CHECKING THE CURRENT COINS 1344–1422

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In 1420 the English gold coinage was in a sorry state. It was less than ten years since a completely new issue of light nobles had been initiated, but the circulating coins were already worn and clipped, and the bullion price of gold had risen above the nominal value of the coins. The mercantile interest of the nation was at that time well-represented in Parliament, and there were demands for action. As a result a programme of renewal was established, part of which was the supplying by the Mint of coin-weights intended for checking the noble, half-noble, and quarter-noble. These weights were round, made of copper-alloy, and they were punched with a crown and a fleur-de-lis (Fig. 1). Until recently examples of these weights were very rare, but nowadays they turn up quite regularly, and they can be seen on the Portable Antiquities website, and eBay. All the evidence suggests that they were widely used for about half a century.

1. Background on weighing

In modern scientific terms the weight of an object is the gravitational force exerted on it by the earth. It can therefore be used as a measure of the mass of the object, that is, the quantity of matter that it contains.

It must be remembered that this way of thinking was unknown in the middle ages. For most people the act of weighing was a mystery, no more capable of rational explanation than the

Acknowledgements. I am grateful to Stewart Lyon for his careful and informed comments on a draft of this paper. Helpful comments were also supplied by Martin Allen, Jim Bolton, Andrew Crawforth, Ritzo Holtman, Elina Screen, and Paul and Bente Withers. 1 Stewartby 2009, 271. 2 Connor 1987.
causes of the Black Death. Some medieval thinkers, such as Jordanus de Nemore in the thirteenth century, grappled with the fundamental ideas, but their conceptual systems were inconsistent and incomplete. In commerce, even those who were literate were apt to confuse the quantity being measured with the mechanics of the apparatus being used.

Examples of this confusion are found in the frequent references to the term ‘auncel weight’ in the fourteenth and fifteenth centuries. At first sight it might be thought that auncel weight was a system of units for measuring weight. But in fact it referred to the measurement of weight by instruments based on levers with unequal arms: we would call them steelyards or bismars. The theory of the lever had been understood since antiquity, but as a practical tool for weighing it had several drawbacks. The characteristics of each auncel were different, and so each one had to be calibrated individually. This meant that the buyer’s only means of checking the seller’s instrument was to use another instrument; if that gave a different answer, there was no easy way of resolving the matter. For this reason there were repeated attempts to ban auncel weight, in favour of weighing by means of a balance with equal arms.

In contrast to the auncel, the equal-arm balance is simple in theory and, on the face of it, easy to explain. Everyone understands that the beam will come to rest in the horizontal position only if the loads on the arms are the same. In particular, the correctness of the instrument can be checked by testing it in the unloaded state. When one of the loads is a group of ‘weights’ (objects with known mass), the mass of the other load can be measured. However, there are opportunities for fraud even with this simple apparatus, as can be seen in a contemporary caricature of a German merchant, published in Professor Spufford’s splendid book. From the metrological point of view, the most remarkable feature is not the merchant’s matchstick legs, but rather his elongated middle finger, which has plainly been over-used for the purpose of upsetting the true working of his balance. If the merchant placed a coin in one of the scales, a weight in the other, and showed that the beam was not horizontal then many people would simply accept his assertion that the coin was not of the correct weight. The fact that such a crude deceit was possible suggests that few people had any real understanding of the mechanical principles involved in equal-arm weighing.

When the citizens of London petitioned for improvements in the practice of weighing in 1256, they pointed out that gold and silver were always weighed per medium clavum, and neque trahens ad pondere neque aurum sive argentum. The first phrase appears to mean that the beam should have the fulcrum in the middle, so that the arms were equal. The second suggests that the beam should come to rest inclining neither towards the weight (counterpoise) nor the gold/silver – that is, in the horizontal position