1631.415) are essentially designed to denote quality as the "light" sails are the more expensive. Rope on the other hand is usually described by length (IG I$^2$313.31f; II$^2$1627.353) or gauge (for anchor cables IG II$^2$1627.123ff, 447ff, 470ff as also on this inscription II$^2$1479 B.51f; it is not clear to me whether this gauge, expressed in inches or rather "fingers", refers to the diameter or, as Morrison and Williams op.cit. p.301, to the circumference of the cable). Alternatively inscriptions give only the function of the rope (τριηρητικαι πλοκες etc, or, for a commercial context, compare the lob cost of enough rope to hang a person with, Lucian Timon.131) or its material (horsehair in AS I.214). There are only three references to the weighing of rope: the inscription in question here (II$^2$1479B); the fourth-century Eleusis record of rope bought from a Peiraeus trader (II$^2$1673.19); and the unit weight per cubit given by Herodotus (VII.36.3) for Xerxes' second Hellespont bridges. This last passage raises special problems to be considered below in Chapter VII.2.(11), but the others have in common the idea of a commercial transaction. This distinguishes them from other simple inventory entries mentioning ropes, and surely points to an explanation for the extraordinary departure in our inscription from normal official Attic practice.

If the explanation for the unusual weighing of rope here is the commercial context, some contact with Egypt in the form of trade or trader must be assumed to account for the fact that the weight units are Egyptian. Though the sources for rope and sails were varied, it is generally agreed that Egypt was a prominent supplier (Hermippus fr.63 and see further Morrison and Williams op.cit. 279-301). More significantly we may note that Xerxes' second bridges were presumably built by Phoenicians and Egyptians just like the first (Hdt.VII.34). The connection of Egypt with weighing rope seems established. We must however leave open here the question of whether this practice was so well established that all traders in rope used the Egyptian system or whether the trader involved in IG II$^2$1479B was himself simply an Egyptian. The former possibility seems, I must admit, the more likely as it is difficult otherwise to explain why the Egyptian weight terms are inserted here into an account for Athenian generals.

## The Navy Lists

The preserved accounts of the fourth-century Athenian Νεώσοικοι are largely inventories of naval equipment (IG II$^2$ 1604-1632 dating from 377/6 to 323/2). This is normally listed by number and type, occasionally by length or volume, and only on two occasions are weights given. In IG II$^2$ 1627.280-351 scrap items of iron and lead are listed by weight (for want of any other means of recording the amorphous and miscellaneous items ?); iron is weighed in minai (never more than a talant), the lead in both talants and minai; no smaller units are used. The second reference to weighing is more important as it refers to a commercial transaction, the sale of four rams ( ἔμβολοι ) in 325/4 BC (IG II$^2$ 1629. 1122-62). Though the exact figures cannot be restored, it is clear that these items (presumably of bronze) were weighed for sale in talants and minai. It is worth noting however that the iron sold in the same sale was not weighed (1629.1153).

## Eleusis

The accounts from Eleusis divide into the inventories of 408/7 and 407/6 (IG I$^2$ 313 and 314 largely supplementing each other) and the records of materials purchased for building between 329/8 and 327/6 (IG II$^2$ 1675 but especially 1672 and 1673). Despite the interval of nearly a century between these two sets of inscriptions the use of weighing can be seen to have changed little.

In the inventories only iron and glue (ἶξος ) are weighed, both in talants and staters (313.124-32; 314.139-47 for iron, and 314.42 for glue). In the building accounts the references for commodities weighed are as follows:

ξύλα weighed always in talants and priced by the unit talant: 1672. 10, 124, 128

μίλτος weighed in staters and priced by unit stater: 1672.12, 184

κολλα ταύρεα weighed in staters and priced by unit stater: 1672.160-1

μολυβδος talant weight (priced worked): 1672.176

στρογγυλος weighed in talants: 1673.19

πίττα weighed in staters and priced by unit stater: 1673.22

σίδηρος worked objects in iron priced by unit stater and weighed in talants and staters: 1672.205-6, 310; 1673.28-9, 53-4

Doubtful iron or "bronze" weighed in staters and priced per unit stater are a number of objects that are most probably iron though the metal is not specified: ἧλοι 1672.30, 166-7; τυχοι 1673.25; ἀμφίδεται 1673.43; δικέλλαι 1673.51; στέλεοι 1673.55-7.

Uncertain: 1673.26, 30f, 34.

Rather different however is the account for χοινικίδες (sockets for door hinges) in 1672.201ff; these are weighed and priced in minai. Though the editors of IG$^2$ assume they are made of iron (see note to 1672.175 'quibus subjectum est solum ferreum ( χοινικις v.201)'), the Delian contractor for these items in IG XI (2) 165.11, Demetrios, also made γομφοι χαλκοι (line 10). As the bronze at Eleusis was handled in minai, I feel certain that these χοινικίδες are also bronze.

χαλκος contract to Blepaios for binding the tympana of columns in 337/6 specifies the source of the copper (Cyprus), the alloy (11 parts to 1 part tin), and the pricing, which is 5$\frac{3}{4}$ ob per mina weight: 1675.26-7 μισθωσεται δε κατα μναν.

The normal weight system in use in Eleusis was therefore that which comprised the stater and the 30-stater talant (the relationship is clearly given from the price calculations); the stater divided into the half-stater (for example 1673.51) but nothing smaller existed in the system. It applied moreover from the late fifth to the later fourth century.

Alongside the stater-talant system was a mina system reserved as far as we can tell for 'bronze' ( χάλκος ). The reason for the distinction is open for discussion: mina-weighing may be peculiar to the 'bronze' market, and this could either be a practice of those who dealt in the market or a reflection of the unit weights in which the raw metal was handled; the possibility of an unrelated weight must also be allowed (Cypriot in view of IG II$^2$ 1675.18 ?) as it is remarkable that nowhere are half-staters confused with minai. Even if by the later fourth century half-staters and minai were equivalent in value (as the actual weight series show) their belonging to different systems at Eleusis is significant evidence of their different origins.

Demes

The arrangements made by the deme Cholargeis for the Thesmophoriae festival, IG II$^2$ 1184 shortly after 350 BC, include cheese ( τυρον 1.13) and garlic ( σκορδοι 1.15) in stater weights. More problematic is the next entry for δαΐς . The text should be cited in full:

— — — τυρου δυο τροφαλιδας μη
ἐλαττον ἢ στατηρια[ι]αν ἑκατεραν
καὶ σκορδων δυο στατηρας καὶ δαϊδ-
[α] μη ἐλαττονος ἢ δυεῖν ὀβολοιν καὶ
ἀργυριου ΗΗΗ δραχμας · ταυτα δε δι-
δοναι τας ἀρχουσας — — —

Is the 4dr 2ob silver limit a weight or a price ? I believe that price must be the correct interpretation, firstly because of the genitive μη ἐλαττονος as opposed to the preceding accusatives ( μη ἐλαττον ἢ στατηριαιαν ), and secondly because if "pine-wood for torches" be meant (compare from LSJ Miletus SIG$^3$ 57.32 making a single torch unlikely) the weight is ridiculously low (under 18gm). A price of this magnitude on the other hand would amply provide enough wood for the whole procession (it would secure more than 3T of ξυλα ἐλαΐνα at Eleusis in 329/8BC: IG II$^2$ 1672.10). We are therefore left with the cheese and the garlic.

Miscellaneous

- IG II$^2$ 659 records preparations for the πομπη Ἀφροδιτης Πανδημου . Though rather late (287/6 BC), I include the inscription here as it illustrates the late weighing of commodities other than gold and silver in (silver) drachmai. At line 27 is listed

πορφυρα δλκην ΗΗ[— — —

- FdD III (5) 25 II.A.5-13 records the purchase of ivory by Delphi. This took place in Athens and the amount of ivory purchased is expressly stated as 93 Attic minai (note also that the price was paid in Attic coin: on the conversion of which see Appendix C). The transaction is a unique example of inter-state commerce, moreover there is no reason to suppose that it involved Athenian officials rather than traders in the Athenian market. Again we find an oblique glimpse behind the veil of official records of more usual commercial practice, and contrast the weight of ivory, noted above under Athena Treasurers (c), in talants and drachmai (ML 59.24-6): both sums are large enough, yet both avoid what is too often assumed to have been the normal system of talants-minai-drachmai.

## 1 (4) Towards an identification of commercial systems in use in Athens

The table above[35] summarises the results of the foregoing discussion of the weighing of both gold and silver and of other commodities. The first point to stress is the clearly apparent variation between the ways different authorities weighed: those at Eleusis were familiar with the talant/stater system while the Athena Treasurers used this only on one occasion. Secondly it has been possible to explain certain variations in terms of the context involved: commercial/temple for the two ways in which the Athena officials weighed gold for example. Thirdly some justification can be claimed for viewing different commodities as handled differently: κρατευτον for lead, and the difference between iron and 'bronze' at Eleusis. Despite the traditional forulation of many of the inscriptions considered, and despite their being essentially meant only for the immediate official context, it has been possible to derive occasional glimpses of a more general weighing practice. It will be useful in conclusion to review this here.

The edges of the categories I am suggesting are of course blurred. It is no indication of the general use of the talant/drachma system if the Athena Treasurers, who used it for accounting, should on occasion weigh commodities other than gold and silver with the system. The case of ivory is important here as it emerges from an independent source[36] that ivory was weighed in minai (and not in talants) on the commercial market. The Athena Treasurers are simply using the system with which they are themselves most familiar, and which fits best the general shape of their accounts. The same argument might apply for firewood (in the Cholargeis deme account)[37], and seems sufficient to explain the weighing of purple dye much later[38]. From clearly commercial contexts (and from clear variation from the normal gold and silver talant/drachma system) can be derived the following commercial systems:

talants - μολυβδος (though also measured in κρατευτον : ? weights)
talants/minai - καττιτερος and χαλκος (60 minai to the T)
staters/drs/obols - χρυσος (2drs to the stater)
Egyptian talants/Egyptian minai - rope and sails (60 minai to the T)

The Navy List inventories use only talants and minai for their internal accounting. As they are only inventories it is impossible to tell whether this system is only a crude version of the talant/drachma system (for it is applied on the Navy Lists only to less valuable commodities than the gold and silver of the Athena accounts) or whether it is a true reflection of commercial practice. In that it is used of lead

and iron (and especially because of the latter use), it contrasts with what is more certainly a reflection of commercial practice in the Eleusis records. From these the above list can be extended somewhat further:

talants - ξύλα ; μολυβδος ; σταφος.
minai - χαλκος (? upper unit)[39]
talants/staters - σιδηρος and ἑξος (30 staters to the T)
staters - μιλτος ; καλλα ταυρεα ; πιττα (? upper unit)[39]

Moreover the Eleusis administration seems to have incorporated these commercial systems into its internal accounting (talants and staters used for σιδηρος and ἑξος ) alongside the usual silver talant/drachma system.

The commercial picture can be completed with the Cholargeis deme account (which compares closely with Eleusis practice) and the Delphic purchase of ivory on the Athenian market:

minai - ἐλεφας (with no upper unit)
staters - τυρον; σκορδον

While there may be some justification for regarding these commercial weight-systems as consistent within a single context (and this must be especially true of the Eleusis building records which were issued by an administration that itself used the talant/stater system for its own internal accounting), the question of absolute consistency cannot be considered answered. This must depend upon the degree of precision required in weights (that I believe was in fact extremely low[40]) and upon the degree to which commercial weights were officially (and even theoretically) systematised (a process I believe to have been rather gradual[41]).

Finally I should emphasise that throughout by"commercial"I mean no more than"used in commerce". That no commercial system as such existed until a separate coin standard was established in the second century I shall argue in the following chapters (and against the prevailing view that it existed from earlier, even from Solonian, times).

2. AEGINA

Sources IG IV 1-191, 1580-95; SIG[3].

There are no references that I can find to Aeginetan weighing[42], and although some actual weights can be suspected of being Aeginetan[43] they do not amount to evidence for any particular systematisation. The relationship between the Aeginetan and Attic coin systems is of course significant, but is discussed in detail in later chapters[44]. The main questions undecided are: how the Aeginetan coin system (staters/drachmai/obols) related to other weight systems; whether there was a specifically Aeginetan weight system; whether the Aeginetan mina existed outside the context of conversion and account. These uncertainties derive from the lack of clear evidence and from the contradictory descriptions of a 70dr Aeginetan mina[45] and a 100 (Attic) mina Aeginetan talant[46]. That Delphi in the fourth century specified Attic weight minai when purchasing ivory[47] could imply other minai were possible, and Delphi used Aeginetan coin weights[48]. It is important to recognise these uncertainties even if they cannot be as yet resolved.

## 3. CORINTHIA, SICYON, PHLIASIA, CLEONAE, ARGOLID, HERMIONE, TROEZENE

Sources IG IV 192-871, 1596-1610; SIG[3].

For direct references to weighing or weights this area is a virtual blank. I have collected only the following incomplete entries:

Nemea (fourth century) IG IV 481.8 and 9 δλκ]ὴ ἡμιναῖ[ον and- -]τελαντ[- -. This is a fragment from a building account (Tod) or possibly an inventory. The larger sums may be prices.

Argos (third century). The Heraion inventory, IG IV 526, included items weighed in minai and drachmai: silver is mentioned in one line (5), but the text is too fragmentary to show whether all the items weighed are also silver.

Troezene (third century). The account IG IV 750.16-17 appears to count silver in Alexandrian drachmai and gold in χρυσοῖ ; this might indicate that the two metals were also weighed differently (cf. Miletus below). The fullest building account from this area, IG IV 823 (fourth century), contains no references to weighing.

There are very few positively identified actual weights from these cities[50] and so there is little reason to pursue the references to coinage that appear in the accounts of other cities[51]; no correlation can be established between coin and other weight sysytems[52].

## 4. EPIDAUROS

Sources IG IV$^2$ (1), with revised texts by A.Burford BSA 61(1966)254-334 [prefixed here B.-]; and see further, by the same author, The Greek temple builders at Epidauros (1969)[53].

Comparative table of commodities weighed

| | | | |
|---|---|---|---|
| - silver coin accounted | - building | - usually Aeginetan [drs, obols (6 to dr), chalkoi (12 to ob) and also ½ob and ¼ cb]; minai and staters are rare and late; never talants | - (4- 3rd c.) |
| - no silver weighed (5th - 3rd c). | | | |
| - gold weighed | - purchase (in Athens probable) for building | - Attic drs and obols | - (4th c) |
| - βόλιμος (= μολυβδος) | - building | - talants, minai | - (4th c) |
| - σίδαρος (objects of) | - building | - talants, minai, half and quarter minai | - (4th c) |
| - χάλκος (objects of) | - building | - minai only | - (4th c) |

## 4 (1) Weighed gold and silver at Epidauros

As there are no inventories in the Epidauros corpus, the evidence for the weighing of gold and silver is unusually meagre. I have found no instances of silver weighed (not even such items as foreign coin) and gold can be almost as briefly dismissed as it again is never certainly weighed. The following passages should be considered.

- B.1.84 Χρυσιου ἐς τους ἀστερας ≡≡≡ ::| that is, 64drs 1ob silver paid for the gold to gild the stars on the Asclepios temple. As is usual on this inscription no specification is given for the material used. Though this is the first commodity whose purchase is mentioned separately of the work for which it is intended, this may be no more than a reflection of the special source (? Athens) from which the gold had to be purchased.
- Ibid.103f. ἐς τος χρυσεος ἅλος πα[ρ' Ἀσκ]λαπιο δα[παναι] ἀργυριου Ἀθικαι δραχμαι ⊟⊟⊟⊟ =-. Here it is clear that Athens was the source for the gold nails cited. Usually foreign coin was avoided as it incurred a loss in terms of the exchange fee (see Appendix C), but Epidauros seems to have not infrequently handled Attic coin in its building payments (see following 4 (2)).
- B.4 Side B III.5-6. The stele here is seriously broken and the right-hand side of the inscription missing. Tentative reconstruction of Side A would suggest lines of 70-75 letters and so there is no possibility of linking at all conclusively the two entries in lines 5 and 6:

  - - - Χρυσιου π[εταλων ? - - - - -]
  ν ὅλκα :: IIIII Ἀτθικ[- - - - - - -]

  If the Erechtheum account can be compared here (IG $I^2$374.282, 289 of 408/7 BC whereas Burford dates B.4 to 370-60 BC), gold leaf was not weighed even in Athens but was sold at 1dr per sheet. However 4dr 5ob remains as a remarkably small weight ( ὅλκα is clearly read), and that it is connected with Athens (apparently Attic drs and obols) recalls the earlier purchase of gold from that city (B.1.103f).

While it is clearly too much to insist that gold is weighed in this last passage (B.4 (B).III.5-6), the use of Attic weights is interesting. No other weight at Epidauros is measured in units smaller than staters or minai. Epidauros apparently did not use either Aeginetan or local coins as weights.

## 4 (2) Coin and account

Although Epidauros had its own fourth-century coinage[54], there is no certain evidence of its use to pay building costs. Instead Aeginetan coin seems almost invariably to have been used.

Normally non-specified coin might be expected to be local. This is true for example of entries on Athenian accounts. However in several places of the Epidauros accounts it is possible to show that non-specified coin is Aeginetan. The Tholos account (B.6.39ff) notes the drawing out by the annual treasury official Python of 49 Aeginetan drachmai and 297 Corinthian; the Corinthian coin is paid directly to Kleostratos for carting stone from the Kenchreai quarry[55], but the Aeginetan can only be accounted for by the sum total of further payments in non-specified coin: 25drs (money changing) and various travel expense grants. The same point can be made for the next month's account (where Attic coin is also involved) and later for the year in which Eukles was the treasury official (B.6.90ff). One can only hazard an explanation of why for these two years the initial issue of Aeginetan coin was actually signalled so explicitly: I should suggest it was because other coinages (Corinthian and Attic) were on these occasions also involved, and so a distinction had to be made. This explanation could apply also to the single mention of Aeginetan coin on the Asklepion account (B.1.103-4): it comes immediately after the entry recording the price paid in Attic coin for the gold studs. The same argument could also account for the mention of Aeginetan coin paid to Laarchidas in the Tholos inscription B.6.122ff, although the format of the entry is considerably different[56].

Laarchidas' contract (B.6.122ff) presents a second argument for supposing most payments at Epidauros to have been in Aeginetan coin. Usual transactions would tend to be settled by the building commission in the usual coin. Hence no specification of the latter for the majority of transactions. On occasion however contractors demanded payment in specific coin[57] and the building commission generally attempted to meet such requirements. The sections of the Tholos accounts already cited indicate sums drawn and then paid out in Attic, Corinthian, and, in the case of Laarchidas, Argive coin. In this last case however not enough Argive coin was available in the treasury; only 300drs were drawn, the rest of Laarchidas' fee consisting of 2310 Aeginetan drachmai and 121 for exchanging it[58]. Somewhat similarly, a year or so earlier, the δέκατα for some Pentelic marble is given as 420 Aeginetan drachmai with a further entry of 25drs (which must now be clearly Aeginetan) for changing it in Athens[59]. In both cases Epidauros lost money through not being able to provide the required coin. It can be concluded that the coinage they used normally, and that which they provided for exchange where this was unavoidable, was Aeginetan.

Further details of Epidauros accounting can quickly be summarised. Most amounts are expressed in drachmai, dividing into 6 obols, each probably of 12 chalkoi[60]. Only rarely are high drachmai figures broken down: thus for example 5600drs become 80 minai (therefore of 70drs each[61]) on IG IV $(1)^2$ 42 of 221/0BC. Elsewhere can be noted ἀργυρίου μναν (IG IV $(1)^2$124.8) and ἡμιμναιον, the equivalent for a ἵππευς, on Demetrios' Charter (IG IV $(1)^2$68.96 - compared with 20drs for a ὁπλίτης). Talant is never used of coined or accounted sums: thus 6167drs is written out as XXX XXX 日ニニニ::: (B.1.12f)[62]. The stater, as a coin, occurs only twice, and on both occasions late: two Corinthian staters (IG IV $(1)^2$ 97.18 along with a number of Alexandrian drachmai) and a fine of 1000 staters (B.27; IG IV $(1)^2$99). Whether it is used as a weight term (and both talant and mina measure weights of commodities other than gold and silver) cannot be decided satisfactorily[63].

## 4 (3) Weighing of commodities other than gold and silver at Epidauros

The only material to be weighed as such is lead. This is measured in talants and minai, but more usually only in talants: the Tholos B.6 62f, 109f, 131f, 132f. Iron and "bronze" (χαλκος) are weighed in manufactured objects or within the contract price for work. Though it is not always possible to distinguish therefore the metal involved, it is clear that the pricing was by unit mina, and the weights expressed in talants, minai, half- and quarter-minai. Iron, for the Tholos at least, was weighed in round numbers of talants. Thus iron: B.6.65, 83, 92, 108, 112f, 114; B.18.Side A.37f (quarter-mina) and 39f (ἡ[μιωβ]ολιου see below); and "bronze": B.8.11f; but generally see also: B.6.98; B.9.Side A.70, 89f, 139, 140, Side C.96f; B.10.121f, 131f; B.18.Side A.9, 16f, 22; B.21.Side B.113f, Side D.120ff.

The weight system of talants/minai/half-mina/quarter-mina (and probably 60 minai to the talant[64]) is modified only twice. B.18.Side A.39f contains the extraordinary entry (for iron) [μν]αν πεντηκοντα ἑπτα ἡ[μιωβ]ολιου at 4drs 3ob per mina; I can only suggest that a half-mina is somehow to be read here. The item apparently weighing one or two minai and ten staters on B.7.Side A.19f (κ]αι στατηρων δεκ[α) is irretrievable.

That so little is weighed on the Epidauros building accounts calls for comment. To a certain extent this can be attributed to the contract procedure which (at least initially) included materials, labour, and subdivisions of the total job in an overall contracted sum. The Asklepios temple accounts illustrate this most clearly, and ἄλοι, βόλυμος, ἔλεφας, κηρος, κολλα, κυανος, ποσα, σιδηρος, and also χρυσιον, all appear with no specification[65]. Whether this method of contracting concealed the lack of more basic pricing methods cannot be determined. Later accounts however where they are detailed do seem concerned to attempt some sort of unit pricing, be this by weight (as noted above), by measure (πυροι, μαρμαρον, λευκ(αν)ωσις, and ξυλα), or by length (wood, stone, plastering and trench excavation). Burford's analysis of the historical development of the Epidauros contract formula regards such factors as availability of labour and funds as significant[66]; she does not consider the possibility that the earlier incomplete pricing procedure was due to lack of experience on the part of the building commissioners. In any case incompleteness of specification[67] and variation in recording procedure are largely responsible for the paucity of evidence available for discussion here.

5. LACONIA

Sources IG V (1) 1-1350 and Addendum

Comparative table of commodities weighed

| | | | |
|---|---|---|---|
| - silver weighed (?) | - state account | - talants, minai, staters | - (end 5th c) |
| - ἀστάθμις | - state account | - talants (?) | - (end 5th c) |
| - σίδηρος | - (Plutarch and Hesychios) | - πέλανορ , χαλκοῖ | - (?) |
| - σύκα | - (Plut/Dikaiarchos) | - ½ minai (??) | - (?) |
| - τυρόν | - (Plut/Dikaiarchos) | - minai (?) | - (?) |

Διὰ τῆς πολιτείας τὸ κρυπτόν[68] little can be reconstructed of weighing in Laconia and at Sparta from all the available sources. Coinage is of course ruled out by Lycurgus' law[69]. Examination of the unmarked iron spits and bars that acted as its substitute has not proved conclusive: one group indicates a system of two weights (c.73kg and c. 400gm), the one 180 times the other[70]. On the other hand there seems to be an ancient tradition reflected in late references to a Spartan weight for iron (called the πέλανορ ) and dividing into four χαλκοῖ[71]. Two obscure weights from Gythium do not clarify anything[72]. The comparative table above relies for the most part on two pieces of evidence: the contributions to the Spartan war fund (IG V (1) 1; ML 67) and those destined for the Spartan messes (Plut.Lyk.12, reflecting(?)Dikaiarchos ap.Athen. 141C). Both allow only tentative conclusions.

ML 67 lists contributions to the Spartan war effort from various states and individuals[73]. Clearly these contributions included coin; numbers of Darics are recorded at line 16 and Aeginetan staters at line 4; but this is far from clear for unspecified silver entries. Sparta

had no currency of her own; and, secondly, some sums do not look like amounts of coin. Could not these round figures of talants, minai, and staters of silver not be weighed-out amounts (9mn 10st; 32mn; 3T; 1T 30mn; 60mn) ? Would it not also be more natural for the authorities issuing the record, the Spartan, to have performed this weighing ?

The same argument applies to the entry of an amount of raisins in lines 13-14. Unfortunately here the text is in bad condition, and the measurement of this amount as a certain number of talants depends upon restoration.

Plutarch gives the monthly contribution to the Syssitia as one medimnos of barley, eight choes of wine, five minai of cheese, and five half-minai of figs per person. Dikaiarchos' version differs in details but at least confirms that a certain weight of cheese and figs was laid down: three half-medimnoi (Attic) of barley, eleven or twelve choes of wine, παρὰ δὲ τούτοις τυροῦ σταθμὸν τινα, καὶ σύκων. Though Dikaiarchos is the older source, and though Plutarch's repetitive five whole and five half minai sounds suspiciously anachronistic, it is difficult to prefer Dikaiarchos' version which continues with ten Aeginetan obols εἰς ὀψωνίαν[74].

Finally some mention should be made here of the representation of wool-weighing on the Laconian Arcesilas Cup[75]. As has already been noted however no weights are used in the scene depicted.

6. MESSENIA

Sources IG V (1) 1351-1496

No evidence of weighing from this area falls within the classical limits of this survey. Though outside these it is interesting to note the duties of the Agoranomos in Andania in the first century BC included ensuring that οἱ πωλοῦντες ... χρῶνται σταθμοῖς καὶ μέτροις συμφώνοις ὅτι τὰ δημόσια[76]. Apart from this statement however there is no reference to the performance of this function, nor to the existence of Andanian city weights.

## 7. ARCADIA

Sources IG V (2)

Comparative table of commodities weighed

| | | | |
|---|---|---|---|
| - τυρον | - official Phigalea (Harmodius Lepreates) | - 5 mina unit | - (4-3rd c) |

---

Evidence of weighing from Arcadia is restricted to part of an account by Harmodius Lepreates (of the fourth or third century BC) about the activities of the corn official at Phigalea. The amounts given compare closely with those noted above for contributions to the Spartan syssitia: οἴνου τρεῖς χοᾶς καὶ ἀλφίτου μεδίμνου καὶ τυροῦ πεντάμνουν[77].

Marks of value are unusually common on Arcadian coins, especially those of lower denominations[78]. There is insufficient evidence to suspect that this practice resulted from a general lack of local understanding of weights.

8. OLYMPIA (with ELIS and ACHAEA)

Sources Inschr. von Olymp. (1896); Pausanias V-VI; SIG$^{3}$.

Comparative table of commodities weighed

| | | | |
|---|---|---|---|
| - χαλκος | - Olympia or Sicyon (?) official inventory (exc.Paus.) | - talants | - (?? 7th c) |

---

No building accounts appear to have survived from the important sanctuary of Olympia, and very little evidence can be cited to parallel the significant (although uninscribed) weight series noted in the last chapter[79]. Interesting, if also most problematic, is the description by Pausanias of two bronze thalami, supposedly dedicated by Myron, the tyrant of Sicyon, and by the Sicyonian Demos in the Sicyonian Treasury at Olympia (Paus.VI.19.1-4). This is the only occasion in his account of the site[80] that a weight is recorded. An inscription, we are told, notes the weight of the bronze as 500T. To what date does this weight belong, and is it genuine ?

The circumstances are not promising. Myron, the late seventh-century tyrant of Sicyon, is noted for nothing beyond what Pausanias tells us here[81]. Moreover this instance of seventh-century weighing is, if we accept it, the earliest known in Greece by over a century[82]. There is, however, room to doubt the seventh-century dating of both weight and, a fortiori, weighing. Quite apart from the obscurity of Myron himself (has Pausanias read the name and inferred himself the tyrant ?), there appear to have been more than one inscription: the dedication and the weight record. Ἐπιγραμματα has a singular, ἐπιγραμμα, used, in the same section (VI.19.4), of the Myanian shield inscription; and Pausanias' careful μεν/δε of the Myron thalami inscriptions clearly makes a distinction. The weight record can therefore be put at a later, and more probable, date than the dedication.

However at a later date it is also more likely that it should be possible to give a value to the talant involved[83]. That indicated by the Olympian weights is c.27kg (the mina being around 450gm[79]). Thus 500T are an incredible 13500kg (or over $13\frac{1}{4}$ tons). Having lowered the date for the weighing of the thalami bronze to a reasonable period, we are faced with an unreasonable mass of metal for the contemporary Greeks to have weighed[84]. No Greek machine could, nor seems to have attempted to, weigh as much as $13\frac{1}{4}$ tons. The alternatives are that the thalami came to pieces (like Pheidias' statue of Athena)[85] or that the weight is fictitious. 500T is a suspiciously round figure after all.

Yet another way of making sense of 500T objects that sound as if they were fairly solid is to suppose that the 500T bronze records the amount of the metal produced initially for the making of the thalami. A parallel conveniently exists in the dedications Croesos made at Delphi, which are also those nearest in date to the tyrant Myron[86]. This explanation would moreover remove a minor difficulty - the weight record occurs on only one thalamos, the smaller, and temple inventory practice would normally have demanded that each individual object be weighed. On this explanation the round figure of 500T also becomes more plausible.

A further difficulty is whether the talants are to be regarded as Olympian or Sicyonian[87]. Transport costs must surely rule out the possibility of the thalami being constructed in Sicyon, and Croesos' gold, the nearest parallel, was moved around in ingots designed for easy handling until cast locally. It is impossible to decide therefore whether Myron measured out the bronze before sending it to Olympia, or whether, like Croesos, it was left to the sanctuary officials to perform the operation.

Speculation on this weight is unlikely to yield any firm conclusion, and, despite its importance, I can simply list at this stage alternatives that subsequent chapters must take into consideration. First, and most interesting, is to take both weight inscription and dedication as seventh-century[88]. On this view the weight refers to the amount of bronze put into the objects which can then have been weighed out in convenient (and small) units. Some sort of talant would seem likely, though there is no way of determining now what this talant was. It should not be confused at any rate with the light Homeric talant, that was restricted to gold; but some other unit could well have existed that later fell out of common use[89]. It is significant, if this

explanation is the right one, that the unit should be the talant rather than virtually anything else[90].

The other alternative explanations can be listed more briefly. Second, it could be possible to regard the weight record as later than seventh-century and to suppose that the thalami came to pieces. This would be somewhat unusual for Olympia, to judge from the rest of Pausanias' description of the monuments on the site (none of which were weighed), and it would be difficult to explain how the thalami were not weighed (as in normal inventory practice) individually. On this interpretation it would be likely that the talant involved was the talant indicated by the weights normally used at Olympia, and therefore that the thalami in fact totalled $13\frac{1}{4}$ tons in weight. Thirdly, both weight and dedication could be regarded as late, Myron being an insignificant Sicyonian official whom Pausanias misidentified with his more illustrious namesake. Again the thalami would weigh $13\frac{1}{4}$ tons, but the weight could be derived from pre-manufacture measurement of the bronze. Fourthly, the weight could be fictitious or an educated guess. Though the reason for this particular weight be obscure, the measurements of statues and of other bulky dedications was, and remains, a means of impressing visiting tourists[91].

We still therefore lack evidence for the use of the many Olympian weights. Pausanias, in the second century AD, saw no detailed inventories, and no other statues, his predominant interest, carried weight inscriptions. However in earlier times there had been significant sums of treasure on the site[92]. Our surviving records simply do not cover these.

It remains to note several inscriptions in the archaic script of Elis. Some threaten fines τάλαντον ἀργυρῶ (Inschr.von Olymp. 9.6-7; SIG$^3$9); πεντακατίας δαρχμας (ibid.4.5 cf.5.4); ϝέκα μνας (2.4,7; 3.4; cf.13.5 τριακοντα μνᾶν ; 16.4 one mina, and 16.13, five minai per day). Payment for an individual Zeuxias κα(τ) τον πολεμιον includes sums restored as 140drs and 3 minai 20drs (Inschr.von Olymp.15). The dates of these references seem to be best taken as fifth/fourth-century[93]. Thucydides (V.31.2) records a one talant fine imposed by Elis on Lepreon in 421 BC that was payable to Olympia.

Significantly no official for weighing, not even an Agoranomos, is mentioned in the first-century BC lists of Olympia officials (eg. SIG$^3$1021).

Elis as a whole (apart from Olympia) appears similarly blank. Inscriptions from Dyme in Achaea in the fourth and third centuries show sums from 65drs to 20drs expressed in an Attic fashion, including smaller elements down to 2 obols[94].

The somewhat perplexing case of the Elean "traitor" Xenias, who measured out his father's silver by the medimnos (Xen.Hell.III.2.27), is discussed below[95].

Polybios mentions as part of the constitution of the Achaean League: Νομοις χρηθαι τοις αὐτοις και σταθμοις και μετροις και νομισμασιν (II.37.10). Like the activities of the Andanian Agoranomos[96], this clear statement of intent has no witness[97].

9. MEGARID and BOEOTIA

Sources IG VII; Megarid and Boeotia sections of SEG I - XXV; SIG$^3$.

Comparative table of commodities weighed

| | | | |
|---|---|---|---|
| - silver | - temple inventory (Oropos) | - from 813 drs to obols and quarter obols (3 chalkoi) | - mid/late 3rd.c. |
| | - contributions (Boeotia) | - talants, minai | - 4th and 3rd. centuries |
| | - temple inventory (Boeotia) | - drachmai, obols, quarter obols (3 chalkoi) | - 3rd c. |
| - gold | - temple inventory (Oropos) | - "4drs" and "drs" | - 3rd c. |
| | - temple inventory (Boeotia) | - χρυσις and obols and quarter obols (3 chalkoi) | - 3rd c. |
| - fish (various named types) | - commercial legislation (Boeotia) | - minai, ½minai | - early 2nd c. |
| - ξύλις (? wood or object) | - temple inventory (Boeotia) | - uncertain (??obols and fractions or higher units) | - 2nd/1st c. |

9 (1) The Megarid

The Megarid must be left as a blank in this survey. No actual weights have been identified from the area, and the first coins, of the late fourth century, do not seem to have been struck on an identifiable standard[98]. Inscriptions refer only to international coinages and no accounts survive to give evidence of local weighing[99].

9 (2) Oropos: the Amphiaraon

The evidence relating to this shrine is somewhat ambiguous on account of the shifting control by Athens and Boeotia from the fifth century onwards. Although perhaps most often in Boeotian hands, it is best treated as a separate item here.

There are two interesting references to weighing to be discussed. In both cases only gold and silver are weighed, for, despite the existence of building accounts, the other materials used are not specified by weight. It is worth noting that Croesos' gold offerings to the sanctuary are not inventoried with the detail accorded his offerings to Delphi[100].

The first inscription, IG VII 303 of the mid third century BC, concerns the melting-down of dedications to provide new receptacles for use in the sanctuary. Detailed instructions are given for the treatment (essentially the purification) of the silver offerings, but most interesting is the requirement that coin be recorded ἀριθμῷ, and then the bulk siver σταθμῷ[101]. The record of dedications preserves the same distinction between bulk siver and coined silver: the latter is simply numbered in whatever units the coins represent, whereas the bulk silver is weighed in drachmai. From the figure of 813drs it seems that minai were not employed, and indeed the only certain evidence is for whole drachmai rather than also fractions of that weight[102]. No record of gold weighed appears in the account.

A second inscription, IG VII 3498, is dated rather later in the third century and is essentially an inventory of the silver offerings in the sanctuary[103]. This inscription reinforces the impression of the drachma unit weight derived from IG VII 303 as weights are expressed in straightforward alphabetic numerals. Below the drachma silver was certainly weighed in obols; fractions of the obol, rather than multiples of the lower chalkous unit, are to be inferred from the fact that these are noted only as 3ch, 6ch, and 9ch: that is one quarter, one half, and three-quarters of the 12ch obol[103a]. Silver was apparently weighed differently from gold: the only weight for gold reads -

τὰ ἤγαγον τετραχμα γ' καὶ [ὁ]ραχμ]ην (60-62).

Keil noted this oddity[104] and inferred that gold was therefore being weighed not by silver weights (as in Athens) but with specific gold pieces. The "4dr" does not however appear to have been a local gold

coin, nor is there evidence for the use of χρυσοῦς (though this is known for the Cabiri shrine at Thebes[105]). Nevertheless, even if the explanation be uncertain, the difference in weighing gold and silver is clear, as further the fact that coin weights were thought accurate enough to be the basis for the former.

## 9 (3) Boeotia

Actual weights from Boeotia have been discovered. The majority however appear to belong to Athens and the only one explicitly marked as local (from Lebadeia) is of the Roman period[106]. Boeotian coinage identified from the sixth to the late fourth century was on the Aeginetan standard; thereafter it included Attic "4drs" and Aetolian "thirds"[107]. One inscription refers to a"Boeotian drachma" equivalent ?? to 9ob Attic[108]. The evidence of local variations however is too incomplete to reconstruct a picture of the absolute values of weights used in the area.

The main references to weighing are to the weighing of gold and silver[109]. They bear on two general questions, and neither is at present entirely clear. First is the apparent reference to minai of silver in donations to Trophonios (IG VII 3055. 11-12) or to Thebes for the Sacred War (IG VII 2418. 7 and 16ff, from Anactorion and Alyzea respectively). Are these weighed amounts of silver (so contrasting Attic practice, and also the apparent practice in Oropos) or are they accounted sums (again a contrast with the more usual use of either talants and drachmai, or of simple drachmai)? I can at present see no way of resolving this difficulty[110], but the contrast with the more usual Greek use of silver minai as units for calculation only[111] is noteworthy.

The second main question raised is the possible difference in systems used for the weighing of gold and silver. It seems likely that whereas silver objects were weighed in drachmai, obols, and chalkoi (if not more probably quarter-obols[112]), gold were weighed in χρυσοῦς, obols, and chalkoi (or quarter-obols). This distinction has already been noted above for the Amphiaraon at Oropos in the third century BC and the Boeotian evidence is of the same date: the Theban Cabiri inventories IG VII 2424 and 2420 of the middle and late third century. In the later inventory the distinction seems clearly indicated, and all the weights are signalled

explicitly as such with the figures written out in full: gold 2ob 3ch; 1 χρυσῆς ; 1ob; 1 χρυσῆς , whereas silver 5drs; 1dr 3ob; 3ob; 3drs; 24drs 5ob 9ch (IG VII 2420). The earlier inventory uses alphabetic numerals and does not specify the material of which most items are composed. However that some gold items are listed must indicate that others were of silver. The two gold items are ΦΙΑΛΙ|ΧΡΥΣΑΒΑΝΑ (which IG read as φιαλι[κ]ὰ χρυσᾶ β' ἀνὰ Σξ]' , "two phialai, gold, of 60drs weight apiece") and ΔΑΚΤΥΛΙΟΝ ΟΛΚΗ Χ (the last monogramme being read as "χρ(υσοῦς)"). I find it difficult to accept that gold was here weighed in drachmai on the sole evidence of the awkward restorations of the first entry, even though I can suggest no more reasonable reading. The other inventory (VII 2420) does after all establish a clear distinction as already shown.

Apart from these problems the weighing of gold in χρυσῆ (even if restricted to IG VII 2420) remains evidence of the use of coins as weights in weighing. Though a weight relationship might in fact have existed, the exchange indicated in SEG XIX 335 seems based on valuation rather than weight. The reference to a silver ring in a 2nd/1st century list of dedications to the Cabiri shrine includes an obscure weight that will be considered below in connection with the possible weighing of ὁλκῆς in the same inscription[113]. Finally, of gold and silver, it can be noted that no difference in precision seems to have existed; weighing to the quarter obol in the third century is moreover comparable with Attic practice at that date.

Other commodities are poorly represented. Although building specifications survive (as for example from Lebadeia[114]), prices are only given per unit (stone) or per number (1000 letters). Whether contracts were based on the amount of material used seems in general unlikely given the vagueness of the Lebadeia formulae[115].

A unique piece of commercial legislation is however preserved in an early second-century decree from Akraiphia that specifies fish prices.[116] These prices are per mina or half-mina weight (depending upon the type and size of fish involved), and some further fraction or multiple may also have been used (to judge from the variant τὰς μνᾶς for τῷ μνᾶϊ ).

Finally there is the problematic weighing of δαΐδες in a 2nd/1st century list of dedications at a Theban sanctuary[117]. These dedications, by free and slave women, include items of jewelery that are probably (and in one instance explicitly[118]) gold or silver. Δαΐδες however are properly pine-torches, and objects, rather than a universal such as "pine-wood", are implied by the plural entry[119]. Three problems emerge: first, whether the items are real pine-torches or reproductions (ex-votos) made possibly out of silver; second, the material, if real torches are meant; and third, what is the significance of the numerical notation used in these entries on the inscription. The signs ICT\ are used for περιτραχήλιον και λῆροι, δαΐδες, δαΐς and περιτραχήλια, but HE for the one specified item, the silver ring. If the suggestion made by Tod[120], that "|" equals lob (and the other signs respectively half-, quarter-, eighth- or twelfth-obol), is accepted, then remarkably low weights result, reproducing, for δαΐς, exactly the same difficulty encountered above under Athens by taking the 4drs 2ob of the Cholargeis Deme inscription as a weight[121]. The alternative interpretation of price is not available here for Thebes as the words for weight (ἄγον, ἄγουσαν, ἄγοντα, ἄγουσας) are quite explicit. I should suggest that unless the δαΐδες in question are ornamental (silver or gold) miniatures, higher weight values should be given to the signs than those suggested by Tod. Since necklaces and rings offer no standard weight[122], and in view of the obscurity of Boeotian weights in general[123], this text must unfortunately be left as uncertain for the present.

## 9 (4) Further note on the absolute values of Boeotian weights

The deduction of absolute values for Boeotian weights might be taken as typical of the worst problems such a metrological manoeuvre involves. Actual weights found in Boeotia, all of which are late, indicate the Attic system (with a mina of around 420gm) and at least one other (with a mina of 296.15gm or 592.3gm[124]). Coins on the other hand are on the Aeginetan standard (staters of 12gm and drachmai of 6gm) down to the late fourth century, and then appear Attic-type staters of 17.2gm dividing into "Aetolian" thirds of 5.18gm. A fourth-century inscription refers to "Boeotian drachmai"; subsequently we find drachmai, obols, chalkoi, and also staters, all apparently local coin. If the 3-chalkoi unit is taken as a means of writing quarters of the obol, all but staters recur as weights for gold and silver. In addition

there is the "4dr" coin weight at Oropos (though this should perhaps be disregarded as possibly being a direct reflection of Athenian control) and the χρυσός at Thebes (though for gold only). Larger amounts of gold and silver may be weighed in talants and minai (Lebadeia and Thebes), but the only sure reference to weights higher than those of coins is the mina and ½mina units in which fish was priced at Akraiphia.

All this is to recapitulate the results of earlier sections, and at the outset the number of variations in system is perhaps disconcerting. In attempting to evaluate the Akraiphia fish prices, Feyel[125] immediately came across one further obstacle that it is necessary to set up here in order to complete the puzzle: the literary evidence and nineteenth-century metrological theory. Epiphanius defined the Theban mina as 60 staters or 2½ Roman lbs[126]; on this account it was about twice as heavy as the Attic mina of 16 oz (only much later of 12½ oz), or one and a third lbs[127]. Feyel did well to suspect whether this "Theban" mina in Epiphanius was necessarily the Boeotian[128], but was then induced by IG II$^2$ 1013, "dans l'incertitude", to settle for a weight mina of 600-800gm for the fish prices.

I wish here simply to underline the uncertainty. There is no reason for inferring any <u>weight</u> mina from the Aeginetan standard used by Boeotian <u>coins</u>. In fact in the evidence already cited there is a stronger trace of Attic weights in general; but more basically I should insist that there is no indication of any relation existing between the coin weights and the higher (talant and mina) weights. Local Boeotian measures of capacity constitute an entirely peculiar system[129], and the awkward combinations of coin names in the area should indicate the likelihood of a similar situation obtaining for measures of weight. Their absolute values are irretrievable[130].

10. DELPHI

Sources FdD III (1-6, but esp.5); SIG$^3$ 35C, 236-53, 276 (FdD superseding the major group 236-53: see Introd.I.321-50); Tod GHI 140; Herodotus.

Comparative table of commodities weighed

| | | | |
|---|---|---|---|
| - no silver weighed | | | |
| - gold | - temple inventory | - talants, half-talants, minai | - 6th to 5th c. |
| | - private dedications (probably official record) | - Darics, ½-Darics, obols, ½-obols | - 4th c. |
| - ivory | - commercial (Athens) | - Attic minai | - 4th c. |
| - στυκτήρια | - Hdt. narrative | - talants, ?minai | - 6th c. (?) |
| - σίδηρος | - temple building | - minai | - 4th c. |
| - καττίτερος | - temple building | - talants, minai | - 4th c. |

Despite the importance of the site there is remarkably little evidence of weighing at Delphi. Unlike most other areas however, weighing is mentioned in a literary account, Herodotus, that dates ostensibly from the early fifth century if it does not in fact go back much earlier.

In contrast to Olympia but like Delos, there are no actual weights belonging to the Apollo sanctuary of Delphi. Apart from a brief issue of high denomination coins around 480 BC (oddly at 18gm and 12.4gm), the earliest coinage comprised only fractions of a drachma of Aeginetan weight[131]. From 355-46 , while under the control of Phocis, the coinage

of Delphi was apparently struck on a much reduced standard[132]. The Amphictyonic revival 346-39 was accompanied by staters, drachmai, and half-drachmai on a slightly less reduced standard. References to these coin changes, with little apparent change in values, are found on the Naopoioi accounts of the fourth-century temple rebuilding programme[133]. From these accounts it is evident that, as at Epidauros, the usual silver coin at Delphi was the Aeginetan (stater or drachma). Nevertheless transactions took place involving considerable sums of Attic coin, and the accounting of the differing coinages involved raises interesting questions of conversion. These are considered in detail in Appendix C. Delphic accounting is peculiar in that sums are invariably written out in full[134]. It is clear that talants and minai are equivalent to the Attic (with 4200 Aeginetan drs to the talant, and 70 to the mina); there is no explicit reference to Aeginetan talants and minai, but, for example, 20T in Aeginetan coin are on one occasion written as ταλαντα [αἰγ]ινα[ι]ου εἰκοσι [135]. I do not feel that any implications for Aeginetan weight terms necessarily follow. It would appear that mina used for accounting was by the fourth century at least fairly established as the Attic[136].

My reason for stressing this point is that there is evidence from Delphi that Attic weight units were still considered distinct. The most impressive example of this is the account of the purchase of ivory from Athens in FdD III (5) 25.II.A.5-13. The price is given in Attic minai and drachmai and converted into Aeginetan drachmai[137], but the weight is also given in Attic minai : ἐλ[ε]φαντα ἐπριαμεθα [δρ]|υρακοσιον (?) ὅλκα ἀττικου [μν]|αι ἑνενηκοντα τρεις. I can see no reason for the specification of Attic minai here unless they were different from Aeginetan (or unless no proper Aeginetan weight mina existed). The twenty Aeginetan talants (noted in the last paragraph) are not comparable because there, as in other parts of the present account, coined amounts, in Aeginetan coin, are involved.

Since the ivory was bought in Athens and with Attic coin, the fact that it was weighed in Attic weights clearly rules it out as evidence of weighing in Delphi[138]. The evidence that exists can now be considered. First can be noted the fact that there is no reference at all to the weighing of silver. It is remarkable that while Herodotus shows that the gold crater given by Croesos was weighed, the measurement of the silver version is given as 600 amphoreis, measures of capacity (Hdt.I.51.2). In the fourth-century temple rebuilding accounts sums not in Aeginetan

coin are converted mathematically into this coin or are left as separately accounted coin.[138a] This contrasts the Attic procedure which was to weigh together all non-Attic coin as bulk silver.

There survive several widely separated instances of the weighing of gold. The first is the celebrated account by Herodotus of Croesos' offerings (Hdt.I.50.2 - 51). Unlike the gifts sent to the shrine of Amphiaraos, for which Herodotus supplies no details[139], the Delphic treasure is carefully measured in a manner which strongly suggests that Herodotus' source was a temple inventory, or a number of them. Although these inventories cannot be dated much before Herodotus' own day[140], they indicate, at least through Herodotus' transcription, that an earlier inventory had been made before the great fire of 548 BC: Croesos' lion apparently had lost 3½T when moved to the Corinthian Treasury after the fire[141]. These earlier records seem to have included detailed measurements both of length and capacity as well as of weight; they also distinguished between different qualities of gold (ἄπεφθος χρυσος and λευκος χρυσος). The gold items are as follows:-

- 117 brick-type ingots (Diod.XVI 56 gives the total as 120, but Stein Herodotus ad loc with diag. justifies Hdt's figure, arguing that the bricks formed a plinth for the lion) each measuring 6 x 3 x 1 palasta; 4 were of pure gold, weighing 2½T each (Τριτον ἡμιταλαντον ἑκαστον ἑλκοντα ), and the remaining 113 of "white gold" (electrum) weighed 2T each ( σταθμον δικαλαντα ).
- Lion, of pure gold, weighing 10T ( ἑλκουσαν σταθμον ταλαντα δεκα ) This subsequently lost 3½T ( ἑλκων σταθμον ἑβδομον ἡμιταλαντον· ἀπετακη γαρ αὐτου τεταρτον ἡμιταλαντον).
- Crater, weighing 8½T 12M ( ἑλκων σταθμον εἰνατον ἡμιταλαντον και ἐτι δυωδεκα μνας).

My reason for thus citing these figures in full will be apparent from the last item, the crater, where speculation is invited on whether the formulae indicate how in practice the weighing operation was performed[142]. Another difficulty is of course whether the weight of the crater can be assumed to have been 8T 42M: it is not certain how many minai there were to this Delphic talant. The measurements are apparently local since, as I have argued, they are taken from local Delphic treasury accounts[143], but no direct proof exists that there were 60, 50 or 100 minai to the talant in the local weight system at this date. This point is pursued tentatively a little further in the additional note at the end of this section on Delphi.

I shall not therefore enter into the traditional controversy that has surrounded the validity of Herodotus' weights for the gold

bricks. Using modern estimates of the metrical terms (for both length and weight), scholars have complained that the weights given are much too low[144]. Attempts have been made to rectify this situation by postulating exaggeration in the tradition[145], hollow or in some sense non-dense bricks[146], or even revised measurements[147]. The fact remains however that there is no evidence of absolute weights for the period in question, nor any coinage from which they might even be inferred[148]. Indeed the very difficulty posed by Herodotus' figures is itself on the contrary a powerful argument for my thesis that such early weights were extremely variable. Thus it is remarkable that Pearson should note at the outset of his discussion "We may assume that, in reporting information from Delphi, he [Herodotus] would speak of the Euboic talant: the traditional equivalent for this talant is 57.75 lbs avoirdupois (for the present instance it is not worthwhile arguing over the exact figure)..."[149].

Unfortunately no further record survives of these items until they were melted down by the Phocians in the fourth century[150]. Nor is there any record from Delphi of the weight as weighed there of Eriphyle's gold necklace, which had once been kept at Delphi[151] and is said to have weighed 156drs when later inventoried at Delos[152]. Although Herodotus had no obvious reason for mentioning this necklace, it can however be doubted whether such a small object would have been weighed at as early a date as his. The large weights of sixth-century date (talants and half-talants) are only reduced to minai units on the early fifth-century weighing. This contrasts greatly with the precision (or at least with the low units used) of later gold weighing. As the date of the weighing of Croesos' offerings is so early, and close on the introduction of coinage, it can reasonably be doubted whether smaller weights (first minai, and subsequently drachmai) were yet available, or were yet correlated with the higher units. This important question will be discussed in Chapter V below, for the present I should note that this passage of Herodotus affords the earliest historical reference to the Greek use of weights[153].

Of similar date to the revised weighing of Croesos' lion is an inscription recording an offering weighing 50T 7M : SIG$^3$ 35.C. The script is Syracusan and the text has been restored and interpreted to refer to the dedication of a tripod and gold Victory by Hiero in 474/3 BC (after the raising of the siege of Cumae)[154]. Certain problems lie in the association but it does seem fairly certain that the inscription is Syracusan and of early fifth-century date (by the lettering).

That the weight is the weight of gold is independently confirmed by comparison with Herodotus' weight of 8½T 12M for Croesos' crater and by the absence of evidence of the weighing of other metals at Delphi[155].

[ἡμιφορον δ Δεινομε]νεος ἀνθεκε [:] πεν-
[τεκοντα ταλαντα] ἑπτα μναι.

A further difficulty is whether the weights are Syracusan or Delphic. This can best be resolved in favour of the latter (and despite the fact that the lettering is Syracusan) for three reasons: Sicilian talants were very small, and yet this dedication supposedly immense, and Sicilian talants subdivided into litrai and not into minai[156]; the weighing of gold in talants and minai is known (from Herodotus) to have been characteristic of Delphi in the early fifth century; and, finally, it is reasonable to assume that a weight record of this type was meant to be understood where it was displayed, and the inscription in question was located in Delphi[157].

Later evidence for the weighing of gold at Delphi reveals a very different approach. In the 330's Samians dedicated two gold crowns and their weights are recorded on associated inscriptions as 20½ Darics ½ obol and 20 Darics 1½ obols (SIG$^3$ 276 A and B)[158]. Even though these inscriptions are private, it seems reasonable to argue that the weighing of gold in Darics and obols was by this date standard Delphic procedure; similar dedications in Athens are not weighed in these units[159], and, though the evidence for Samos itself is lacking, Delphic public accounts of this period do recognise the Daric as a unit of account. This is perhaps obscured by the conversion of Darics in FdD III (5) 58.5-8, but Darics are the basic unit of the weight of gold in SIG$^3$ 253 II.5-12 (which possibly concerned the remaking of Croesos' craters) even if a further conversion into silver coin weights was made on that occasion[160]. Gold Cyzicene staters and Rhodian (gold ?) drachmai are on the other hand not converted on the records of contributions to the temple rebuilding programme[161]. The reading ὁλ[κα ΗΗΓΔ]Δι on the Daric account FdD III (5) 58.6, which would disprove my contention here, has been replaced by ὁλ[υμπια]δι on independent grounds[162].

References to the weighing of other commodities must also begin with Herodotus. Towards the rebuilding of the temple in the later sixth century Amasis and the Greeks in Egypt are said to have contributed 1000 talants of alum (στυπτηρια) and 20 minai (presumably also of alum)[163]. These facts are given by Herodotus in a narrative account

of the difficulties Delphi was experiencing in raising funds for the rebuilding, and it is therefore unlikely that they come from any authentic contemprary record[164].

With no evidence from the fifth century, the next to be considered is that of the fourth-century accounts. These show weight measured (in talants and minai) of two metals only. Iron ( σίδηρος ) is weighed in the form of nails (SIG$^3$ 245 I.69-73) or as γόμφοι and δέσμαι (FdD III (5) 27 II.A.5-7, 10-14; II.B.9, 13; and FdD III (5) 35). Tin (κασσίτερος ) is weighed for transport from Kirrha to Delphi on FdD III (5) 25 I.3-6.

Note on the possible use of literary evidence to consolidate the fifth-century picture

A tentative argument can be advanced towards the reconstruction of the procedure for weighing gold and silver in Delphi in the fifth century, while at the same time preserving some distinction between the manner in which each metal was weighed. The argument hangs on the influence access to the official Delphic accounts had upon Herodotus' approach to the weights of gold and silver when he came to record these at other parts of his history. In favour of a strong influence are (a) the fact that he did have access to these official records as also to local Delphic officials[165]; (b) that he used these sources with careful attention to their detail[166]; (c) that the fifth-century use of minai as well as talants for gold is corroborated by the Hieronian dedication; and (d) that Herodotus went to the lengths of converting gold into silver for his overall total of Persian tribute (III.95). It is this last point which gives rise to this additional note because academic totalisation of this sort is precisely that found in (and peculiar to) fourth-century Delphic accounts. If the same procedure was already used in the fifth century then there is some likelihood of it's being the decisive influence on Herodotus in III.95. Given this position, two inferences can be made from Herodotus' account of the Persian tribute and be applied to contemporary (fifth-century) Delphi: (a) silver was accounted in Euboic talants (of 60 minai), and (b) gold was accounted in the different (though weight-related) system of Babylonian talants.

I do not wish in any sense to force this argument. There are many alternative hypotheses, and a more reasonable one could well be that Herodotus was influenced by Delphi to record weights, but that he derived his conversion figures and Babylonian standards from Halicarnassos. My reason for advancing the argument however was to explore a possible way of using literary evidence to bridge the gap that exists in the epigraphic record of fifth-century Delphi. Herodotus is a particularly difficult literary source as he was so widely travelled. A more satisfactory use of such literary evidence is in the indication it gives of general Greek attitudes to weighing (rather than of specific weight values), and these will be analysed in subsequent chapters.

11. NORTH GREECE

Sources IG IX $1^2$ (Aetolia, Acarnania, W.Locris); IX 1 (Phocis, E.Locris, Corcyra etc); $_3$IX 2 (Thessaly); X (Macedon, Epirus, Thrace, Scythia); $SIG^3$218 (Pleket no.7).

This area furnishes no literary or epigraphic evidence of weighing that might be added to the scattered finds of weights already listed in the last chapter. I should perhaps note however the record of sales in the Tauric Chersonese c.200 BC that Tod interpreted as expressed concurrently in two sorts of money (gold staters followed by silver drachmai)[167]. I have not yet systematically examined the fourth-century inscriptions from Olynthus. The Olbia coinage decree ($SIG^3$218) refers to the use of electrumn bronze and silver coinage in the fourth century; although exchange rates are given in detail, no reference is made to weight and it might be doubted if this bore any relevance to the rates given[168]. Finally should be noted the activities of Callistratus in Macedon in the early 350's, although the economic aspect of these is frequently over-exaggerated[169].

12. DELOS

Sources IG $I^2$ 377 (Tod 54; ML 62); IG V (1) p.xx no.1564 (Tod 99); IG $II^2$ 1633-53 (Athenian versions; 1635 is Tod 125; the most important Delian text is BCH 10(1886)pp.461-7 of 364BC and this supplements the others); for Delos Libera the texts are numbered consecutively through ID and IG XI 1-2879, of these 1-509 have been read in detail for the following section, 510-1349 appear not to contain suitable material and the remainder date from after 166 BC; of the many texts also included in $SIG^3$ note especially 975 (ID 509; Pleket no.10; Larsen ESAR IV.352ff; Schulhof and Huvelin BCH 31(1907)46-93).

Comparative table of commodities weighed

(a) Early period prior to Athenian administration

| | | | |
|---|---|---|---|
| - λιβανωτος | - Hdt. narrative | - talants (? wt) | - early 5th c. |

(b) Athenian administration 5th-4th cc.

| | | | |
|---|---|---|---|
| - silver | - temple inventory | - talants, drs, obols, ½obs | - 5th/4th c. |
| - gold | - temple inventory | - (talants), drs, obols, half- and quarter obols | - 5th/4th c. |
| - χαλκος | - temple inventory | - talants | - 5th/4th c. |

continued over...

(c) Delos Libera 314 - 166 BC (refs. to the consecutive series ID/IG XI)

| | | |
|---|---|---|
| - silver | - temple inventories (also contracts: 199.67ff, 83ff) | - talants (high drs exceptional on 161.B.17), ½talants, minai (only composite weighings), drs, 3ob (½dr) |
| - gold | - temple inventories | - drachmai, obols (fractions of the obol are legacies from the Athenian period)<br>- χρυσον, drachma, obols (442 B.120ff. and 443 Bb.41ff only) |
| - ἀσφαλτος | - inventory | - talants, minai (320 B.68) |
| - ἔβενος | - inventories | - talants, minai (298 A.113; 320 B.68; 442 B.165 etc) |
| - ἐλεφας (as tusks) | - commercial purchase | - talants, minai, half- and eighth-mina (priced per T on 203.71); usually only minai (and priced per M as on 163.7 and 287.118) |
| | - inventory | - minai (287 B.74; 298 A.181 etc) |
| - καττιτερος | - inventory | - minai (320 B.66; 442 B.170-1) |
| - κηρος | - commercial purchase | - minai (165.26; 175 Ab.11; 182.6) |
| - κολλα | - commercial purchase | - minai, ½mina (290.237) |
| - λιβανωτος | - commercial purchase | - ½ and ¼mina (287.43, 73) |
| - λιθος | - inventory | - minai (203 B.99) |
| - μιλτος | - commercial purchase | - minai (165.26) |
| - μολυβδος | - commercial purchase and (mixed with iron) inventory | - talants, ½talant, minai (153.13; 163.36; 203.34, 52, 71; the inventory is 372 B.36-7) |
| - ξυλα | - commercial purchase | - talants (passim) |
| - πορφυρα | - commercial purchase | - minai, ½mina (159.23; 203.73) |
| - πυρων | - commercial purchase | - minai (444 B.107) |
| - ῥητινη | - commercial purchase | - minai (165.7) |
| - σιδηρος (objects) | - purchase and also inventory | - talants, minai. ½ and ¼minai (passim for fractions see 287.115 and 444 B.105 purchases) |
| - χαλκος (usu. objects) | - purchase and also inventory | - talants, minai, ½minai (the last only in purchases) |
| - ψιμυθιον | - commercial purchase | - minai (165.25) |

## 12 (1) Note on early Delos

No inscriptions appear to have survived earlier than the fifth-century accounts which relate to the Athenian administration of the sanctuary. Nevertheless it is clear that Delos had reached a fairly advanced stage of development before this period. It emerged from the Dark Ages as an Ionian religious centre[170]; Athenian representatives attended gatherings; but the first direct involvement in the island by Athens was not until Peisistratos' purification[171]. Even at this point Athenian control was not sufficiently strong to incline Datis against Delos in 490 BC[172] although the Delians themselves seem to have suspected that it might well have been. No local objections are mentioned in connection with the establishment of the Delian League and with the use of the island as its base in 478/7, nor also as a result of the subsequent removal of the League treasury to Athens in 454.

It is difficult therefore to set a date for Athenian control of Delos. Early building did take place and it is likely that other commercial activity was dictated by the religious gatherings there. Herodotus' report that Datis offered 300 talants of incense ( λιβανωτος ), which was burnt on the altar in 490 BC, may suggest some form of local accounting that included weighing; the huge amount involved however would indicate either that the story was apochryphal or that the 300 talants were a valuation rather than a weight[173]. The possibility of a Delian weight system differing from the later Attic of the surviving evidence may tentatively be supported by the identification of an Aeginetan standard behind the earliest coins[174] and by the vestiges of certain metrological peculiarities (the wood and charcoal weights and measures) that will be considered in the next part.

## 12 (2) General indications of relevance to Greek weighing

The vast majority of the Delian accounts and inventories lie outside the chronological limits of this survey, and might therefore legitimately be excluded. However these accounts form as a whole the most detailed and continuous series that has survived from ancient Greece, and contain several particular pieces of evidence that are directly of

fundamental importance to the general picture of weighing in the classical period. Although the direct evidence may not therefore be relevant, I have decided to give some space here to the Delian series as a whole in order to bring out these important elements. The particular problems they generate will mainly be discussed in detail in later chapters.

(a) Reference to specific commodity weights. The late third-century decree ID 509 (Pleket no.10) mentions ξυληρα σταθμα and ἀνθρακηρα μετρα. Evidence exists of the special charcoal measures in other inscriptions; these show the material measured in καλαθοι, ἡμικαλαθιον, and ὀγδοημορον (203 A.59; 161 A.109); it is even priced per καλαθος-unit. Wood (be it generic ξυλα or more specific κρανεια etc) is weighed and priced only in whole talants[175]. The question therefore arises of whether this wood-talant is a local weight with local value. It is interesting in this context to note that a bronze weight is listed in 269 BC as 1½ talants[176]; if Athenian silver talants are understood then the weight is several times heavier than any surviving Greek weight; a smaller value to the talant could make better sense of the bronze weight which then should be interpreted as a wood-weight and not a weight for bronze. As wood was weighed elsewhere only in talants (for example at Eleusis), the possibility of a wood-talant may be generalisable[177]. A difficulty remains in the plurality of these ξυληρα σταθμα.

(b) Reference to the use of public weighing machines (ID 509; also the Temple Builders' accounts 287 B.142 and 442 B.27) and also reference to the use of weighing in practical contexts (199 A.90, a contract of 274 BC, ἀποσκησαμενοι μετα του ἀρχιτεκτονος και των ἐπιμελητων). Further there is direct evidence of the use of these scales in conjunction with actual weights: the so-called "wood-weights" mentioned above.

(c) Discrepancies are noted between actual and inscribed weights in a temple inventory of 279 BC (ID 161 B.107-14). The implications for accuracy and precision are discussed below and especially in ch.VIII.

(d) There is evidence that numbered coin drachmai were incorporated into the same account as weighed drachmai of silver: ID 199 A.67f κηρυκειον ἀργυρουν... ὁλκην ΔΔΗΗΙΙΙ· ἀποδομεν τας τε ΔΔΗΗΙΙΙ και τομισθον δραχμας ΗΗΗ; ibid 83f, a contract for a silver-plated τραπεζα. This is naturally related to the next point.

(e) The use of coins as weights to weigh other articles is also indicated by the Delos accounts. This emerges most clearly in ID 287 B.142f (c. 250 BC) τῶν ἑστηκότων ἐν τῶι ζυγῶι τῶι ἐλαττονι τῶν ἐν ἀγορανομίαι πρὸς ἀργύριον Ἀττ(ι)κὸν ὁλοσχερές ... [178]. Less explicit, but comparable, is weighing simply πρὸς ἀργύριον in ID 298 A.161; 427.12; 439 a.81-2; it possibly is also implied by the weight given in ἀργυρίου δραχμῆς in 199 B.73. The phrase πρὸς ἀργύριον ἑστάθη also occurs in the fourth-century accounts (IG II$^2$ 1643.5 and BCH 10(1886) 461.20ff) and raises several further questions: were all drachma weights calculated with coins as weights; what coins were used; what consistency exists in the absolute values of the weights terms (taking the higher units of minai and talants, which are clearly not coins, as multiples of coin base units) ? These issues will be pursued in later chapters, but it must be admitted here that many of the questions raised (especially those concerning absolute values of the weights used) do not present any obvious solutions.

## 12 (3) Weighing at Delos: a general survey

Against the wealth of evidence of weighing at Delos (in the fourth to second centuries) must be set the fact that there is a virtual total blank of actual surviving weights identifiable from inscribed legends[179]. This applies both to the Delian series proper, but also to other series, and in particular Attic, that might well be assumed to have been used there[180]. The only weights surviving from Delos are accidentals, of scattered origins, and not at all likely to represent Delian practice. The contrast with measures of capacity, where the Delian series of 58 sekomata is by far the largest series from any single Greek state[181], is extraordinary. The lack of weights is further remarkable given the unusually large number of references to actual weights in the inscriptions themselves[182]. The use of coins as weights, already noted above, may to some extent explain the lack of smaller weights, and it is also possible that the explicit reference to weights on inscriptions was a result of the weights mentioned not being at all usual: special wood weights but not others[183].

No less a block to the interpretation of weight values at Delos results from the small, but significantly non-Attic weight, silver coinage. Head assigns to the whole period from the end of the fourth century to the first a series of 3gm"drachmai"and their halves, which he describes as on the "Rhodian" or "Ptolemaic" standards[184]. It will be remembered of course that when the Delians used coins as weights on ID 287 B these coins were specified as Attic. Can it be inferred from this that the practice of using coins as weights was in fact not Delian but Attic on the grounds that the Delians were not here using their own coins ?

The general use of Attic weights is partially confirmed by the small differences apparent in the accounting and inventory procedures between Delos under Athenian control and Delos Libera. From a comparison of the fourth- and third-century accounts[185] the following points can be underlined:

(a) Accounted silver coin. In the Athenian period high sums were expressed in talants as well as in drachmai[186] whereas only drachmai occur in the subsequent independent period: for example IG XI (2) 287 A.198f κεφαλὴ ΓΜΜΓΧΧΧΧΗΗΙΙΗΓΗΗΧ. The return of Athenian control after 166 BC is marked by the resumption of accounting in talants as well as drachmai. This observation applies to Delos even though the practice at Athens itself (see above) was not quite as consistent.

(b) "Precision", in terms of the lowest weight units used in recording weight[187], is noticeably higher in the Athenian period. In that both silver and gold were weighed to the ½ obol[188], whereas the only ½-obol weights mentioned in the Delos Libera accounts are those inscribed on objects[189] weighed earlier in the Athenian period. Where the later Delian officials were able to check these earlier weight records it is revealing that they should have preferred in every instance to correct the weight to whole drachmai, or at the most to ½ drachmai[190]. I prefer to interpret this as a move towards greater accuracy on the part of these later officials for it seems to involve a recognition of the limited predsion of contemporary weighing techniques.

(c) There is a marked increase in the range of commodities weighed by the third and second-century officials. For the earlier Athenian period only χάλκος is weighed (in talants only) other than gold and silver[191]. The increased range of the later Delos Libera may however be an artificial result of more detailed accounting procedure. It is difficult to be sure that any significance lies, for example, in the fact that πέταλα χρυσᾶ were not weighed by Athens (Tod 125.36-7) but were by Delos (ID 385 g.5f). The wood-weights, however, do appear to have been peculiar to Delos (ID 509).

As the evidence for the weighing of these various commodities can be incorporated in the summary list at the head of this section, I shall not repeat it here. Instead I shall conclude with some comments on the weighing of gold in χρυσοῖ. Usually gold was weighed in drachmai like silver, on ID 442 B.120ff (cf.443 Bb.41ff) of the first half of the second century we find however several χρύματα weighed as follows: τὸ πρῶτον χύμα, ὅλ.χρυσοῖ ΓΔΔΔΔ καὶ Ͱ ; (second) χρυ ΓΔΓIIIIϹ (the last sign indicating ½ χρυσοῦς rather than its equivalent 1dr); (third) χρυ ΓΓ καὶ ͰIII ; (eleventh) χρυ Γ ὀβολοὶ ΓIIII . This is an inexplicable deviation from normal procedure, and in the same inventory the next series of χρύματα is weighed in drachmai only (ID 442 B.124ff). Another variation, which is probably one of weighing, occurs in the inventory records of the notorious necklace of Eriphyle. In ID 161 B.42 this is described as χρυσοῦς ὅλκην δραχμαὶ ΗΓΓͰ but in 199 B.58 the entry reads ὅρμον τὸν τῆς Ἐριφύλης ἀριθμὸν χρυσιῶν ΗΔΔΓIII. No other item is altered in this manner, and the insertion of ἀριθμόν here is very disquieting if weight is involved. Subsequently the necklace appears ἄστατος (ID 223 B.21; 287 B.18)[192].

13. AEGEAN ISLANDS

Sources IG XII and Supplement; Paton and Hicks (for Cos).

Comparative table of commodities weighed

| | | | |
|---|---|---|---|
| - σαρξ | - sacrifice regulations (Lesbos) | - minai XII (2) 498.16f | - end 3 c. |
| - τυρον | - sacrifice regulations (Thera) | - staters XII (3) 330.180f, 186f | - c.200 BC |
| - silver coin | - honorary (Ios) | - ? (no wts.given) XII (5) 1010.5ff | - 3rd c. |
| - ὑς | - arrangements for feast (Amorgos: Aegiale) | - mina XII (7) 515.64 | - end 2 c. |
| - gold and silver | - temple inventory (Imbros) | - drachmai, obols, half and quarter obols XII (8) 51 | - 2nd c. |
| - general cargo (?) | - commercial legislation (Thasos) | - talants XII Supp.348 (Pleket no.9) | - late 3 c. |

The evidence from this area that I have so far collected does not justify detailed analysis. The majority of the references included in the above comparative table are late. To them can be added the following notes.

Samos. The two late fourth-century dedications of gold crowns at Delphi, though made by Samians, have been argued above to relate to Delphic practice: SIG$^{3}$ 276 A and B (see above ch.III.10). The crowns sent by Samians to Athens were inventories by the local (Athenian) temple officials: IG II$^{2}$ 1437.20 and 1643 II.89f.

Amorgos (Aegiale). City loans specify repayment in coin described, along with other adjectives, as ὁλοσχερῆς: IG XII (7) 67.9-11, 56; 68. 11; 69.22. The implications of this adjective, apparently meaning "of full weight", are discussed below in ch.VII 1 (3).

Thasos. Some estimate or measurement of weight is implied in the regulations for ship anchorage, based as these are on cargo weight. It is not clear how this might have been assessed. Although I have included the item in the comparative table see below under ch.VII 2 (12).

Euboea. Mention should be made of the tantalising digramma asking those in charge of stores on the island to weigh and measure everything that can be weighed and measured for inventory purposes: ὧν μέτρον ἐστίν, ἀναμετρησάτωσαν ... ὧν δὲ σταθμός, ἀναστησάτωσαν IG XII Supp. 644.4-6 (second century BC). There is no indication however either of what might have been involved in either category or of the weight system(s) that were to be used. No inventories have survived. Personal inventories are considered as a special context for weighing below in ch.VII 1 (5).

Although lists could be compiled of accounting systems and local coinages, it seems useless to include these where no positive light is shown by them (by contrast or by explanation) on weighing practice.

14. CRETE

Sources Gortyn Code (Willetts); SIG$^3$.

No evidence of weighing has yet been systematically collected. For weights see the brief description in ch.II 1 (2).III- [Crete]; for discussion of the third-century coinage decree (SIG$^3$ 525) see Appendix E.

15. WESTERN CREEKS

No reliable evidence has yet been systematically collected.

16. EASTERN GREEKS

I have not yet examined systematically the evidence of weighing in the Greek cities of Asia Minor or further east. Each city in effect presents special problems of the degree to which its weight systems are independent or the result of fusion with surrounding non-Greek systems. These near-eastern systems, and the attitude to weighing that accompanied them, will be shown in a later chapter (IX) to be basically very different from those of the central Greek area. For this reason I feel that a cursory glance at the Eastern Greeks can be at this stage justified.

Halicarnassos. It has been suggested that prices recorded on the fifth-century sales inscription SIG$^3$ 46 are in silver coin of two different weight standards - "Phoenician"drachmai and "Babylonian" staters. The distinction is indicated by the use of acrophonic numerals for the former and of the early Carian alphabetic system for the latter (Keil Hermes 29.249ff; the stater is mentioned in full on the earlier inscription SIG$^3$ 45.38 [ML 32 and Tod 25]). There is no substantial local coinage to confirm this suggestion (Head HN$^2$ 616). More significant would possibly be the fact that the two sorts of coin are accounted together; if they were on close, but different, standards this would be further evidence of lack of concern about small weight variations in coin.

I have raised above (under Delphi in this chapter) the unlikely possibility that Herodotus' method of describing weights was derived from his native city.

Miletus. CIG 2855 (Boekh) appears to be a third-century or later inventory of gold and silver items in the temple of Apollo. While silver objects were weighed in drachmai (especially Alexandrian, but also Milesian in lines 19-20, and Rhodian in lines 33-4: the range presenting a typical East Greek puzzle), the gold were weighed in χρυσοῦ (lines 25-31 especially). This inscription therefore offers evidence both of the use of coins to weigh, and of different systems used for gold and silver weighing.

Persian tribute in Hdt. III.89.2 - 95. The principle stated at the outset of this account is that gold and silver were weighed in different weights (respectively in Euboic and Babylonian talants). Herodotus provides a conversion factor (89.2 needing emendation)

which he then uses to present a total of the tribute (gold and silver) in terms of Euboic silver talants (95). Two main observations can be made:

(a) All the Greek areas involved are said to have paid straightforwardly in silver talants: the Greek cities of Asia Minor, Egypt, Cyrene, and the Black Sea. None of these areas need therefore be supposed to have handled the common conversion from gold or silver.

(b) The conversion is made by Herodotus for his own readers; it is therefore an exercise he felt he had to make and not one that he could leave to his Greek readers.

Monetary agreement between Mytilene and Phocaea IG XII (2) 1; Tod 112; Pleket no.6 (early fourth-century BC). This decree is discussed below in Appendix E. It is remarkable that no reference to the weights of coins is made in the regulations it supposedly enforces concerning the amount of gold in the electrum coins of the two states.

17. CYRENE

Sources SEG IX.1-795; XX.703-780 and note Tod BSA 37(1936-7)255-7 on numerals.

Comparative table of commodities weighed

| | | | |
|---|---|---|---|
| - silver (??) | - mercenary payment (?wt) | - talants, minai | - 4th c. |
| | - Lex Sacra | - drs, obols | - 2/1 cc. |
| - σκορδον | - temple (?) admin. | - talants | - 3rd c. |
| - κρομμυα | - ,, | - talants | - 2nd c. |
| - σταφις | - ,, | - talants | - 2nd c. |
| - συκα | - ,, | - talants | - 2nd c. |

If the Laconian who painted the Arcesilas Cup had in his mind a type of scene he had seen in Cyrene we might with some confidence feel that no weight system was used there in the mid sixth century for the weighing of wool: no weights are shown and wool is simply weighed against wool[193]. Nor have any actual weights apparently been found on the site. The evidence of weight systems can only be sought in the coinage, the numerical system, and the few late inscriptions from the area.

The coinage of Cyrene as it is traditionally interpreted represents a mixture of as many as three different weight standards: "Euboic-Attic", "Phoenician", and "Rhodian" (this last restricted to the third century and later)[194]. These standards have been identified in coins of Cyrene from the earliest phase (sixth-century) onwards; they range moreover over gold, silver and electrum coin without apparent distinction in type marking either denominations or standards. The problems of the use of Greek coinage are therefore extreme in the case of Cyrene[195]. But so also is the difficulty of accepting that the people of Cyrene made any conscious distinction between the standards on which their coins were struck.

The "acrophonic" numerical system of fourth and third-century Cyrene is unique and most obscure. The accepted solution proposed by Tod[196] obscures I believe one of the salient features of the system, which is the repeating sequence (upwards) >Z[≥, and his identification of minai and drachmai can therefore be suspected. Sums are it is true frequently introduced by "M" and in at least one inscription the full form "μνᾶν" also occurs[197], but there is no evidence for "drachmai" until the second century (when all sums are expressed in large numbers of drachmai only)[198]. "M" could on the other hand be read as "Σ" for "stater".

Examination of the relationships between the symbols led Tod to deduce the following sequence, which I should in the main follow: "Δ" one fifth of "—" one half of ">" one fifth of "Z" one half of "[" one half of "≥" one fifth of "X" one fifth of "—" one fifth of "Π" one fifth of ">" one fifth of "Z" one half of "[" one half of "≥", with a further symbol "H" larger than ≥≥[>> , and also (below "Δ") "|" and "⁘". If the repeated series that I noted above are maintained as series with similar relationships, then it would appear that the symbols represent three main weight series; moreover, if "H" is allowed as intermediary between "X" and "≥" (low), though not a round multiple of "≥", a certain regularity emerges. I should suggest:

lower unit ">" - multiples "Z"(5); "["(10); "≥"(20)
- fractions "—"(½); "Δ"( δέκατον tenth); with uncertain "|" and "⁘"

middle unit "H" (50 x lower) - multiples "X"(2); "—"(10); "Π"(πεντηκοντα 50)

upper unit ">" (100 "H" and 5000 lower ">") - multiples "Z"(5); "["(10); "≥"(20)

Alternatively the middle series could be regarded as fractions of the upper: thus in descending order "Π" (half upper ">"); "—" (tenth); "X" (fiftieth); and "H" (hundredth). This only properly suits "H" (ἑκατον μερος ? ).

If this reconstruction is correct it does not take us very far. It would however be sufficient to show that the weight system did not follow the normal Greek pattern of 60 minai units to an upper talant unit. There are I feel grounds for suspecting that Cyrene, on the fringe of the Greek world, maintained an incompatible weight system even in the late Classical period. The origins of the system, and of the complex coin standards, most probably could be sought in the Near East (Egypt or, if fairly late, Persia).

The remaining evidence from Cyrene, the inscriptional references to weighing, is briefly reviewed. Several items appear in measured amounts in lists of agricultural produce: priced by the talant are σκοραδῶν (SEG IX 33.6-7; 35.6-7: both third-century), and then later σταφίδος and κροκμιῶν by inference from ὄυκων (on SEG IX 41.22: second century). The only reference to measuremental weighing is somewhat uncertain. A second or first-century Lex Sacra lists individual ποτηρια and δικοτυλα with their weights of 1dr 2ob and 2ob respectively in all cases (SEG IX 73). Although the formula used might normally leave no doubts about the involvement of weighing ( ἐὰν δὲ ποτηρ[ι]ον ἕν, δίκης ⊦-- ), the consistent weights look more like specifications. The fourth-century inscription recording the distribution of spoils of war SEG XX 716 mentions round figures of talants and minai: it is not clear whether these are counted coin sums, nor of what metal.

## Conclusions

Detailed conclusions from the copious Attic evidence have already been drawn above[199]. Here I wish to comment on one or two general features of the evidence that may point towards what is to be discussed in the following chapters. The main function of the survey is to provide a place for assembling the bulk of evidence for later analysis. This evidence is often inconclusive, and at present it is incomplete, the variation in coverage being more significant than that the periphery of the Greek world (the Western and Eastern Greeks) has been largely omitted. In looking for the ways in which Greeks reacted to weighing it would be premature to attempt to distinguish the several layers of influence from surrounding civilisations in these outlying areas[200].

One significant result of this survey concerns chronology. Apart from three references to early weighing, none straightforward[201], nothing antedates the fifth century[202], and most useful detail, apart from the Attic, does not antedate the third. Much of this later evidence is too far removed from the essentially classical limits of this thesis that I have not included it here. The lesson for the use of weighing in classical Greece will be drawn below. The lack of pre-fifth-century material in particular can be compared with the evidence of actual weights assembled in Chapter II. I believe it is also related to the fact that coinage only started in Greece in the late sixth century. It is certainly not simply a question of insufficient documentation though this argument has often been used.

I shall pursue this point further in Chapter V. Here I wish to insert a brief note on the earliest literary evidence, so far unmentioned for lack of a suitable geographical location, the Homeric. Although they hardly amount to a "system", Homeric weights point

directly to two features of later Greek weight systems. These I shall consider subsequently, they are: the association of particular commodities with certain weights, or even weight systems; and the particular interest in weighing precious metals (the later, post Homeric, coinage).

The Homeric weight system is simple to state, although difficult to incorporate in any general picture of the development of Greek weights[203]. The only weight term Homer uses is the talant (divided on one occasion to the half-talant), and he only uses it of gold[204]. This restriction appears not to be accidental as other commodities that might well have also been measured by weight are in fact measured by much more devious means. Thus silver bowls are measured by their capacity in lists of prizes also containing talants of gold[205]; the similarity with the way the craters donated by Croesos to Delphi were recorded may not be accidental[206]. Again, in Homer a lump of iron, its own prize in a later contest, is described as "enough to keep a man in iron for five years or more"[207]. Perhaps to be included here are also the prizes for the archery contest, ἴσα τὰ σίδηρον, described as δέκα πελέκεας and δέκα ἡμιπέλεκκα[208]. Comparison can be made with the bronze-age double-axe bronze ingots that some have argued to be weight standards but which might equally be regarded as shaped units irrespective of whether the sense was one of volume, weight, or even function.

The evidence I have collected from the historical period clearly shows no such consistent pattern of weighing. The question should therefore be raised as to whether there were in fact several systems, carefully distinguished in antiquity although now obscured by the chance survival of our evidence, or whether the inconsistency that can be noted reflects rather the reverse, a lack of proper systematisation. This is perhaps to put the problem rather too crudely, and there may well be some element of truth on both sides. Certainly some systems can be isolated and be shown to have been applied fairly consistently; but equally there is evidence even in late classical periods of ad hoc weight terms and doubts can be raised on occasion about whether weighing in fact accompanied certain entries of weights on inscriptions[209]. As the coverage presented by the evidence is so incomplete, the best way to approach the problem here will be to isolate areas of common systematisation and of clear differentiation. The problem can therefore be considered under four headings : context, state, date, and commodity.

(a) Context. The greatest consistency emerges, as would seem natural, within authorities (temple officials or building commissioners of a certain temple or building operation). This is best illustrated by the Athenian material (qv). It should be noted however that variations exist between different authorities even where engaged upon the same operation (for example over whether to weigh other commodities on the same system as gold and silver, or indeed over whether to weigh them at all). Secondly, variations appear within a single authority depending upon the operation involved: thus gold can be weighed in talants, drachmai and obols for inventory purposes but in staters (and on occasion numbered simply in gold-leaves) in contexts that appear to be commercial. Much of this variation could be ascribed to variation in accounting procedure and need not imply necessarily that there was any significant variation in weight sy stems; however even the question of whether or not to weigh can I believe be indicative when it is a matter of variations in date and in the treatment of different commodities. It can be noted finally that there is clear evidence of a difference between commercial and non-commercial weight systems. This is apparent not only from the explicit ἐμπορικὴ μνᾶ of the late second-century decree IG II$^2$ 1013; it is also borne out by comparison of the systems for commercial and temple-inventory weighing in classical Athens[210].

(b) State. That different Greek states operated different weight systems is immediately, and not at all controversially, established from their variant coinages. Whatever the reasons for the different coin standards and systems in ancient Greece[211], these differences are recognised as being not simply differences in nomenclature. Contemporary inscriptions bear this out in specifying "other" coin as such, even when the coin term (drachma or stater or obol) might exist in the local coinage, and in totalling non-local coin as bulk-silver (weighed) where local might simply be counted.

Coinage I believe became a crucial factor in the standardisation of higher weights and in their systematisation[212], but even apart from this considerable evidence exists to show that weights such as "talants", "minai", and in particular "staters" could vary between states. Sicilian talants, Egyptian talants and minai, Babylonian and Euboic talants, are all named in contemporary sources (rather than in the later metrological writers) in a manner that presupposes variation. At this point however we should recognise the limitations of the

evidence. Where weights are not specified, are they necessarily local ? More significantly I should raise the possibility of commodity-defined weight terms: gold talants as opposed to wood talants, just as gold staters are not the same as staters of cheese or iron. Alongside this point however is the possibility of gradual standardisation over the classical period towards the "commercial" systems of the late second century.

(c) Date. Several changes can be noted during the chronological range of the evidence that has been assembled. Early weights, and especially the very earliest (from Delphi and possibly from Olympia), are in talants only. The first low units are used of gold and silver, and for a considerable period are disconnected from the units used to weigh other commodities. This is precisely the pattern of the actual weights (I am thinking here essentially of the only full series, the Attic) which begin with staters and fractions of staters, including the third which cannot be expressed in drachmai. Eventually minai are introduced (in Athens first as a term of account for silver) although the use of staters does not immediately cease. This process, which I have greatly simplified here[213], cannot be simply attributed to the development of standardised accounting procedures: it is too general and is a development towards a simpler procedure which, if available, should plausibly be expected to have been used at the outset. Part of the evidence undoubtedly consists of the increase, not simply in the precision, but in the actual decision to weigh (and record) more commodities other than gold and silver. Thus again the commodity appears as the key to detectable variation in weight systems.

(d) Commodity. Obscured by variations in accounting procedure, by the differences between the weight systems of different states, and by a gradual overall systematisation in time, the relationship between commodity and weight is nevertheless appreciable. It is surely of great significance for the origins and the development of the eventual non-commodity-related general Greek weight systems. Over the following chapters I shall show that Greek weighing was basically not concerned with absolute measured weight so much as with rough amounts of commodities, counted out in multiples of an agreed (or understood) unit. Such a unit need not have been constant outside the particular transaction, and need not have been part of any general weight system although in so far as it could presumably be divided simply into halves it could

perhaps be thought of as a sort of mini-system in itself. One such commodity, silver (with gold), was the first to provide a precise and officially-recognised series of such units in system form: coinage. From this basis I should suggest a wider system developed that incorporated the varied range of other ad hoc and formerly disconnected commodity units.

The relationship of weights (and rudimentary weight systems) to particular commodities is difficult to establish conclusively. To most of the observations that follow here there exist objections and alternatives that are independently perhaps quite valid. The evidence is clearly not decisive; equally however it is not sufficient to justify any of these possible alternative explanations either; the general weight of the evidence is definitely in favour of the reconstruction I am suggesting and many supporting arguments can be drawn from independent consideration of the Greek attitude to weighing. Many of these arguments are presented in subsequent chapters but their anticipation here has seemed desirable in order to clarify the direction of this thesis as a whole.

First should be placed the simple observation of differences in the way different commodities are weighed. In the Athenian accounts[214] gold and silver are, virtually without exception (and even though these exceptions are of course significant), weighed in talants/drachmai/obols whereas other commodities are weighed only in talants ( ξυλα , μολυβδος and στροφος ), or in talants/minai ( καττιτερος , χαλκος ), or in staters only ( μαλτος, κολλα ταυρεα, πιτυα , τυρος , σκορδοι ) or minai only (? χαλκος , but certainly ἑλεφας ). Similar variation can be seen later in Delos[215] , and there the most immediately noticeable distinction lies between commodities priced and/or weighed in (talants)/minai and those handled in staters. This distinction belongs to a period when two minai seem equivalent to the stater, and the only explanation for the distinction would appear to lie in the weighing having developed from a period when the basic units (mina and stater) were not so readily compatible. The alternative explanation, that different commodities might more conveniently be handled in one or the other of these amounts, is difficult to sustain for the actual commodities involved.

Second, I have already observed variation in handling different commodities - whether they are weighed, measured by volume or length, whether numbered, or whether not subjected to any such control at all.

As this sort of variation can occur within single inscriptions as well as over time and different contexts, it is most likely to be a reflection of the lack of standard accounting techniques and so should not be over-stressed here. However it is very apparent that there is a sudden rise in the range of commodities weighed in the late fourth/early third century. If, as I am suggesting, other commodities had originally their own peculiar ways of being handled, if the weights involved were not initially standardised, it is possible to explain the apparent lack of records of their being weighed and also to resolve the contradiction with the evidence (such as the Arcesilas Cup) that shows clearly that these commodities were weighed in the early period.

A further inference from the growth of the number and variety of commodities weighed in the late fourth century onwards is that it was only by that date that the weight system, on which they were then weighed, was becoming general and sufficiently standardised. Just as Homer and the early Delphians did not weigh silver, though they were happy to weigh gold, so the later Greeks took a certain amount of time before they were ready to use the silver and gold weight systems to weigh other commodities[216].

Third, explicit evidence does exist of commodity-related weights. It may seem odd to call such weights systems, but as has been said above small mini-systems probably developed from earlier scattered weight units[217]. Most obvious are the gold and silver weights: the Homeric gold talant[218], and the specific coin weight terms, especially the stater. More interesting perhaps are the wood weights attested for third-century Delos[219]. These might be simply weights for weighing wood, differing from other weights of a standard system only by their being specially reserved for wood weighing; but such an explanation is surely unconvincing: the same site used special measures for charcoal, and evidence of wood weighing in many other parts of Greece suggests that the units in which it was done (invariably "talants") were somehow peculiar. Three further references can be added here to the above discussion under Delos: Aristotle De Caelo 311.b.3-4 ταλαντιαῖον ξύλον; Hultsch SM sv. τάλαντον gives references to a ξύλικον τάλαντον in both Alexandria and Antioch[220]; a talant of wood is also mentioned in the Hittite Law Code[221]. If it were not for the Delian reference to wood weights, there could be some justification in suspecting that the wood

talant was in fact a shape, the word being related to the balance beam[222] and the weighing of heavy pieces of wood apparently a cumbersome and improbable process. Such a suspicion may however be entirely in order for explaining the origin of the later weight unit. Other shape terms become later weights: for iron have been noted the Homeric πελεκεες and ἡμιπελεκκα[223], Greek tradition associated also the obol (derived from spits), and their handful the drachma[224]; lead is inventoried on one occasion in Athens in κρατευται, which may well conceal a similar shape-based weight unit[225].

These terms are relatively few in number. I prefer however to wonder how even these few have survived. The reason I suggest lies in the relatively late date of general weight-systematisation. Up to such a date such terms as have been assembled need have had no proper weight status: they may have been reproduced by weighing machines, but they were not conceived of as themselves measured units, as so many drachmai any more than as so many grammes.

Fourth, capacity measures offer a striking parallel to the commodity-unit origin I am suggesting for Greek weights. I have already referred to the charcoal measures of Delos; to this can be added olive-, vinegar-, pickle-measures as well as the semi-generalised wine- and corn-measures established by the fourth century[226]. In addition there exists a host of container terms that were apparently treated as measure-terms, and I am not meaning solely the central kotyle/amphoreus... series[227]. The similarity with what appears to be the case for Greek weights is striking; but the fact that both weights and measures underwent a similar form of development is only reasonable.

Fifth and finally, I should observe that the variable absolute values of such terms as talant and stater, both of which are derived from the actual process of weighing[228], are a strong indication of the absence of overall systematisation at an early stage in the development of Greek weighing. This is underlined by the application of these varying terms to different commodities even within a single state.

The preceding observations greatly clarify the problem of the development of Greek weight systems. The essential feature of this development was I believe the gradual widening of the number of

commodities weighed by a single system. This was a process of simplification that probably derived from official interest in one particular set of ad hoc weights, namely those represented by coinage and used also for the weighing of the precious metals of coinage, gold and silver. Thus my final conclusion here concerns the degree of interest focused on the systematic weighing of these metals. It was evidently widespread and is well attested over the longest period. One explanation is obviously that weighing would be the most natural way of measuring these metals, and such measurement was needed in view of their being valued. However this explanation overlooks the crucial difference between the simple single weight unit (of Homeric gold weighing) and the system of related weights (which is first found with the subdivisions of Greek gold, electrum and silver coinage). Why Greek states took the step of subdividing their coinage is very much open to speculation, but will not be pursued further here. This subdividing however was the basis of the eventual development of the gold and silver weight system into one which could include other commodity weights.

Some comment should be made here on the variation between the weighing of gold and of silver although I remain uncertain of the implications, if any, of this variation in later classical times. Homer, as has been noted, knew only of gold weights and resisted applying them to silver; the Delphians did exactly the same with the dedications of Croesos. One can only speculate whether the fact that the Egyptians had special weights for gold is relevant here[229]. Later Greek practice was not consistent. Gold and silver, though weighed similarly in Athens and other places, were handled differently in Boeotia (both Oropos and Thebes), in Miletus, and in Delos; the commercial market at Athens also made a distinction[230]. The deciding factor appears to have been the availability of gold coin. It is clear that coin, both silver and gold, was used to weigh; it could be counted and so included simply with other weighed amounts of the metals where totals were required; in third-century Delos (silver) coin is explicitly mentioned as used in this manner. I shall return to the question below in Chapter VIII on the accuracy of Greek weighing; meanwhile in the next two chapters I shall pursue the close relationship between coinage and the development and origin of Greek weights and weight systems.

chapter four

# ABSOLUTE VALUES AND STANDARDS

Introductory

If the weight systems of Greeks varied, the same is also true, and to a wider extent, of the absolute values associated with these terms. The problems in deducing standards from extant weights were discussed in chapter II above where I assembled this evidence and concluded that it was first essential to consider how the contemporary Greeks described their weights (ch.III). I shall now return to the question of absolute values and discuss the evidence for weight standards. Recent attempts have been made to sort the extant weights into several distinct though related standards on the basis of scattered indications in 4th-century or later evidence: especially Arist. Ath.Pol. 10 and IG $II^2$.1013. One suggestion, that coin weights were related to silver weights in a certain ratio, can relatively simply be disproved; but considerable evidence of absolute weight variations remains. This I set out and then consider another modern suggestion that a commercial standard existed (at least in classical Athens), officially fixed in relation to the coin weight standard, which will contain these variations. This suggestion, as the first, is untenable as the sole official weight standards of classical Greece were coin standards.

## 1. Official weight standards and IG II$^2$ 1013

Official control and standardisation of weights would appear to have been minimal, and unless coinage can be included there is no clear classical evidence of official reform or specification of weight apart from the stamped weights that have survived. Though there obviously must be gaps in our evidence, that we only hear of coinage reform cannot but be significant, especially if no mention or interest seems especially paid to coin weights even in these references. The implications of this general silence about weights properly belong to a later part[1]; here however I shall assemble and discuss evidence for the official control of weights. The question I shall hope to answer is whether this official control was (as I have just suggested) solely confined to coinage, or whether there existed (from the outset or established in course of classical period) clearly defined and correlated weight standards (and systems) of several commodities.

This question is controversial, and to illustrate this we must briefly look beyond the classical period to IG II$^2$.1013 and modern theories. This inscription is an Athenian decree of the end of the 2nd century B.C. specifically concerning the establishment of new weights and measures together with regulations on their use and safekeeping[2]. While the sections on measures are important (being the first standardisation of wet and dry measures as I believe, though these both are distinct) they do not concern us here as the type of reform indicated for weights is of a different order. This consists in raising the commercial weight mina from 138 to 150 coin drachmai, with further increases in higher weights (lines 29-37, 54-56).

There are several difficulties in details and the text of the inscription is properly suspect. The phraseology is precise if unusual (29-33):

ἀγέτω δὲ καὶ ἡ μνᾶ ἡ ἐμπορικὴ Στε[φανηφο-
[ρου δραχ]μὰς ἑκατὸν τριακοντα κ[αὶ] ὀκτὼ προ[ς]τα σταθμια τα ἐν
τῳ ἀργυροκοπίῳ [κ]αὶ [ζ]οπ]ὴν Σ[τε]φανηφορου δραχμὰς δεκα δυο,
καὶ πωλε[ιτ]ωσαν πάντες τἄλλα πάντα τὰν[τηι] τῆι μνᾶι πλὴν

ὅσα πρὸς ἀργυρίον διαρρηδὴν εἴρηται πωλεῖν, ἑστάντες τὸν πῆχυν
τοῦ ζυγ[οῦ] [ἐσόρ]ροπον ἄγοντα τὰς ἑκατὸν πεντήκοντα δραχ[μὰ]ς
τοῦ Σ[τεφανηφ]όρου κτλ..

"Stephanephoros drachmai" seem securely identified now with New-Style coinage bearing the wreath of victory.[3] On phraseology details see elsewhere discussion of weighing vocabulary and technique[4]; here it is clear that a change is being made from an ἐμπορικὴ μνᾶ of 138 to a new one of 150 New-Style coins (the ῥοπὴ is an additional weight, here of 12 drs)[5], an increase of about 1/12. Difficulties arise from the prescribed increases in higher weights, and from an ambiguity of whether these increases are in old or new minai (for drachmai are only used in this case quoted). The text gives as it stands:

| | | | |
|---|---|---|---|
| ἐμπ. μνᾶ | ... | 138 + ῥοπὴ of 12 St.drs | → new mina 150 St.drs. |
| ἐμπ. πέντε μνοῦν | ... | ῥοπὴ ἐμπ. μνᾶ | → ἐμπ. μναῖ ἓξ |
| ἐμπ. τάλαντον | ... | ῥοπὴ 5 ἐμπ. μναῖ | → ἐμπ. ταλ. καὶ 5 ἐμπ. μναῖ |

The last column clearly expresses weights in old ἐμπορικὰ measurement (or coin for the first) and it is more likely that the ῥοπαὶ similarly are in the old (unaltered) mina of 138 drachmai rather than 150. This makes proportional increase easier, but still the 5-mina entry is wildly wrong, being closer to an increase of 1/5 rather than that of 1/12 which holds for both mina and talant. Expressing the table above in Stephanephoros drachmai:[6]

| | | |
|---|---|---|
| mina | 138 + 12 | = 150 St.drs. |
| 5 mina | 690 + 138 (+150 if new) | = 828 (840 if new) St.drs. |
| talant | 8280 + 690 (+750 if new) | = 8970 (9030 if new) St.drs. |

The final figures should be (assuming mina : 5 mina : talant ratio or subdivision to be constant) 150, 750, 9000 Stephanephoros drachmai. While it is possible that the contemporary Athenians were not worried by this inaccuracy, it is hardly slight; it is rather more appreciable than the change proposed by the reform of 138-150 Stephanephoros drachmai mina itself; and must be a mistake. Indicative I consider is the list of weights deposited for safe-keeping on the Acropolis at ll. 54-56:

ἀνατιθεσθω δὲ καὶ εἰς ἀ]κρόπολιν σήκωματα τοῦ τ[ῆ]ς ἐμπορί[ου
[ταλαν|το]υ καὶ δεκάμνου καὶ δίμνου [καὶ μνᾶς] καὶ ἡμιμναίου
καὶ τα[ρ]τημορίου ...

Pleket inserts Καὶ πεντάμνου after δεκάμνου in view of the problematic lines earlier, but I feel that it is better instead to read δεκάμνου (l.33 and for πεντάμνου ) and ἑνδέκα (l.35 for ἓξ ) whereby the 1/12 increase is preserved throughout the reform.

The more import implications of the decree do not however hang on these detailed problems of its application. In the first place the text proves the existence of a commercial weight system, ἐμπορικὴ μνᾶ and τάλαντον alongside the coin weights; and secondly, in so far as a change is proposed from 138 to 150 (the way ῥοπὴ of 12 drs is expressed), there was obviously a commercial weight system for some period before this inscription, itself equally (if not more precisely) officially defined in relation to the coin weights. The problem is how far back this concept of an officially-defined commercial weight system goes. There is no direct evidence as I believe to solve this question, but recent attempts have been made to reconstruct Solon's reform as described in Arist. Ath.Pol. 10 and to argue that a commercial weight system was recognised in Athens from the early 6th century (or at least from the beginning of coinage)[7]. Although I cannot precisely settle the question of when the 138 drachmai commercial mina was officially first instituted (or earlier set ratios), I think it possible to show that this cannot have been before the end of the classical period, and is most likely to be near IG II$^2$.1013. It therefore probably is no earlier than the 2nd century B.C.

2. Official differentiation between coin weight and its metal

The first point is that there is no distinction made ever in the weights of coin and the metal coined by Greek authorities; variations that do occur are variations of context, of terminology, but not of weight. Several arguments can be used in support of this point, and I shall leave to last the most controversial, namely Arist. Ath. Pol.10, whence springs much of this problem.

2. (1) IG II$^2$ 1013 itself sharply preserves a distinction between coin and other commodities, but silver is to be weighed in coin weights not commercial weights. 1.32. πλην δσα προς ἀργυριον διαρρηδην εἰρηται πωλειν. As late as the 2nd century B.C., when a commercial weight system was officially recognised, this then is virtually explicit evidence for no distinction operating between coin weights and silver weights.

2. (2) IG XI 287.B.129-143 is a mid-third-century Delian inventory of 76 broken vases (from the Andros treasury? 287B87) that are fully described and then weighed: ταυτα ἐστησαμεν ἐν τῳ ζυγῳ τῳ ἐλαττονι τῳ ἐν ἀγορανο|μιῳ προς ἀργυριον Ἀτ(τ)ικον δλοσχερες, και ἡλκυσεν συν τοις πυθμεσι και τοις ὠσιν τοις ἀποπεπτωκοσιν δραχμας [X]ΗΗΗΔΓ ΙΙΙΙ (142.3). This entry is unique, both for weighing of fragments and for detailed description of how it was done. The vases can be presumed to be of silver, and the passage is clear indication of the use of coin as silver weights.[8] The ~~description~~ description, not the practice, can be seen to be unusual from the following.

2. (3) Accounting procedure at Athens, though showing some variation between weighed silver and accounted coin, generally does not distinguish between them and on occasion simply combines totals derived from the different procedures. This argument holds for all classical accounting, and of later periods, and is also the general practice at Delos; it amounts to further corroboration of the inference already made above that silver (and on an earlier agreement also gold) was weighed in the same units as coin, if not actually by means of coins as weights.[9]

The only differentiation of weight from coin is by some phrase such as σταθμον, ἧγον, ἑλκοντες etc. (apart from the description of an article itself). In the late 4th century it is true that χαλκοι appear in sums of money accounted[10] but is not, I should argue, normally a weighed amount[11]; however this is patently not a silver weight. Other differentiae are more conventional than fundamental - thus sums over 6,000 drachmai are always, if weights, expressed in talants and drachmai (while both simple drachmai and talants + drachmai occur for accounted coin[12]); minai sometimes occur in accounts, usually to express a proportion, but never for silver (or gold) weights[13]; finally staters appear on occasion for gold coin and also apparently for gold weight, the contexts are different and I shall argue that the coin term was used to denote a coin type (rather than was accepted as weight) and that the weight came from commercial context, and was anyway not to be equated with the coin term. Variation outside the official context (as in accounts) may of course still be officially controlled.[14]

A common, unitary system is surely implied by the format of Athenian accounts and inventories, that frequently reduced everything that could be weighed or counted to drachmai and obols. Exceptions to such a thesis are of course numerous and should be recognised:

- Gold and silver were usually weighed separately, these figures being entered into the account without conversion and with no possibility of combination: thus inventories usually - and only in the 4th century were gold separated from silver objects etc: Athena inventories 374/3ff (Ferguson, Treasures of Athena 11ff).

- Requirements of inventory or account frequently did not demand total reduction to silver drachmai , in particular gold coins are numbered, for examples: Eleusis a/c 408-406 B.C. IG $i^2$.313-314; Other Gods 429/8 B.C. IG $i^2$.310 and the notorious 74 Lampsacus and 27 1/6 Cyzicus staters of the Parthenon building accounts carried forward from the beginning to the end of the operation (see ML.59 note on p.163). Much also is simply described with the phrase ὀστατα, or less.

Nevertheless the impression is that where a total figure was required (when officials handed over a total account at the end of a year perhaps) it could well have included figures from weighing silver, from converting weighed (or numbered coin) gold, from numbered silver coin (either received or paid out):

- The Treasurers of Athena (late 5th century) were concerned to hand over with full and detailed accounts of receipts and expenditure. In 409/8 they counted gold coin (converting them x 24 into silver drachmai), as well as weighed uncoined gold in drachmai (converting by a factor of 10 or 11) SEG X.233 (IG $1^2$.301.b) especially 90ff.

  Earlier in the same account silver is listed in what can be restored as foreign coin and uncoined silver (weighed) 11.74-79 and Attic coin (numbered) 80ff.

  Presumably all totals, gold and silver would be combined into an annual figure such as was handed over, perhaps to them, χρυσιο καὶ ἀργυριο κεφαλαιον (end IG $i^2$301.A.63).

  Of course 409/8 was an unusually varied year for payments by the Athena treasurers (See Ferguson, Treasurers of Athena, ch.III.16-37, but esp.23); but, whether through a lack of Attic coin, or of the ability to disburse embarrassing sums of gold (electron) or silver bullion, such problems were overcome without comment by simply weighing such as could not be counted.

- Eleusis inventories and accounts of 408/407 B.C. set side by side ἀργυριον ἀσημον και ξενικον ὁμου (which must have weighed the 504 drachmai given) and ἀργυριον ἐπισημον (presumably, as usual, counted in Attic coin to 1 tal. 974 drs 1 ob): IG $i^2$.313.56-58. The statement of income and expenditure that ends this inscription does not seem related to either of these figures.

- Similarly on the 4th-century Aesculapius accounts can be found, on a continuous list, drachmai sums that are counted money offerings and weighed sums. Thus ἀργυριον συμμεικτον στἀθ= ΗΗΗ IG $ii^2$.1533.9 (340/39 B.C.). This is not however an account only of silver, but gold entries appear also, e.g. 1.19 χρυσιον στἀθμ : Ι — .

– Surely the most specific evidence for the point being made here is on an account entirely in silver, of the offerings at Ἥρως Ἰατρος that were melted down and remade into a silver oinochoe (IG ii$^2$.839, 221/0 B.C.). The details of this account are worth examining in some detail (lines 80ff):

| | | |
|---|---|---|
| From offerings: | silver drachmai (numbered) | 18drs |
| | weight of τυποι | 116drs |
| | weight of φιαλη | 100drs |
| | total ( κεφαλαιον ) | 234drs |

The weights of τυποι and φιαλη are expressed in drachmae (ΗΔΓΡ and Η ), but from κεφαλαιον it is clear that these weights are simply added to the total account from coins numbered. What follows is more interesting:

| | | |
|---|---|---|
| Debit: | ἀρέστηριον (decreed earlier) | 15drs (money) |
| | weight loss (through melting) | 12drs |
| | cost of inscribing stone | 8drs 3ob |
| | work (to make the new jug) | 12drs |
| | actual weight of jug | 183drs 3ob |
| | total debit | 232drs |
| | remainder ( λοιπον from 234drs above) | 2drs |

Although the officials concerned were scrupulous enough to donate the 2 drachmai remaining back to the temple, their arithmetic in the expenditure sum is faulty (if the recorded figures are accepted), as the total should be 231 drachmai. I suggest that the discrepancy has arisen either from variations in the weights of the silver coin involved in the operation[15] or from the successive weighings.[16] What is interesting however is that, despite these discrepancies, the officials adhered to their single account (even to the extent of fabricating a total to coincide with the fact of the remainder , 2 drachmai).

It is unfortunate that no operation comparable to that described by this Ἥρως Ἰατρος account is recorded in earlier classical inscriptions, but the assumption that earlier system differentiation would be less, rather than more, extensive is surely justified.[17]

2. (4) The problematic Arist. Ath. Pol. 10 is discussed in detail in Appendix D. The interpretation recently put forward by Kraay (Studies

to Robinson (1968) 1-9) most closely affects the present argument, as he argues that the passage establishes a 5% difference between coin weights and silver bullion weights, that Kraay believes was intended to cover mint costs. A special arrangement built into mint procedure need not affect the more general context in which I am maintaining there was no difference between coin and silver weights; but it is somewhat unlikely in view of the arguments already put forward for states (in accounts etc.) drawing no distinction between the two. The cost of minting could be more naturally expressed in terms of drachmai weighed or minted (5 in every 100 if Kraay's 5% figure is reasonable; or perhaps "a mina in the talant" to reflect the more usual Greek phrasing and suggest a somewhat lower charge), such would be a simple and obvious way of levying a fee, and I can see no reason to introduce the complication of different coin and silver weights for this purpose (which is what Kraay claims for Arist. Ath.Pol. 10). Kraay's interpretation appears unsatisfactory on other grounds (noteably that mina and stater cannot properly be applied to coinage weights) and the passage, in my opinion, cannot support the hypothesis of dual weight standards either silver/coin (as here discussed) or other commercial weights/silver.[18]

3. Variation in the absolute values of Greek weights

Though silver weights and coin weights may not vary there is evidence for variant weights in classical Greece. This evidence forms the basis for the mistaken view that this variation was officially controlled; but while I shall show subsequently that there was no classical equivalent of the ἐμπορικὴ μνᾶ or ταλάντου of IG ii$^2$.1013, it is important to establish first that there were commercial weights in the earlier period, as long as by "commercial" is understood no more than non-official or used in commerce. This discussion follows on therefore from the position reached at the end of the last chapter where I isolated varying systems of weights associated with different commodities and contexts. The immediate question is what variation attaches to the absolute values of the system-terminology involved: though it is not difficult to show this variation to be extensive, a precise statement of absolute values of the weights themselves cannot be usefully attempted.

The limitations of the largely inscriptional sources used for the establishment of weight systems are obvious. These records are both unrepresentative in that they are largely official accounts, only occasionally reflecting directly practices of general commerce, and uncertain in their variable methods of describing weights and purchases. Thus no guarantee attaches to conformity or variation, and it is far from possible to argue that the unique reference to weighing against full-weight Attic coin on IG XI. 287B precludes the practice elsewhere,[19] just as it is unwise to assume that all references to staters or talants are necessarily to identical weights on the Eleusis accounts. The lack of sufficient (and consistent) specification on Greek building inscriptions is a well-known obstacle to price interpretation,[20] and it is just as relevant to the attempted use of the inscriptions I am making here.

Limitations of a different order surround inferences from those weight systems that can be derived from these inscriptions. If wool is always weighed in talants, where silver is weighed in drachmai and talants, is this not partly, if not totally, a reflection of the relative values of these

commodities, and the bulk of material ordinarily involved in each case? This is a very valid and fundamental objection to the immediate inference of absolute weight variation from variation in weight systems (i.e. in terminology) as the units for bulkier and cheaper commodities are likely to be higher than for the less-commonplace. While recognising this objection I think the evidence (at least within a single state - such as Athens) sufficient at least to justify a doubt that the smaller units are necessarily compatible with these larger ones; as well as showing variation in similarly named units themselves. Inter-state variation is more problematic, and a different argument must be used.

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Discussion of weight systems above brought out three pieces of evidence of absolute variation in weights inside a single city (Athens). Firstly, Αἰγυπτια ταλαντα and μνας[21] clearly and explicitly differ from other unspecified- or coin-weights[22] of the same name. Secondly, from examination of the internal structure of the weight systems analysed it emerges that στατηρ has two values (at least): of gold, in IG II$^2$ 1496, equivalent to 2 drachmai, and of other materials, on the Eleusis accounts (IG ii$^2$ 1672 etc), equivalent to 1/30 talant, or 2 minai. On neither occasion is στατηρ specifically distinguished, and natural suspicions must arise for other occurrences of the term, as also for other terms, granted the chance specification of the unique Αἰγυπτια ταλαντα κτλ noted above. Thirdly, there appear to have been special wood-weights. This inference is based on ξυλικον ταλαντον which, though admittedly late, coincides rather too well with the invariable weighing of wood in round talants.[23] Κρατευτης could be added here if it is a weight unit, however unspecified, and derived in practice from the old iron spits rather than a shape unit (as πετηλα for gold).[24]

How is this weight variation, attested to an unknown but nevertheless undoubted extent, to be described? The results of chapter III on weight systems show variation in these systems according to commodity and context (authority, inventory, commerce or official building accounts); standardisation is only apparent for silver and the ad hoc contexts of particular authorities. Given the official nature of our sources here, the variations

noted can be agreed to be particularly significant. Variation on the other hand could be said to be least where inside the exclusively official context of official inventories and accounts (where the system for silver is extended to other commodities) and to be most noticeable between this context and those involving outside dealers (general commerce). The operation of this outside activity cannot be illustrated from inscriptional evidence. Variation in the absolute values of the weight terms just discovered is less helpful; but it does show (and this is about all that can be deduced) that variation in weight-term value occurs only in what I am calling the commercial sector, and not within the official.

Athens is the only state for which detailed analysis can be attempted, and even there the results are not particularly exciting. The tendency to conformity in official inventories, and on the weights of silver coinage, does appear to contrast with the tendency to variation outside this context and in the weighing of other commodities. Several other considerations encourage a belief in this absolute variation of weights outside those of coinage.

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Connected also with the evidence discussed in the last chapter on general weight systems is the absence of any evidence of exchange rates between states. The exchange (or conversion) of coinage was of course commonplace; rates apparently were derived from the standard weights of coins involved, even though an open market existed and exchange fees could vary.[25] The degree to which these rates were fixed is directly demonstrated by the extent to which conversion was done (especially in the fourth century where the evidence is full) without recourse to weighing at all.[26] Conversion of weights other than coinage is another matter: and I can find no example of such conversion taking place. Closest is the purchase by the Delphi temple authorities of 93 minai of ivory; but this was purchased in Athens, with Attic coin (for which the Delphians paid heavy conversion fees), and the weight is expressed in Attic minai (ὅλκα ἀττικοῦ [μν]αῖ ἐνενήκοντα τρεῖς)[27]. Obviously there was no absolute need to convert the amount of ivory into local weights, and the force of the negative argument is limited to this extent. A slightly earlier Delphi parallel is however interesting, for when the Apollonians donated some barley to the rebuilding programme of the temple at Delphi this was to be subsequently resold for cash and an account produced. My understanding of this account, FdD.III.5.3 (Tod 140) 80ff, is that the

Apollonians claimed to be giving 3000 medimnoi of barley; these measures however were smaller than the local medimnos-measure and are thereby labelled "Pheidonian" prior to conversion into 1875 Delphic medimnoi. The point of interest here is that the proper exchange rate, evidently 8Appollonian : 5 Delphic, is most unlikely to have been expressed in such terms and the assumption is virtually unavoidable that the 1875 Delphic-medimnoi figure was achieved by actual measurement (particularly as they were to be sold off on the spot)[28]. That the same applied to weight "conversion" is an equally likely possibility.[29]

Delos in the 3rd century was a centre of Greek trading, and might reasonably be expected to have been able to handle set variations between local weight systems if these existed. However it is from Delos that comes our most explicit evidence of commodity-defined weights, to which must be added Delian insistence on the use of official measures and even weighing machines (Pleket 10 ; ID.509)[30]. While indicating that weights (and measures) of commerce even at this late period were greatly variable, these regulations hardly support the thesis that these variations were perhaps standardised.

While many equivalences are given by contemporary and later historical writers, these again are virtually without exception equivalences, relating coin weights to each other. Herodotus' controversial equation of the Babylonian talant with 78 Euboean minai is not about general weights simply because the Babylonian weight was general,[31] but because the Euboean talant (of 60 minai) was the recognised upper limit of the contemporary silver coinage of Athens.[32] More explicitly all Aristotle's many remarks about West Greek weights were made in the context of describing the coinages of these areas.[33]

Again I do not wish to overstate my argument. The evidence is largely negative, but the absolute silence surrounding the conversion of any special weights of one state (other than coinage) is confirmation at least that if such weights existed they were not sufficiently recognisable to be converted. A further qualification is that one must consider as rare the occasions where such conversion could take place, especially where traders were neither nationals nor of one particularly community.

To return briefly to the initial point of this last section: the varying weight-systems of different states. Outisde Athens, as has been noted, the evidence is virtually non-existent till the fourth century and even then, with the exception of Delos, Delphi and Epidauros, it is not particularly strong. Though contemporary with Athenian accounts cited earlier

to indicate varieties of weights in use, these three states appear remarkably consistent both internally and (with the exception of coin accounting) between eath other. All weigh commodities other than silver and gold in talants (not Delphi) and minai (and the term stater occurs only as a coin name on Delphi and Epidaurus inscriptions: in the latter used of Corinthian not Aeginetan coin). So it must be borne in mind that the variations in weights around which this chapter is constructed may be applicable only to Athens. This is not in fact true in my opinion, and Delian ξυληρα σταθμα and problems about Delphic minai lead me to suspect the consistency of these accounts as possibly superficial. The doubt nevertheless remains and should be acknowledged.[34] It can be incorporated without difficulty into my conclusion on weight standards which is that these reflect directly coin standards until some time beyond the limits of our period.

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The terminology of weights does however point to considerable variation between states in the absolute values associated with a single term, and this evidence can be set against the apparent conformity noted in the last paragraph. Most striking are the values of the term stater : even if it can only be illustrated from coinage, at a minimum it should be allowed that the same variations would be likely in the term used simply as weight.

In 5th and 4th-century Attic inscriptions the term is used of silver staters of Corinth (IG $i^2$ 310.114 and $ii^2$ 1414.9) and of Aegina ($i^2$ 310.110, 292; $ii^2$ 1388.70; 1126.17 etc); and especially of what is called gold, but was often electrum, staters of Cyzicus and Lampsacus, and also Croesids, Darics, 'Philippeioi' (IG $i^2$ 313.10,48; 339-353 (eg ML 59.13ff); $i^2$ 356; $ii^2$ 1687; 1428; $ii^2$ 1544.46 etc). Acanthian staters are restored on IG $i^2$ 310.290. Finally Attic gold (coin) staters occur at the end of the 5th century (IG $ii^2$ 1686.24-5; 1687.5). Though stater might be supposed a flexible coin-term for a set (but unknown) weight, it would be wrong to argue that the Athenians were responsible for using it of these foreign coins without reference to general and local conventions. For example the 4th-century Olbian coinage decree arranges exchange rates for τον στατηρα τον Κυζικηνον in terms of local Olbian staters (Pleket number 7 ; SIG $^3$ 218); and inscriptions from Thasos (5th - 3rd century etc. especially IG xii. supp.

347.I.3 Pleket 2 ), Samos (6th century ML.8 (Tod.1)), Arcadia, Eresos, Nesos, Lesbos 4th century; Acarnania, West Locris, Amorgos 3rd century etc. all refer to local coins as staters. Nor is Athenian practice without parallel in areas where coins of different states were in circulation - the Delian inscription IG xi.161.B.20-1, 38 (3rd c.) refers to Aeginetan, Cretan, Corinthian and Cyzicus staters; the Epidauros inscription IG iv$^2$.97. 18 refers to Corinthian 3rd century (interestingly Aeginetan here as drachmai); and the Laconian inscription IG v (i).1.10 (ML.67) mentions Aeginetan staters amongst other contributions.[35]

These lists are far from complete but a brief summary of the weights of the coins called "stater" will illustrate how variable the term was :-

| | | |
|---|---|---|
| Cyzicus | EL | 16 gm [36] |
| Lampsacus | EL | 15.35 gm [36] |
| Croesids | Gold | 8.04 gm [37] |
| Darics | Gold | 8.42 gm [38] |
| Attic | Gold | 8.6 gm [39] |
| Philippeioi | Gold | as Attic [40] |
| Aeginetan | Silver | probably 12 gm [41] |
| Corinthian | Silver | probably the 8.6 gm "3 dr." coin [42] |
| Thasian | Silver | said to be 9.44-9.72 gm [43] |

This point could be developed by correlating these coin staters with other known staters. In Athens the thirtieth talant stater, that can be deduced from inscriptions, is in the theoretical relation to the smaller coin stater of 100 : 1. Coin weights vary from 4.2 gm drachma [44] to the 4.6 gm drachma [45] so theoretically the 1/30 Talant stater would be 840-860 gm. Extant weights (as already noted) vary very considerably, but only one marked weight (SW.16 c 500 BC, which purports to be two staters of 868.7 gm) is close to this theoretical weight. The interpretation of other "staters" must consider whether the relationship (and theoretical weight) should be relevant, and the question of precision is important. However other weights are not sufficiently removed from 840-860 gm. to suggest a different stater with any certainty.

The correlation seems less justifiable in the case of the two weights from Thera (nos. (1) and (2) above, ch.II) indicating staters of 843.3 gm and possibly 2132 gm respectively. The former may be close to the Attic (theoretical) weight, but the latter bears no apparent relation.[46] The 100 : 1

ratio between coin and higher weight staters, argued by Barron from a convenient modern weighing of a Samos bronze weight has already been noted as suspect.[47]

For present purposes it is sufficient to show that the "stater" term did have a place in weight systems, at least as validly as "mina", and that there was great variation from one area of the Greek world to the next. What is more if the 1 : 100 ratio was generally accepted, even if it did not apply universally, the variations stemmed entirely from the differences in local coin weights.

"Stater" is unusual in that in many areas it may well have applied inside a state to two distinct weights as well as showing inter-state variation in which we are here interested. The evidence for the absolute variation of other weights is mainly of variation from one place to another only. It is shown by extant weights (coin or other), by specification of a geographically-defined weight, and by direct reference to variations in ancient writers. The mass of this material is not controversial, but three interesting points should be noted: (a) the question of a standard mina with varying numbers of drachmai, as well as of variant minai; (b) extreme variations in the talant; (c) the way these terms are all ultimately based in coinage as the "stater" already considered.

Drachma and obol. As coin names the variation in absolute value between these is easily illustrated as it was commented upon in antiquity: the Aeginetan πραχμα drachma (of 6 gm) was contrasted with the Athenian (of 4.2 - 4.6 gm) by Pollux 9.76.[48] Specification of geographical drachma/obol is commonplace - eg. Aeginetan obols and drachmai in the 420 BC treaty between Athens, Argos, Mantineia and Elis (IG $i^2$ 86 = Tod 72 = Thuc. 5.47 11.23-4); Argive drachmai (inferred from numeral) at Epidauros : IG $iv^2$ 103 (B.6) 123-127; etc. These references invariably relate to coinage however, and not to absolute weight, for which the only references I can find are the purchases of gold for Epidauros in Attic weights (drachmai and obols).[49] That little except gold and silver was weighed in drachmai and obols is the reason for this lack of evidence: normally each area would use its own coinage-weights for this sort of thing (if not actually the coins themselves).[50] No actual weights survive with inscribed "drachmai" or "obols" from the period of this survey.

Mina. Despite Pollux 9.56, this is never known as a coin or coin weight, and its relation to coin weights appears to have been largely theoretical. I discuss later the possible origins of this weight term: here I shall first note variations implied in its value by geographical specification: thus:-

Attic minai (in Delphi purchase of ivory: FdD III.5.25. col II.A. 6-7 (344 BC));

Egyptian minai with talants in Attic sale of ropes etc: IG ii$^2$ 1479B (313/12);

Euboean minai in Herodotus' equivalence to Babylonian talants: Hdt. 3.89?.

This evidence is taken from within the classical limits to my survey; from later it seems can be cited the evidence of a specifically defined ἐμπορικὴ μνᾶ at Athens (raised from 138 to 150 coin drachmai at the end of the 2nd century BC: IG ii$^2$ 1013, with which this chapter began) and later still Pollux' account (9.86-87)[51] where local talants are given their values in Attic drachmai and minai. This table will be relevant also for discussion of the talant that follows so I quote it in full :-

| | | |
|---|---|---|
| Attic talant | 6000 Attic drachmai | 60 Attic minai |
| Babylonian | 7000 ,, | 70 ,, |
| Aeginetan | 10000 ,, | 100 ,, |
| Syrian | 4500 ,, | etc[52] |
| Cilician | 3000 ,, | |
| Egyptian | 1500 ,, | |
| Sicilian | 24 and later 12 nummi; probably 6 and later 3 Attic drachmai[53] | |

According to Pollux here the Aeginetan mina, like the Attic and all others, had 100 local (Aeginetan) drachmai. Now the mina was in every case 1/60 talant.[54] Therefore we find presented by this latish date a uniform system, but a wide variety of minai (and talants). Apparently there is classical evidence to support the picture.[55]

There is a major difficulty here in that fairly certain contemporary 4th to 3rd-century evidence can be produced to show an Aeginetan mina of 70 Aeginetan drachmai, and one which in weight was equivalent to the Attic.

I discuss in Appendix C the Delphic accounts of the conversion Aeginetan/Attic coinage - 6 gm : 4.2 gm (taking the most favourable figures); furthermore the reforms ascribed to Solon by 4th-century Attic writers may well, as is my opinion, be little more than a reflection of this fact (see the next chapter and Appendix D on Arist. Ath.Pol.10).

Of the two clashes, the numerical one is less important, as it is easily supposed that the exchange-rate Attic/Aeginetan coin may have changed from the classical rate 10 : 7 (with the higher 4 : 3 to include costs of exchange) to Pollux' 10 : 6. Alternatively this latter rate may be that used (including costs) to convert Attic into Aeginetan, where 4 : 3 was used for converting Aeginetan into Attic: in each case the exchange going against the currency to be bought.[56] If one could be sure of Pollux' authority - if it was Aristotle or even Attic evidence[57] - this latter interpretation could well be correct.

That the Aeginetan talant had 6000 Aeginetan drachmai (and the mina 100 Aeginetan drachmai) seems plainly to contradict the evidence we have (especially from Delphi accounts) and must be a mistaken inference by Pollux. In that the general context of his description is properly coinage and not weight, it is clear that the specification of talants and minai, themselves never coins (as remarked above), is the result of some misunderstanding.[58]

The clearest element in Pollux' paragraph is the variation in size (absolute rather than systematic) of talants. Pollux ends τὸ μέντοι Σικελικὸν τάλαντον ἐλαχίστου ῥοπὴν and cites Aristotle. This Sicilian talant is expressed in weights which can only be coin terms (νόμμοι and ἡμιωβολία); otherwise the talants are expressed in drachmai which are coin terms, but also in minai which are not. From this basis we might reconstruct Pollux' account as a description properly of the variations in weight terms and units, those of minai being noted in commercial contexts at the outset to the section. Can we therefore connect the resultant picture of variable (talants and) minai with the variation between coin and commercial minai (and talants) of IG ii$^2$ 1013 and suppose that a similar variation obtained as early as the 4th century (the earliest clear evidence)? Whatever variation existed at this earlier period cannot of course have survived the reform of IG ii$^2$ 1013 (and its possible predecessor establishing 138 drachmai), but some variation could be indicated.

I do not see how on the present evidence this possibility can be proven, but equally it does not (or need not) make conceptual or organisational

demands.[59] Furthermore several points invite the hypothesis, or something close to it: there are references to Attic weight minai specifically on inscriptions that normally do not distinguish Attic coin minai (or Talants) from Aeginetan/or Amphictyonic and local; and there are the differences (and wild variations) in absolute weight of Attic extant weights; plus the undeniable fact that IG ii$^2$ 1013 needs some precedent (to establish the 138 drachmai mina). The hypothesis cannot however be more than a general one, and as I wish to be very clear about what I do not want it to imply, I shall briefly summarise the position it would suppose. This is that there existed, on the one hand, officially-defined and fixed coin ratios such that, for Attic and Aeginetan, the weights were in the ratio of 10 Attic drachmai to 7 Aeginetan and the respective systems were 100 drachmai to the mina and 60 minai to the talant (Attic), and 70 drachmai (or 35 staters) to the mina and 60 minai to the talant (Aegina). On the other hand there existed an unofficial but uniform weight system of 60 minai to the talant but not involving drachmai; the absolute weights varied (with Attic, to judge from extant weights, rather below the theoretical standard)[60]; this system was used to weigh commodities for which the drachma weight was never used.[61]

I shall pursue this point in the next section; clearly what has been said here of the mina (with local variations) can also be said for the talant for which most of the evidence has already been cited. Though both talant and mina must cede priority of weight-value to the stater,[62] "talant" has a very much longer historical existence as a Greek weight than either of these other two terms and it is from the variations of the earlier talants that the Table on the following page develops.

The degree of non-specification of the talants in which objects appear weighed on classical inscriptions is remarkable. No extant weights, that are certainly weights,[63] bear the inscription "talant" or fraction of talant yet a wide range of items are weighed only in talants. I argued above that it seems to be a likely inference from frequent commodity-related occurrences of the term that its absolute value in fact varies even where specification is absent.[64] This point can be transferred furthermore to the mina, where this is defined as 1/60 talant,[65] and some confirmation results from the hypothesis advanced above that enabled the mina to float fairly freely outside the officially-defined coin-weight system, within which, it need hardly be proved, the talant (and mina) have precise positions

TABLE

Evidence for talant variation

Estimates for the Homeric talant, invariably of gold, were as wild in antiquity as in modern scholarship (see ch.III n.204; for ancient interpretations Hultsch SM pp.298-301; for modern Hultsch GRM[2] 128-9, Seltman GC[2] 5-7). It is generally agreed however that it was a small weight in comparison to the later classical mainland Greek talant (Poll.9.55 referring to Iliad 23.262-70).

In this variety of estimates of the Homeric talant must be seen evidence of the varied experiences of those writers who made the estimates. Aristotle apparently said that the later talant was variable: ἔφην οὖν ὁ Ἀριστοτέλης μὴ εἶναι τὸ ταλαντον ὡρισμένον ποσον, ἀλλα καὶ ἐπι ἡσσονος καὶ μειζονος λαμβανεσθαι (SM p.299.3). Timaeos is cited for its being 1dr or 24drs; Theophrastus for 14drs; Diphylos for a small piece of silver. I am suggesting that this variation of the talant is in fact commodity-related (ch.III Conclusions with ch.V).

Contemporary Greek accounts, of the fifth and fourth centuries especially, give little evidence of this sort of wild variation. However it is possible to note:
Egyptian talants (and minai) on the Attic sale of ropes etc IG II[2] 1479 B.
Babylonian talants for silver on Herdotus' account of Persian tribute III.89.
Euboic talants for gold on the same account.

Δοκιμαστον ταλαντον means however a talant of coined money and is not a separate weight.

Commercial talants do not appear before IG II[2] 1013 (ἐμπορικον ταλαντον).

For completeness can be added the table of talants derived from Poll.9.86f (and already given above for the mina qv. with nn.52-3):

| | | |
|---|---|---|
| Attic talant | ... | 6000 Attic drachmai |
| Babylonian | ... | 7000 ,, |
| Aeginetan | ... | 10000 ,, |
| Syrian | ... | 4500 ,, |
| Cilician | ... | 3000 ,, |
| Egyptian | ... | 1500 ,, |

and finally, with the authority of Aristotle (Poll.9.87) and also Timaeus (SM 299.3):

| | | |
|---|---|---|
| Sicilian | ... | 6, 3, or 1 Attic dr. (whereby a coin could be called a talant: Poll.9.53f) |

in relation to the basic unit of account: thus Attic 6000 drachmai = 60 minai = 1 talant; and Aeginetan 4200 drachmai = 2100 staters = 60 minai = 1 talant (perhaps best indicated by the Delphi accounts, as those of Epidaurus, though in Aeginetan coin, ordinarily express all sums in high drachmai fractions).

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An obvious indicator of the variation in question must be the actual weights that have survived. As discussed above, these show a degree of inconsistency that goes beyond possible damage in survival, but also the interpretation of such inconsistency rather begs the very issues this analysis is seeking to solve - the extent of interest in precision[66] and, more relevantly to this chapter, the question of standard variation through official control. A further difficulty must be that unless the context of any particular weight is established, we cannot expect the weights to speak by themselves: how, for instance, should we recognise the ξύληρα στάθμα of 3rd-century Delos if (as seems unfortunately the case) weights are not usually inscribed with the commodity to which (on my general thesis) they should properly be assigned? Weights are unlike οἰνήρα and σιτήρα μέτρα the σήκωματα of which seem from about the classical period to have been explicitly so labelled.

Perhaps this is to exaggerate. The differences (or variations) in actual weights are not sufficient (given consistency of marking or more explicit weight and value specification) to admit any general explanation along the lines of their being different weights. The question of precision is more relevant: on one view (Lang's) variations are variations in commercial standards. There is also the more general question of whether the state was interested in a fixed commercial weight system. These and other considerations are decisive in my opinion against the explanation of the variations in absolute weight in terms of dual (or multiple) standards. This important issue needs discussion now at greater length.

## 4. Arguments against dual (or multiple) standards in individual states

To the variation in terminology discussed in the last chapter has now in this been added variations in the absolute values of weight terms. Whereas terminology varied according to commodity and context, the extent of absolute variation cannot be so straightforwardly quantified on the available evidence, and a slightly indirect, if more interesting, approach must be examined. At the outset of this chapter I noted the late 2nd-century B.C. inscription IG ii$^2$ 1013 that established a change in the ratio of coin weights (Stephanephoros drachmai) to commercial weights (ἐμπορικὴ μνᾶ and ταλάντον). At this late date there apparently were two officially recognised weight standards; indeed the implication of the reform of IG ii$^2$ 1013 is that there was already in existence from some unspecified time before it a dual standard set at 138 : 100. The question I now wish to consider is whether this concept of dual standards, commercial and coin, will explain the variations in weights that the earlier part of this chapter has established; and more particularly whether these dual standards can have been officially recognised and, as Lang argues, have been manipulated in the classical period. In my opinion there is evidence only for official recognition of a coin weight standard, even though other variations, especially in commerce, were commonplace.

The most noticeable variations have, it must be admitted, been found between official coin weights (and inventory practices) and weighing in commercial contexts. To a certain extent this can be explained as a direct result of the different commodities involved and the scale of weighing in these two contexts. Also it is true that official authorities apparently operated with commercial weights in accounts.[67] Moreover weights marked "δημόσιον" survive that belong to the commercial context[68] from as early as 500 B.C. This official involvement with commercial weights is taken a vital stage further to official specification of the commercial standard by Lang[69] with arguments drawn from Arist. Ath.Pol.10, establishing at the outset (from Solon's day) a 105 : 100 ratio and connecting eventually with the 138 : 100 then 150 : 100

ratios of IG ii$^2$ 1013. Confirmation for this hypothesis is finally sought in the retrievable weights of weights that have survived. These are in turn used by Lang to suggest further changes in standard than are attested by supporting evidence.

This is I hope a fair statement of Lang's position, the most developed account of the dual-standard hypothesis under consideration. While the evidence is restricted to Athens it is important to realise that this must also apply to both weight standards suggested. The variations in absolute weights discussed earlier in this chapter included variation of non-coin weights between states (notably the Attic mina in which Delphi purchased ivory, but also true of the stater between Samos and Athens, and of talants in general). The hypothesis of dual-standards therefore is not that Greek states varied their coinage with reference to a universal commercial standard, but that these states individually operated set ratios between their coin-weights and their own commercial-weights.[70]

A general criticism of the hypothesis is that it does not facilitate trade either within a state (where coin weights were recognised) or between states (where the variation in coin weights combined with problems of varyingly-related commercial weight systems). Consideration of the small extent to which weights were actually used (chapter VII) will minimise the difficulties here, but hardly help justify the hypothesis of weight standards specifically designed for commerce. A further general argument corroborates this criticism. The normal Greek state was little interested in the social class of traders, or the mechanism and furtherance of trade, till late in the 4th century, possibly not even till later when political activity perforce declined; a commercial weight system, like a commercial policy of any sort, is very unlikely on general grounds for the classical and pre-classical[71] period in Greece. To argue from this point at this stage would of course rather beg the question at issue, but I note it to indicate that it is really for those who postulate commercial weight standards to prove their case beyond doubt. My present position, and the need to argue against such a hypothesis as that of Lang's dual standards, is therefore to a certain extent false. It is however a necessary result of the apparent willingness on the part of some modern scholarship to follow the more ambitious and mistaken conceptual assumptions made of Greek metrology for over a century.

The case against an Athenian commercial standard must needs therefore be put. I shall divide it into 6 particular heads, roughly corresponding to the arguments noted in my summary of Lang's position above.

1. Arist. Ath.Pol.10 offers no support at all for the hypothesis. This passage I discuss in Appendix D, and show that, if examined in detail, it describes no more than the establishment (in parallel) of two weight systems, and the fixing (or raising) of one weight standard, namely the coin weight standard.[72] At best the historical value of the passage is a reflection of the late 4th-century attitude to weight. It entirely supports what I believe to have been this situation, namely an official defined coin standard and associated coin system, with other systems more appropriate (because of scale etc.) to commerce loosely associated with the coin standard but not officially controlled and so absolutely variable.

2. Extant weights, with marks of official stamping and apparent adherence to fairly straight-forward systems, do not support Lang's thesis any more than any other hypothesis including that of a non-defined commercial system. The purposes to which the weights were put is not known, and even their suitability for commerce a questionable inference from their presence in the Agora and their official nature. Furthermore, that they are not designated "ἐμπορικα-" is decisive against the view that they represent an officially recognised commercial standard so described. The use to which these marked weights, as other weights in general, might be put will be discussed below;[73] here I should point out that their original value might well have lain in their being a series. Though no such series have survived, it would be easier to understand variations if they were variations between series, represented each by the surviving weight, rather than variations within one. In individual contexts the weights might well form part of a standard set suitable for the constant operation (accurately) of such a context. Repeated inventory-work would be a clear example.

3. Official use of weight terms in inventories or accounts of such commercial activities as building, contracting etc., offers no guarantee that the terms are standard, and far from constitutes proof that any such standards were officially defined. Furthermore, doubts can be raised about the relevance of weight at all to certain records involving weight terms.[74]

4. No evidence of earlier reforms along the lines of IG ii$^2$ 1013 can be cited (with the exception of Arist. Ath.Pol.10). This may be supposed to be because the reforms were recorded on stones that have not survived (as the establishment of the 138:100 ratio in IG ii$^2$ 1013, and as possibly the legislation and records of early Metronomoi and Sitophylakes: see Arist. Ath.Pol 51 and Appendix E). However, many references and inscriptions do refer to weights without any indication of there being more than one weight standard. These inscriptions are collected in Appendix E, where it will be seen that, as in IG ii$^2$ 1013, weights are mentioned in conjunction with coinage,[75] but that any further details concern only the coinage. In later chapters I shall consider in greater detail another feature of this evidence which is that nowhere is the actual weight of this coinage mentioned as of importance in legislation, nor is there any reference to individual concern for coin weight in the extensive literature.[76] Either the Greeks were not concerned about the weights of their coins, or they assumed experts (e.g. the producing mint) were sufficiently reliable. In both cases Greek commerce is most unlikely to have related its weights in any sophisticated way to the coin standards. Correspension on a single standard is all the silence of the evidence will support. The actual weights are too close for chance correspension or for the subtle interrelationships, detected by modern scholars, to have been intended.

5. A somewhat similar argument can be derived from the terminology for specifying weights discussed in the preceding chapter. This can be classified as based on commodity (? ξυλήρα ), geographical location (Αἰγυπτια, Εὐβοϊκα ), relative size (possibly "Phaidonian" and essentially only measures), and above all on coinage (local being specified by an adjective; δοκιμαστος/δοκιμος, ὁλοσχέρες etc.) There is no reference to ἐμπορικα σταθμα either as a local Athenian standard or as a general Greek one, and the only proposed/possible reconstruction of this adjective, on the basis of the initial E only in SEG X.243 II.55, can be ruled out on grounds other than the infrequency of the term.[77] IG ii$^2$ 1013 contains the first known occurrence of this "commercial" weight, and it would seem reasonable to relate it to the general commercial climate of the 2nd century B.C. when such a term might have had more than purely local significance and so attracted definition in terms of a particular coinage.

6. The only positive incentive to the hypothesis of a separately-defined commercial standard is the fact that IG ii$^2$ 1013 records a change to 150 : 100 from 138 : 100 existing previously. With no explicit reference to the establishment of this 138 : 100 ratio scholars have felt free to push the event back - even, with Lang, as far as Solon. The arguments already given show this to be unlikely, but I believe that the establishment of the "commercial" mina etc. can be narrowed down very much further than the post-classical terminus argued so far.

The inscription specifies both an old and a new ἐμπορικὴ μνᾶ in terms of στεφανηφόρου δραχμαί (29, 31, 33). These are now recognised to be the so-called "New-style" Attic coins with a wreath-bearing owl on the reverse.[3] The date of the introduction of this coinage is not certain though present opinion seems to place it between 196 and c.165 B.C., rather favouring the latter date.[78] This can amount to a virtual terminus ante quem non for the 138 : 100 equivalence described in IG ii$^2$ 1013.

More important however is the context of the "New-style" coinage itself, for, whether the above argument is watertight or not, it remains true that this period of Attic coinage shows the greatest interest in accountancy and more innovations in detail than any other earlier period.[79] Such information unfortunately can only be drawn from the coins themselves, but it is sufficient to argue that in the 2nd century there was a climate of approach to coin and weight such as might well have systematised commercially variant weights. These features of New-style coinage are well described, and are controversial only in detail and chronology:[80] firstly there was a gap between the end of the usual Attic type and fabric (Macedonian occupation etc.); secondly a radically new design was now adopted;[81] but thirdly records of officials, dates and silver sources now begin to appear on coins themselves, indicating a specially established authority with responsibility for the coinage, and of sufficient importance for the post of official to be honorary (being conferred on a Mithridates King of Pontus)

I am rather less certain of the strength of a further point, that the weights of these coins were slightly different from earlier standards. Not only does this depend upon how certain (in the sense of established) the earlier standards were, and on how reliably they can be inferred from extant coinage; but also the change being considered is far too small properly to account either for an increase from equality to 138 or 150, or even from

138 to 150 coin drachmai to the commercial mina (of 100 hypothetical commercial drachmai). The relevant figures appear to be 17.20 gm for 5th-century coins[82] and 16.80 gm for the New-Style,[83] whereas for 100 - 138 the coins would be close to 12 gm and for 138-150 would be around 15.80 gm. Nevertheless a change in standard, however slight, is remarkable where such close attention is being paid to other aspects of the production of coinage (quality, record, type etc.); and, more importantly, the new standard, and coins minted on it, is consistent with the evidence of IG ii$^2$ 1013 that the reform(s) affected and revised the commercial weights and maintained a consistent coin weight.

The more general economic position of Athens at this period confirms the evidence of the coins that this was a time when commercial weight reforms might anyway be expected. Two points can be considered here:- firstly, the increased freedom accorded to Greek cities in general following the removal of Macedonian rule (essentially 196 BC. ff when Flamininus declared the cities free, an act which obviously meant much to the contemporary Greeks,[84] who even portrayed him on their coinage[85]). Athens in particular was able to resume her central position in Greek commercial life, especially after the presentation of the free port of Delos by Rome ca. 165 B.C.. Delos has been noted above as particularly concerned, in her independent period, to set official checks on commercial weights and measures.[86] Athens managed to avoid involvement in the further 2nd-century troubles, that ended with the destruction of Corinth in 146 B.C., and it can be presumed that her commerce flourished accordingly.

146 B.C. was the date of the establishment of the Roman province of Achaea, and my second point here is that Greek commerce was in the course of the 2nd century coming closely under the influence of Rome. The extent of this is difficult to estimate, and the problems of early Roman metrology are hardly less complex than contemporary Greek. However it is interesting to note that the treaty of Apamea in Asia Minor as early as 188 B.C. set a minimum weight (in Roman weights) for the Athenian tetradrachms of Antiochos' indemnity (see Appendix E on Legislation). I shall be considering in the next part how very novel and un-Greek this sort of specification is, and yet the date, 188 B.C., is quite far removed from the end of the 2nd century B.C. IG ii$^2$ 1013. There is good reason therefore to suppose that the establishment of the commercial weight system, mentioned in this inscription, was as much a product of the changed climate in Athens

by the end of the 2nd century, as the change in the system described by the inscription.

I feel that these arguments against multiple official weight standards in classical Greece are convincing enough to counteract the tendency to explain extant weights on the hypothesis of such standards, which is in effect the procedure followed by Lang. It could perhaps still be objected that I am ignoring the official Metronomoi (as also the Sitophylakes of Arist. Ath.Pol. 51) whose competence undoubtedly concerned weights in a commercial context. However the duties of such officials are more in the maintenance of established standards than in the calculation of new; their existence certainly does not imply the existence of commercial standards and I shall discuss in a later chapter whether it necessarily implied even the extensive use of weights and measures in general trade. The question of mint officials will be considered in the same context.[87]

## Conclusions

In this chapter I have shown that Greek weights varied in absolute values just as the weight systems discussed in the earlier chapter. The variations are not compatible, however; for whereas systems varied with commodity and context (essentially at the whim of the authority concerned), official and unofficial absolute values seem to have varied essentially in the degree to which they reflected local coin standards. I have argued that it is wrong to attempt to ascribe these variations to weight standards other than coin as the only recognised standards were the coin. Many unofficial weights fall right outside any imprecise reflection of coin weights; and the origin (and ultimate disappearance) of these weights, as too of the coin weights, will be discussed in the next chapter.

chapter five

# THE ORIGINS OF GREEK STANDARD WEIGHTS

## Introductory

After arguing in the last chapter that official control of weights seems to have been limited to coin weights and to systems of weights based on these, I shall now develop the view that these weights only started with coinage. Pre-coinage weighing, and whether this was with weights or not, will be discussed subsequently. In fact, as I shall show, pre-coinage weighing constituted an important brake on the use of standard weights and continued to affect the Greek attitude to weighing even after the adoption of standard weight systems. There may also be a more direct connection between standard weights and earlier, pre-standardisation, units; these units however varied, virtually upon each occasion on which they were used, and, with no firm evidence, the connection cannot be pursued far. It has led however to serious confusions in earlier discussions of the origins of Greek standard weights.

There are therefore three sides to the question faced in this chapter: the origin of standard weights; the origin of non-standard weights; and the possible connection between these two (the problem of which non-standard weights led to the later standard ones). As already indicated, I feel that the first problem demands greatest attention, and it occupies therefore the greater part of the chapter.

First there is an obvious difficulty posed by the peculiar function of coinage. I shall discuss the limitations to arguing from coin-weights to other weights; although on my view that standard weights did not precede coinage, these limitations simply do not apply, it is necessary to dispose of the approach adopted by Breglia and others who have attempted to deduce pre-coinage trade-routes from the evidence of variations in later coin standards. It is not however true that coin weights have no relation to later standard weights (as the last chapter has already argued in detail).

Next I review the evidence of pre-coinage weights. There appear to have been no official standards, although certain conventions in individual contexts can be detected. The terminology (and subdivisions) of later weight systems is then reconsidered and, with the variations in absolute values (for which bimetalism is seen as an inadequate explanation), amounts to impressive evidence for the haphazard and arbitrary nature of weights used in the pre-coinage period. The Greeks lacked basic, naturally occurring, constants.

There are indications in this terminology that several terms of the later weight systems were adopted from the context of coinage rather than from any earlier practice.

It can then be noted that classical Greek traditions about the origins of coinage and weights largely coincide: Pheidon, Solon, and Aristotle. It is fair to regard the exceptional tradition of Palamedes as reflecting the awkward transition from earlier weight units.

In conclusion I develop my view that it was only after, and because of, the introduction of coinage that Greek states began to experience officially standarised weights. The origins of pre-coinage weights were haphazard and defy specification: they seem most probably related (in varying ways) to commodity and to context. This may indicate a source for certain coin weights, but many others may also be conjectured, and the variation in the resulting standards suggests that many in fact should be supposed[1].

## 1. Coin weights and other weights

One problem that has contributed most to the difficulty of discerning the origins of Greek weights is undoubtedly the differences between coin weights and other weights. I myself doubt whether this problem is in fact a real one, but it is true that there are many factors relevant to coinage (and so to coin weights) which are not so applicable to other weights. Firstly, the idea of coinage, the specialist skills necessary for its production, and its official nature, all argue for the probability of some degree of imitation in the spread of the practice of coinage itself: it may even be the case that the same individuals were frequently involved in different states in the later sixth century. Thus coin weights need reflect simply the extent of (or accidents in) the transmission of the practice of making coins. This argument hits immediately at the basic assumption of such work as Breglia's Antiche Rotte, which assumes that coin weights reflect pre-existent general weights. Another difficulty to this inference is that coinage is officially controlled, but for non-commercial reasons[2], while the official control of other commercial weights is rather to be doubted till the post-classical period[3]. There is therefore no reason for coin weights, established by the state, to reflect weights in commercial use, and with which the state had little or no basic concern. Furthermore the difference in scale between most commercial weights (by which I mean in orders of magnitude in which more common materials would be traded) and the gold and silver coin weights makes comparison in absolute terms impossible (through lack of common units of measurement) or at most highly unlikely[4].

## 2. Pre-coinage weights

I shall not pursue the last controversy further here as I feel a more important difficulty has been generally overlooked: this is whether there actually were any pre-coinage weights, that is official and standardised weights, in ancient Greece. At issue between Breglia and her opponents is whether coin weights are an accurate guide to the standards and the systems of subdivision of pre-coinage weight systems. However it is in fact extraordinarily difficult to find evidence of pre-coinage weights upon which such controversy could be based.

2.(1). Homer mentions talants of gold and ever since debate has continued over what this apparently variable weight was [5]. I have also already noted that in referring to "axes" and "half-axes" of iron he may have been preserving a tradition in which these were weight terms; he did not himself have any way to measure iron apart from the time it might last[6]. On one occasion he describes a woman working wool with a balance and (on the usual interpretaion) a weight. The passage is difficult to interpret (and not least problematic is the function of the weight); it has been discussed in detail above [7]. On no account however is a particular weight involved as opposed to a constant ad hoc unit for measuring out multiples of an understood amount. It could very well be a chance stone. Such Homeric references are possibly legacies, half-understood, from the Greek bronze age when weights and weighing were at a considerably higher level, or rather considerably more compatible with modern attitudes to weighing, than was ever the case in classical Greece[8].

2.(2). A certain amount of doubt must also surround interpretation of the iron spits found in the Peloponnese. In view of classical theories that the term "drachma" was derived from a handful of "obeloi" (spits)[9], it has been assumed that the surviving iron spits represent pre-coinage

weights[10]. However the tradition states that Lycurgus instituted the spits as currency substitutes, and although it emphasises the bulk of this "currency" it nowhere attributes a weight value to the iron spits themselves[11]. The early seventh-century bundle recovered from the Argive Heraion together with a large iron bar does seem to illustrate some form of weight equivalence (the larger bar being close in weight to the restored total weight of the 180 spits found with it)[12]. Such an occurrence may however be coincidental; the iron bars are not marked or known to have been used as weights; their similarity in weight may happily be explained by their similar shape, and result from the manufacturing process employed[13].

2.(3). Only one possible pre-coinage weight has been recovered, and its identification is highly doubtful. It is from Pithekoussai (Ischia in Italy) and is dated by the excavators to the first quarter of the seventh century (by context)[14]. There is no inscription, and, although details are as yet not available, its type is most unusual: a piece of lead bound in a bronze ring. The only justification for regarding this object in fact as a weight at all (as opposed to a talisman, or better, a small hammer) is its weight of 8.79gm which, it is said, "corresponds exactly to the stater of the Euboean standard". Inscribed weights proper begin to appear only towards the end of the sixth century in Greece[15]. They do not therefore antedate coinage.

2.(4). Two important literary references have already been noted that might indicate the use of weights in a pre-coinage context: Croesos' dedications at Delphi as described in Herodotus I.50-51, and Myron's thalami at Olympia mentioned by Pausanias VI.19. Both references however are uncertain[16]. Although the details of Herodotus' account are convincing at least for the weighing in talants and half-talants of gold in the third quarter of the sixth century, it is not entirely certain that the actual context should be regarded as pre-coinage. Croesos after all was a Lydian and might well have dictated that his dedication was measured in this sort of way. Coinage, and on a very sophisticated weight system, is of course well-established for Lydia at this date even though uncertain for Delphi. While there could hardly be any argument that Myron, in the mid seventh century, was pre-coinage, I have raised objections above over the reliability of

Pausanias' (second-century AD) description. The 500T weight given is moreover an enormously heavy weight on the standard used at Olympia in classical times.

The identification of the weights referred to in these passages is of course bound up with the very question of the transmission of weights from pre- to post-coinage times. If the references are properly to pre-coinage contexts, both the variations in later Delphic weighing of Croesos' gold lion[17] and the improbably vast apparent size of the Olympian thalami can be explained by suggesting that the earlier talants were small. Speculation however is not helpful. We can note that only talants are involved (with half-talants also at Delphi), and we can note that the Delphians, as Homer, measured the silver crater in capacity measures and not by weight as the gold. I incline however to disregard Myron as late, and to treat the weighing at Delphi as a very early application of a system of inventory taking (possibly on the instigation of the Lydian practice), not properly pre-coinage.

A further reference to pre-coinage weighing could be considered. Hdt.II.180 records the contribution of 1000T of alum by Amasis of Egypt towards the temple rebuilding at Delphi in the late sixth century. As has already been argued, the reference lacks the probable epigraphic backing of the record of Croesos' dedications; it anyway seems fairly clearly within the period of coinage as the accompanying gift from the Greeks in Egypt appears as a sum of silver, in minai, and so presumably accounted[18].

2.(5). "Talant" is the only weight term that I have found named in an early, pre-coinage context of weighing (i.e. in Homer). The earliest occurrence of the term "stater" is in a law from Chios, dated 575-550 BC[19], where the term clearly refers to the number of coins of that name to be paid in a fine. The term "mina" seems to make its first appearance in accounting, where is bridges the large gap between the high talant and the low coin drachma or stater. "Mina" only is used of weight units after the middle of the fifth century, and then only for certain commodities[20]. "Ὀβελοί" are not associated with "ὀβολοί" until their function was presumed similar by later Greek historians.

The early appearance of "talant" may be significant. The term is of Greek origin[21], but in historical times its value varied widely[22]. This variation is comparable to the variation of the stater or "weighed weight", and would seem to indicate independent local practice and development. Unlike the stater, which was a basic unit, the talant does not seem to have been fixed absolutely prior to its being incorporated into systems of weights which themselves already included a fixed unit. The element of oscillation or at least of inclination that lies behind the very word " τάλαντον ", relates to a form of weighing for which absolute weights were not essential; this might indeed explain how the term is applied to a variety of absolute weights, and also why it is the only term that can be found used in periods before the introduction of fixed-weight staters[23].

2.(6). I shall argue below (and further in Appendix D) that despite Greek traditions and modern scholarship, no certain reconstruction of the reforms of either Solon or Pheidon (both of whom were associated with coinage apparently anachronistically) establishes that they manipulated weights. Either the references to coinage in the traditions should be down-dated; or the legislators should be left only with reforms in measures, which in the case of Solon on Aristotle's account is to be left with very little; or the traditions should be regarded as imaginative reconstructions and so ignored.

2.(7). Certain coin names have been supposed to relate to non-coin weights: essentially West Greek νόμμος, οὐγκία and λίτρα. The problem of relating the weights of coins of these denominations to the non-coin weights they represent has been noted above, and I concluded that the coin weights were conventionally placed in the normal Greek system, and that only multiples (more uncertainly fractions) were affected by attempts to produce coin corresponding to these non-coin weights[24]. There is no appreciable distinction between the weights of coins apparently regarded as obols and litrai to judge from their types. This point is confirmed by the convention that a Corinthian stater was held equivalent to 10 litrai[25]. A more general consideration here however is that the weights in question are non-Greek weights (nummus, uncia, and litra); furthermore their incorporation into coinage only occurs after Greek coinage has begun in the area.

In conclusion, I can find no evidence of standardisation of weights before such standardisation was imposed through, or perhaps simply with, the introduction of coinage. The evidence so far considered has been largely negative, but I shall be able in the following chapters to construct a picture of weighing that did not use weights; this picture will thus quite satisfactorily account for the non-existence of identifiable pre-coinage weights. However, although I am arguing against a necessary connection between coin weights and other weights, it is clear from the terminology used by the Greeks that both were connected. I shall continue the present investigation into the origins of Greek weights by considering in some detail this terminology.

## 3. Weight and coin terminology

The many general and basic terms of Greek weights do amount to an impressive argument for haphazard and diverse origins for their weight values[26].

These terms may be grouped according to their indicated origin. (a) The first group consists of terms applied by the Greeks to certain coins: in the West λιτρα , νουμμος , ουγκια , and in the East σιγλος . These terms do not occur as Greek weights proper, even if the coins may (as always in the case of σιγλος ) form part of a non-Greek weight system. (b) Explicit eastern origin can only be seen for the mina (μνα), and the same origin can be sought for its metrological value as one-sixtieth of a higher weight and one hundred multiples of a lower in Attic and many other Greek systems. The term is indeed only found as a notional weight initially. No justification can be found for Pollux' claim: ἦν δὲ καὶ ἡ μνᾶ σταθμοῦ τε καὶ νομίσματος ὄνομα (IX.56). (c) A third sort of weight term is that corresponding to the possible iron-age practice of iron spits: ὀβολος and δραχμη , to which κρατευτη may also be added[27]. As noted above, no necessary fixed or standard weight need have been associated with these objects by their users. If a link is demanded between their earlier and later forms, it can as much be that of value, or of their use as value indicators. In both senses it is likely that they were applied to coins before being applied to the weights these coins had. (d) A final group of particularly Greek weight terms is that of those directly derived from the process of weighing: στατηρ (from ἵστημι) a weighed constant, of no particular absolute value but implying some recognition of standardisation, and ταλαντον, a word also applied to the whole balance itself and related to its movement in use, variable but always incorporated into the top end of a weight series[28]. Although στατηρ is frequently found both as a coin weight and as an independent (far heavier) weight, ταλαντον seems only rarely applied directly to actual weights[29], and is most usually used of notional sums. In this way the term could be used in a coin context, though not directly of coin.

In none of these terms is there any element of intrinsic or particular absolute value. The doubtfully-Greek weights of group (a) were possibly taken, as convenient, from independent silver (or other metal) weight systems. The mina, group (b), is perhaps exceptional as it was standard in the Near East and was also used as a weight term by the Greeks: the absolute value was not however the same even though the system value was. The apparent degree of consistency in systems of weighing in Greek states is indeed significant[30]. How far this consistency was a survival from an earlier common system applied to the whole area or how far it was the result of development from initially very disparate systems is difficult to decide. Our evidence only begins properly in the fifth century. The following reasons however incline me to the view that the consistency was a relatively late development, not quite completed (if the material is rigorously examined) even in the historical period.

Firstly, there is the wide variation of the talant and the even more fully documented weight vagiaries of the stater[31]. If stater be thought too indeterminate a concept to argue from, there is no other term with reference to any absolute weight that remains to be considered. Secondly, most examples of actual weighing, or rather the greater number of differing contexts in which weighing took place, involve recource to this indeterminate and unsystematised stater unit[32]. The fully developed system (talant/mina/drachma/obol) is virtually restricted to the weighing of precious metals by officials. Practical weighing in ancient Greece would not seem likely, even in the historical period, to broadcast knowledge of available systems.

Thirdly, consistency in subdivision is only apparent in higher weights; if the basic subdivisions of coinage, for instance, are considered, a great deal of variation comes to light, and of somewhat earlier date than most of the evidence for higher weight systems and for accounting. It is reasonable to emphasise systems of subdivision as an especially valid (and practicable) guide for grouping or differentiating areas in which compatible weight systems were used. The problem of making inferences from coin to weight systems naturally recurs here as it did in the last chapter in discussing weight standards. I feel however that, as fractions are a subsequent development from initial standard coins, and as they are more directly related to practical use,

the clear value origins of the obol:drachma relation (6:1) can suggest similar relations in other cases. Whether this point applies only to coin weights or can also be extended outside them[33], and whether the principle of subdivision be (in origin) by weight or by value or simply haphazard, nevertheless, as we are thinking of the resultant systematisation (and not its origins), the lack of basic consistency remains valid. Because of the lateness of our written evidence, it is impossible to be certain that higher weights did not (where they existed) follow the same variable pattern.

This leads to my fourth point, which is that all explicit evidence of common systematisation of subdivision is late Athenian theory. The consistency I mentioned at the start of this discussion may be entirely superficial (just as the "Pheidonian" medimnoi of Apollonian grain may have been so called by the Delphians alone[34]). By the time of Aristotle it is perhaps more likely that the equivalences of higher units may have been systematised. Coin is possibly the key to the process, and it is noticeable that weights other than coin are not so carefully controlled in fifth and fourth-century inscriptions. Was this because no equivalences as yet existed ? I have argued that this is a likely explanation.

4. Variation in absolute values: bimetalism discounted: lack of natural constants

I have mentioned the wide variations in absolute weights and should perhaps briefly consider the view that these variations were originally related. This hypothesis is ordinarily applied to coin weights, but is naturally of wider relevance as I am arguing that eventual absolute weight systems in fact derived from those of certain areas based on (or closely attached to) coin standards. Codrington has argued that the whole organisation of Greek coins "is derived from the fact that their basis lies in bimetalism"[35]. Ridgeway said rather earlier that "from first to last the Greek communities were engaged in an endless quest after bimetalism"[36]. The basis of this theory is that gold weight-units were related to silver in a manner that reflected the relative value of these metals, and it is well illustrated by Darius' coinage: thus Head "The Babylonic and Persic Silver Minae in their various forms... were derived from the corresponding Gold Minae on the basis of the relation of gold to silver as 1:13.3. The standard Persian silver coin, the siglos or shekel, was in weight the hundreth part of the silver mina, and in value the twentieth part of the contemporary gold daric: hence:- 1 ℳ Daric of 130 grs. x 13.3 = 1729 grs. Ⱥ = 20 Persian sigloi of 86.45 grs. ..."[37]. In his recent statement of the hypothesis Codrington argues Greek coin weights (silver) resulted from contemporary equivalences to the universal Persian daric (gold)[38]. Obviously some such gold basis must be postulated.

To this approach there are several immediate, and straight-forward, objections. Firstly the theoretical basis is at best improbable: the earliest coin was electrum, and at a time when the actual value of the alloy could not be discovered by analysis[39]. Moreover there is little evidence that Greeks operated in gold weights at all: gold coinage was extremely rare,[40] and when it did occur it was the result of special circumstances and directly related to silver coin weights[41]. There is

no evidence that gold was weighed in units that differed either absolutely or in their subdivision[42]. That gold was available on the commercial market in different units from silver (which was apparently only available in coined form) in fifth/fourth-century Athens should argue against the hypothesis under consideration as by it the state (being the minting authority) would be the source of this second unit.

Another general objection to bimetalism is the very variation in weights that it is supposed to explain. Though fluctuation in the gold:silver ratio might account for minor variations in standards[43], it cannot explain why the Aeginetan standard coin weighed 6gm. while the Attic 4.3gm., or 8.6gm., or 17.2gm. (depending upon where we might wish to set the Attic "stater"). Nor can it explain the variation in subdivision of such basic units. Here can best be contrasted the Corinthian "stater", dividing first into thirds, and the Athenian didrachm, dividing into halves; the coins were equivalent (approx. 8.6gm.).

Contemporary awareness of the gold:silver ratio undoubtedly existed. It was used by Herodotus in an entirely theoretical totalisation of Persian tribute[44], and appears similarly implied in Athenian accounts[45]. It can be seen moreover to have varied slightly in antiquity. Yet surely it is surprising that this variation should be so openly noted if silver weights (and standards) were <u>based on</u> gold: silver ratios[46].

Even if <u>some</u> degree of bimetallic thoery may have been responsible for <u>some</u> choices of weight values, and even this is entirely hypothetical where no bimetallic currency obtained, the significance of the fact must be severely limited to the commodities and people involved. Moreover it could only occur within a framework of established weights. While natural in the Near East, with official weight-systems long-established in one commodity (silver in Persia/Babylonia although gold was possibly more basic in Egypt), this precondition is met in neither Dark-Age nor Archaic Greece. I should conclude therefore that bimetalism is properly relevant as an explanation only of the setting up of coin weights where other weights were already in force. Thus, as officially standard weights do not in Greece seem to have preceded coin weights, I cannot accept the hypothesis of bimetalism as at all relevant to the question of the origins of Greek weights.

Whatever debt the Greeks owed to the Near East, it is however quite clear that they derived no basic weight. Though apparent from the great variety of small coin weights already mentioned in Chapter II.2, this point is also shown by the lack in Greek metrological terminology of the classical period of terms relating to any fixed, naturally-occurring constants. Contrast the Babylonian halluru, a bean-weight of 0.2014gm, basic to the karash unit of Persian accounting, and also the many Indian seed weights of comparable precision[47]. Small weights of this type appear in Alexandrine Greek writers: κεράτιον, the later carat, and κόκκος for example are first used as weights by Dioscurides in the first century of this era. Indeed their incorporation into the Roman weight system may be a late development, as the $\frac{1}{1728}$ lb siliqua seems not to antedate the period of Constantine[48]. This point is significant in two ways as it happens that such natural constants are also minimal weights.

Firstly, the lack of a small unit weight: this acts as a necessary check to all limits of accuracy in Greek measurement of weight. Such measurement moreover might normally be thought of as in units, but the Greeks tended to use as units different weights that corresponded most suitably to the desired accuracy (and reflected the value and scale of items being weighed). This point will be developed in what follows, and it is perhaps not remarkable if wood should be weighed in talants where gold is weighed in drachmai and obols. However it is important to recall that reduction to lowest units (Philo speaks of τὴς μονάδας ἀγαγεῖν [49]) is an obvious step in practical weight measurement that is rarely encountered consciously until late in the classical period - Herodotus recorded the weights of Delphic offerings correct to the last half-talant[50]. In fact I should suggest that this lack of a small absolute weight is symptomatic of the variety of non-related weights, especially where these weights have so often identical names. Finally, there remain the practical difficulties posed by this lack of a small absolute weight. It is most noticeable in the problem of how to construct fractional weights. Nevertheless the Greeks attempted to do this, and it is therefore necessary to imagine alternative methods: trial and error, length measurement of thin strips of wire etc[51]. In any case it was not possible for them to say, for example, that half an 8gm stater was 4gm, for they had no such basic units. Some other explanation than weight should therefore be sought to explain fractional subdivision. The need for it could be sufficient: value requirements, or the parallel of subdivision of the higher end of the system.

Secondly, the lack of natural constants.[52] No Greek weights were fixed to absolutes by virtue of their terminology, and so any consistency both in terminology and also in absolute value must have depended on the circumstances of the origins of the weights and the practice of Greeks using them or of states enforcing them. It is important to note then that the likelihood is greater that weights would tend towards subsequent variation than that they should largely conform to a constant and uniform system as is generally assumed. The questions of the degree of official control and the extent of the practical use of weights become crucial at this point. In the next few chapters I shall show that both factors were largely absent in Greece (at least until late in the classical period) for most weights apart from coin weights.

There remains also the question of whether the variation (which has been shown true of both classical Greek terminology and of the absolute values of Greek weights) arose as a result of deviation from an initial unitary system or simply from a variety of origins. Both the above discussion of weight standards and that of the origins of weights (which I believe to have been as coin weights) will have established reasonable grounds for believing that the direction of classical Greek metrology was towards unification, rather than away from it.

## 5. Greek traditions concerning the origins of weights (and coins)

Classical Greek traditions of the origins of coinage and of weights may in general be no closer to the truth than modern hypotheses. Nevertheless they obviously bear upon this subject, moreso perhaps on contemporary attitudes that will be discussed in the next chapter, and do in fact show two important points consistent with the direction of my present argument: first, that weights and measures were arbitrary in origin; and second, that their origins were somehow bound up with the introduction of coinage.

### 5.(1) Palamedes

The heroic Palamedes comes naturally first. Alongside the traditions of his exploits at Troy and his quarrel with Odysseus[53] is the characterisation of Palamedes as the inventor of a list of items that in most versions includes weights and measures. One of the earliest accounts to survive is in the rhetorical Defence of Palamedes written by Gorgias in the fifth century. In this Palamedes justifies himself as benefactor:

> (οὐκ οὖν των νυν ὄντων ἀλλα των μελλοντων) ... τίς γαρ ἂν ἐποιησε ἀνθρωπειον βιον πορισμον ἐξ ἀπορου και κεκοσμημενον ἐξ ἀκοσμου, τάξεις τε πολεμικας εὗρων, μεγιστον εἰς πλεονεκτηματα, νομους τε γραπτους, φυλακας του δικαιου, γραμματα τε, μνημης ὀργανον, μετρα τε και σταθμα, συναλλαγων εὐπορους διαλλαγας, ἀριθμον τε χρηματων φυλακα, πυρσους τε ... πεδας τε ...[54]

The key-words are discovery (or invention: εὗρων) and the commercial context (συναλλαγων εὐπορους διαλλαγας) as opposed to what could be labelled the inventory-value of number. Sophocles fr.432 also attributed the dicovery of weights and measures to Palamedes: οὗτος δε γ' ἡὗρε ... σταθμων ἀριθμων και μετρων εὑρηματα[55]; and the kind of discovery involved seems fairly basic as is shown by the extended account of the discovery of number[56]. Later sources can be briefly cited, and

obviously relate the same tradition: Philostr. Her.11.1 προγαρ δη [illegible] ... οὐδε νομισμα ἠν οὐδε σταθμα και μετρα οὐδε ἀριθμην, and Schol.Eur. Orestes 432: πρωτον μεν τα Φοινικια διδαξας γραμματα αὐτους ... ἐπειτα και περι κυβους ἐτρεψεν αὐτων την ὀλιγωριαν και μετρα ἐξευρε και ψηφον ... ἀλλως ... φασι δε αὐτον εὑρειν φρυκτωριας και μετρα και σταθμους και πεττους και γραμματα και φυλακας και ἀστραγαλους.

It would therefore appear that fairly closely connected in this tradition are the Greek alphabet, weights and measures (coinage only directly in Philostratus, but also perhaps indirectly by Gorgias' συναλλαγων ἐμπορους διαλλαγας), beacon signalling, and various games of dice, draughts, or knuckle-bones. Naturally the first question should be whether the indication of Phoenician origin for the alphabet (Schol.Eur. Or.432) can apply to the whole list. Palamedes' origins do suggest at least a connection with overseas trading. His father, or ancestor, Nauplios, travelled as an Argonaut[57], but more relevantly was also connected with slave-trading: he was given Auge ἐμποριον ἀπεμπολησαι (Apollod.2.7.4) and also Aerope and Klymene εἰς ἀλλοδαπας ἠπειρους ἀπεμπολησαι (ibid.3.2.2). Obviously the name Nauplios and descent from Poseidon relate to a similar sea-faring context. A near-eastern origin for Palamedes' discoveries is therefore feasible, but it is remarkable that he, and not his father, should be credited with having made them. Indeed the only known example of a φρυκτωρια in the story is that lit by Nauplios on Mt.Kaphereos to wreck the Greek fleet on its return in revenge for the stoning of his son (Apollod. Epit. 6.7). While appearing in danger of rationalising this tradition, in suggesting the son learnt from the father's experiences, I think one or two arguments point to the essential Greekness of Palamedes' discoveries. Firstly, the length of the list of inventions and the fact that not all are external to Greek culture[58], make it possible to separate son from father's possible Phoenician context. Secondly, Sophocles' elongated description of the discovery of Number puts this on a basic (primitive) level - that of the discovery of units. Thirdly, that these matters were all considered "inventions" makes modern sense for games and beacon fires, but appears odd for numbers and weights and measures. The combination is therefore more plausible in view of this oddness.

This preliminary is necessary to the next question: what did this dicovery of weights and measures amount to ? My interpretation is

that these are non-connected units; they are contrasted with Sophocles' description of number systematisation, and they are disconnected: Gorgias labels ἀριθμος and not σταθμα as χρηματων φυλακα. There is no standard weight term associated with the tradition; the invention of number is parallel and not incorporated[59]. Beyond this it is unwise to speculate[60].

## 5.(2) Pheidon

It is perhaps significant that there is no fifth-century tradition about the origins of Greek weights other than the Palamedes myth just discussed. Herodotus brifly notes of Pheidon that he made measures for the Peloponnesians[61], but there is no trace of a weight reform at the same time. "Pheidonian" measures existed, or at least measures that were called Pheidonian, in the fourth century: thus the Delphians account 3,000 Pheidonian medimnoi of grain from Apollonia in 363 BC and convert it into 1875 Delphic medimnoi[62], and later Theophrastus characterises ἀδοχροκερδεια as Φειδωνιῳ (var. φειδομενῳ !) μετρῳ τον πυνδακα ἐξοκεκρουμενῳ (MSS. ἑκα-) μετρειν αὐτος τοις ἑνδον σφοδρα δε ἀποφων τον ἐπιτηδεια[63]. There is unlikely to have been a set exchange rate for the Delphic conversion[64], and the variant φειδομενῳ in the Theophrastus is disquieting. Pollux reveals that φειδων was also the name of a narrow-necked oil-flask[65], and this may perhaps better indicate the origin of the tradition about Pheidon's reform of measures than the interpretation Pollux himself offers: εἰη δ'ἀν και φειδων τι ἀγγειον ἐλαιηρον ἀπο των Φειδωνειων μετρων ὀνομαζομενον ὑπερ ὧν ἐν Ἀργειων πολιτειᾳ Ἀριστοτελης λεγει. Unfortunately Aristotle's Argive Constitution is lost; but that Pheidonian measures were smaller at least than Attic is Aristotelian dogma, recorded in Ath.Pol.10.2: ἐπ'ἐκεινου (sc.του Σολωνος) γαρ ἐγενετο και τα μετρα μειζω των Φειδωνειων. This passage of course continues --- και τα σταθμια, and will be discussed in detail below and in Appendix D. It implies that Solon made Attic measures and weights larger than Pheidon's.[66]

The tradition that associated weights with Pheidon, also associated coins with him. It is a tradition that seems as far as can be told (and Pollux' citation is indicative) to have begun with Aristotle[67]. There is little doubt about the eventual story, which placed Pheidon as

a contender for the title of being the first Greek to coin (with no doubt about the fact that he did coin), and which explained the bundle of iron spits and bar at the Argive Heraion as being the currency for which he substituted coin and as the dedication he made when he did this[68]. Modern scholars have taken up and developed this tradition[69], and several degrees of scepticism emerge in its criticism[70]. Two main points establish my own disbelief. First, the dedication, if of value, should surely have been of the new rather than the old, and superseded currency. It has been suggested that Pheidon was responsible for the particular weight standard of the spits[71], but I can find no justification for the belief that these spits were in any sense of measured weight; there can therefore be no sense in a changed standard. Second, there are severe chronological difficulties. The Heraion dedication (first half of seventh century) is consistent with recent Peloponnesian chronology that would place Pheidon's tyranny c.675 BC[72]. Greek coinage however only began in the late seventh century; the rudimentary early stages are shown by the Ephesian Artemision deposit of c.600 BC and there is no such stage known for the mainland coinages; these, including the Aeginetan with which Pheidon tends to be associated, cannot have begun till well inside the sixth century[73].

If, as seems to have been the case, Pheidon's connection with weights was established by the misinterpretation of his spit dedication as a coinage reform, then the fact that Pheidon must certainly be dissociated from the possibility of any such reform is also sufficient to dissociate him from a weight reform. As I have already pointed out this latter reform was not attributed to him until the late fourth century.

## 5.(3) Solon

Solon naturally must be considered next. His weight and coinage reforms however are no less fictitious, I believe, than those of Pheidon. The origin of the tradition is again fourth-century, but its elements were probably anticipated by oligarchic propaganda of the end of the fifth. Doubt arises from the fact that our evidence is derived from a psephisma, quoted by Andocides, assigned to Teisamenos in 403/2BC:

> πολιτευεσθαι Ἀθηναιους κατα τα πατρια, νομοις δε χρησθαι τοις Σολωνος και μετροις και σταθμοις, χρησθαι δε και τοις Δρακοντος θεσμοις, οισπερ ἐχρωμεθα ἐν τῳ προσθεν χρονῳ κτλ.[74]

The problems raised by this decree range well outside the scope of this enquiry, but the central question is relevant: whether the claim to follow the laws of Solon and Dracon was a propaganda justification for a new law-code, whether it was simply a way of referring to a code evolved prior to the oligarchic coups of The Fourhundred and of The Thirty, or whether it genuinely meant to suggest a return to actual Solonian and Draconian legislation. On this controversy I am persuaded to follow closely Hignett, who has made out a clear case for reference to Solon being, even in the fifth century, standard rhetorical practice[75]. In this particular instance, Andocides, on Hignett's view, is concealing the fact that Teisamenos' reform was part of the revision of laws already begun under the oligarchs of 411[76]. The decree of Teisamenos itself, whether properly historical or not, nevertheless shows that at the end of the fifth century Attic weights and measures could be attributed to Solon. I do not however feel that, given the political context and the general Athenian practice of ascribing institutions to the earliest available (as opposed to possible) source, this attribution carries any historical weight whatsoever.

The remaining two major references to Solon's treatment of weights, measures, and coin both come from the second part of the fourth century: Androtion 324 FGH 34 (ap.Plut.Solon 15.3-4) and Aristotle Ath.Pol.10. They are often considered together in attempts to arrive at a reconstruction of Solon's reforms[77]. It seems fair to consider the later Aristotelian version as in some sense a reaction to, or a revision of details in, Androtion's earlier Atthis[78]. Political attitudes, which have been suggested as a reason for Aristotle's reaction, are however very little relevant to what is essentially a factual clash between the two accounts in that part of Solon's legislation with which we are interested. I shall consider the two accounts separately in the order in which they were written, as in this way the illusion that there might be fact behind the correspondence of the two can be best avoided.

(a) Androtion. Androtion's Atthis is cited by Plutarch as a variant account of how Solon helped the poorer elements of society. Debts, according to this account, were not cancelled, but interest on them was reduced. Alongside was effected an increase in measures and in the value of (?) money:

> καὶ τὴν δραχμὰ ταύτῃ γενομένην τῶν τε μέτρων ἐπαύξησιν καὶ τοῦ νομίσματος τιμήν· ἑκατὸν γὰρ ἐποίησε δραχμῶν τὴν μνᾶν πρότερον ἑβδομήκοντα τριῶν οὔσαν, ὥστ' ἀριθμῷ μὲν ἴσον,

δυνάμει δ' ἐλάττων ἀποδιδοὺς ὠφελεῖσθαι μὲν τοὺς ἑκτήνοντας μεγάλα, μηδὲν δὲ βλάπτεσθαι τοὺς κομιζομένους.[79]

Several problems surround the text as it stands. First, ἐπαύξησις should apply both to measures and to something else (τῶν τε μέτρων). Either καὶ σταθμῶν has dropped out in Plutarch's paraphrase, or we should read τιμῆς (or τῆς τιμῆς) as suggested by Sintenis and Jacoby. In favour of the former, which is my own suggestion and not noted elsewhere, is the problem of how an increase in the value of coinage (drachmai, not mina, which is never a coin) could have been produced by changing the old ratio of 73 (?70) drs to the mina to a new ratio of 100 drs to the mina. Whether the mina or the drachma was altered, the reform would either retain the value of the coinage or decrease it: in neither case could an increase occur. Second, was the mina increased or the drachma decreased ? "Ἀριθμὸν μὲν ἴσον, δυνάμει δ' ἐλάττονα", and the suggestion of greater benefit to debtors than to those to whom they were indebted (ὠφελεῖσθαι --- μεγάλα as opposed to μηδὲν βλάπτεσθαι), both argue for a decreased drachma. Third, the apparent assertion of a pre-Solonian mina of 73 drachmai is unparallelled. It presents an awkward obstacle to emendation in favour of the 70 drachmai suggested by Jacoby. On this the natural interpretation would be that Androtion (or Solon) had in mind the ratio between Athenian and Aeginetan coin, respectively 100 and 70 drachmai to the same weight mina. The alternative (and lectio difficilior etc), the retention of the 73 drs, can only be explained with recourse to considerable ingenuity. Thus Lang[80] has explained Androtion's figure as based on the Aeginetan weight drachma (of 6.23gm), and argues that the reform concerned a change in the weight standard as opposed to the coin standard[81]. This ingenuity can be seen to be misplaced when the general context of Androtion's reconstruction is considered (as below), but it is also quite impossible. Apart from also requiring the misinterpretation of Ath.Pol.10 as a 5% decrease in coin weights as against non-coin weights, the equation proposed by Lang does not in fact work: 73 times 6.23gm does not equal 105 times 4.36gm as she claims (454.79 and 457.80), even if the coin change is closer: 70 times 6.23gm (436.10) compared with 100 times 4.36gm (436.00). Moreover the equation is not what Androtion gives, as his 73 dr. mina becomes 100 drs, not 105 drs. Finally, in suggesting that Androtion's 73 dr figure relates to a non-coin weight, Lang is overlooking the one clear element of Androtion's account: namely that he was describing a coinage reform. I conclude that no sense can be made of the 73 dr. figure and that it would perhaps be wiser to postpone emendation until

Androtion's facts can be independently established. For the present an emendation of 70 for the figure 73 seems called for.

The general interpretation of Androtion's account can only show how anachronistic and impossible is the reform he attempts to attribute here to Solon. The reduction in interest-rate as a means of alleviating debt has rightly been seen as a mid-fourth-century practice[82]. Solon's own poems show that debts in the early sixth century were in grain, in labour, in property but not in coin[83]; indeed they cannot have been in coin, nor can Solon's other reforms have concerned coin, if coin was only introduced into Athens fifty years after Solon as is generally accepted now as being the case. In so far as coinage is the basis of both reforms decribed by Androtion (the reduction in interest rate and also that indicated after τοῦ νομισματος τὴν ), both reforms can be discarded as unhistorical. Indeed, even in the economic conditions of the later fourth century, the second reform makes economic nonesense unless it is a pathetic misunderstanding on Androtion's part, as he seems to have thought that creditors would not lose from reforms aimed (obscurely enough) at reducing the obligations of debtors.

It is less difficult to understand how Androtion's account came to be written now that the above position has been clarified. From the political point of view he can be supposed to have wanted to show Solon as something other than simply a democratic, left-wing reformer. As regards weights and measures, Androtion's inferences seem (with the emended 70 and 100 drs) to derive from, and need presuppose no more than, observation of the contemporary variations between the coin weights of Athens and Aegina. If Pheidon was associated with the latter (see above), they antedated Solon; and we have already noted the fifth-century tradition (associated with Teisamenos' decree) that connected Solon with some reform of weights and measures. This last inference at least need not have been made by Androtion, ~~though as he is also our source for Teisamenos it is nevertheless a possibility that he is responsible for both.~~ He certainly seems however to have been responsible for the incorporation of a coinage reform. This contribution, and the associated problems of interpretation, have not strikingly advanced this inquiry into the origins of Greek weights.

(b) Aristotle Ath.Pol.10. A similar conclusion applies to Aristotle's decription of Solon's reforms. Written about twenty years later than Androtion's Atthis, this can now be recognised as little more than an attempted revision of Androtion's version which it consciously echoes: distinguishing χρέων ἀποκοπή from susequent τήν τε τῶν μέτρων καὶ σταθμῶν καὶ τὴν τοῦ νομίσματος αὔξησιν ... καὶ ἡ μνᾶ πρότερον ἔχουσα σταθμὸν ἑβδομήκοντα δραχμὰς ἀνεπληρώθη τοῖς ἑκατόν. Detailed discussion of this central passage is so important for the whole of this thesis that I have set it out separately in Appendix D. For our present purposes I need only note that if the anachronistic coinage reform (be it reconstruction, hypothesis, or properly historical if not applicable to Solon) is removed, nothing further remains than an association with Solon of responsibility for the distinction (appreciable in the fourth century) between Attic and Aëginetan coin drachmai[84]. As I am arguing, such "Solonian" traditions were widespread from the fifth century onwards, and presuppose no more than such observation of contemporary facts. They are not historical.

## 5.(4) Lykurgus

Lykurgus inevitably has also a place in this list of figures traditionally associated with early coinage, even though his role was largely negative: ἀκυρώσας τὸν νομισθέντα χρυσοῦν καὶ ἀργυροῦν μόνῃ χρήσθαι τῷ σιδήρῳ προσέταξε (Plut. Lyk.9; cf. Lys.17). This iron was specially treated to be unusable for anything else, and the aim was to avoid the moral and civil evils of coinage. This should give a clear indication that the date of the tradition postdates by a very long way the introduction of coinage[85]. I should place it somewhere in the fourth century.

I am assuming that there is no historical validity to the tradition. Lykurgus is perhaps the clearest Greek target for posthumously-accredited legislation, and, either as a result of the extent of this or possibly as a reason for this extent, the figure of Lykurgus itself has no proper historical setting. Clearly the tradition is an attempted explanation, in moralising terms well-suited to Plutarch's interest in biography, of Sparta's continued use of iron-spit currency that has already been discussed above in connection with Pheidon. The weights of such spits may have been fairly consistent, but they were not regarded as measured constants. There is indeed no mention in the Lykurgus tradition about the weights of the spits, and for this we should perhaps be grateful.

## 5.(5) Aristotle on the origins of coinage

Aristotle discussed more generally the question of the origins of coinage. Politics 1256.b.40-1257.b.10 follows the development of trade from simple barter (καθαπερ ἐκ πολλα ποιει και των βαρβαρικων ἐθνων, κατα την ἀλλαγην) to commerce (το καπηλικον, το μεν πρωτον ἁπλως ἰσως γενομενον, εἶτα δι' ἐμπειριας ἤδη τεχνικωτερον, ποθεν και πως μεταβαλλομενον πλειστον ποιησει κερδος)[86]. Currency, he argued, occurred by necessity in the process of this development in order to facilitate exchange and led directly to το καπηλικον itself (1257.a.33-b.1). This currency was originally a utilitarian material, easily handled, such as iron or silver: it was of fixed size and weight, and only later came to be stamped as proof (or indication) of its weight and in order to avoid the necessity of users' measuring it:

> το μεν πρωτον ἁπλως ὁριστον μεγεθει και σταθμῳ, το δε τελευταιον και χαρακτηρα ἐπιβαλλοντων ἱνα ἀπολυσῃ της μετρησεως αὐτους· ὁ γαρ χαρακτηρ ἐτεθη του ποσου σημειον.

The degree of theory behind this important passage must be immediately apparent after what has already been said of the difficulty of discerning fractional coin values from their type[87]. Our immediate interest is however in the phrase ὁριστον μεγεθει και σταθμῳ. Nowhere else did Aristotle propound a theory of weights, but from this passage it is clear that a fixed, or set, weight was in each case meant rather than a standard measured weight. Future users would, Aristotle does say, be relieved of the need to "measure" (μετρησις) the weight, but I do not feel this need imply more than the checking of the weight against another standard. We are returned therefore to the same position as reached in the question of the iron spits[88]; the origin of coinage is simply tied in with recognised fixed amounts of metal.

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Greek accounts of the origins of weights are not therefore particularly impressive. The most specific tradition, that surrounding Palamedes, represents weights as "discoverable", and nothing more precise than ad hoc arbitrary weight standards are implied by the account of Aristotle or the evidence of the early iron-spits. A significant stage in the development of weights is their official sanction and systematisation; in the evidence considered this is only mentioned in the context of coinage reforms.

## Conclusions

If the historical anachronism of Greek traditions concerning the early figures of Lykurgus, Solon, and Pheidon be accepted, it remains possible to ask why every account of the origin of weights is (and Palamedes need not be regarded as an exception) bound up with coinage. That these traditions are late reconstructions, based on contemporary theory, must be admitted as a probability. However I do not wish to dismiss too lightly the common context in these traditions of weights, measures and coinage. Misplaced in time though the connection may be, it can be argued in part at least to be historical. I shall conclude here with the hypothesis that it was only with the introduction and establishment by Greek states of coinage that weights in general began to be recognised as at all standard or systematic also[89]. For this purpose the evidence discussed to this point must be briefly reviewed.

Some weights clearly pre-existed coinage. They are mentioned by Homer and are associated with Palamedes and Aristotle's account of the origins of coinage. It is not necessary here to be concerned with how these early weights may have been used, nor with their values, as it is sufficient to allow them as constants in particular (ad hoc) contexts.

Considerable evidence has been collected of the haphazard origins of what later became basic weights. I have also indicated the absolute variations between weights of apparently identical names, as also the variations in the systems used for weighing different commodities. There may even be further variation than it is possible on the present evidence to prove. General standardisation on the other hand seems only established by the time of IG $II^2$ 1013, at the end of the second century BC.

This picture naturally prompts the question of how such an arbitrary and haphazard collection of weights came into existence. My suggestion is that weights came into use by practice, dictated in most cases by practical considerations of scale, value or density. Thus precious metals would be handled in small quantities and by small weights because of their high value, while only heaviness might limit (or dictate) the handling of iron, and bulk determine the most convenient weight for wood. It is only by postulating this sort of commodity variation at the outset, that the variations in the later picture can be explained. Nor is the hypothesis itself at all improbable, given the absence of marked weights and of evidence of official control of trading activity in the pre-coinage period. Furthermore I hope to show in later chapters that very little weighing with set weights (to measure weight) can have taken place in this period, just as it was hardly commonplace even in later classical times.

If certain of the early Greek weights could be shown similar in weight to those in the systems of other near-eastern civilisations, no significant connection is thereby necessarily established. The near-eastern weight might itself reflect similar considerations of practical handling; alternatively a particular near-eastern weight may have found its way into Greece and have been adopted by the Greeks simply because on the occasion it filled such a practical requirement. Bronze-age Greek weights could be incorporated into the later Greek systems in a similar way. A chance stone by the wayside however could have an equal possibility of being the origin of a later "standard". Although I do not mean to rule out survival or even influence from earlier or parallel cultures, I would maintain that such survivals are not particularly significant features in the development of Greek weights. The most important stage of this development was the fixing of certain weights as standards <u>for something</u>. This I suggest was for coinage, even though the origins of the practice may have lain in Lydia. Only after the introduction of coinage, and its systematisation by official control, did the mina appear in Greece.

The introduction of coinage by its nature (fixed weight-units of metal even if not actually weighed in practice) but more importantly by the fact that it was officially controlled, had a profound effect on the development of Greek weights. Once a basic weight and system had been selected, it naturally stood in sharp contrast to the miscellaneous

weights associated with other commodities. The subsequent weighing of these other commodities has been shown to have tended towards at least the same system as used for coinage. Doubts about possible continued variation in absolute values cannot be altogether removed: and the variable talant or stater stand as warnings in this direction. There is also a general uncertainty over the extent to which the largely official nature of most surviving epigraphic evidence can be taken as a reliable indication of more general practice.

It is not therefore surprising if traditions about early weight reforms should be so indissolubly bound up with coinage (either with coinage reforms or with the question of the origin of coinage). It was in the establishment of coinage that weights, I have argued, first came to be standardised in Greek states, just as it was also with subsequent coin legislation that the official weight systems developed. Why the standardisation of weights should have waited upon coinage, and why even in the classical period this standardisation was so partial and disorganised, was I suggest a direct result of the Greek attitude to weighing. In it weights, and weight, played a very minor part. This I shall develop in the following chapters.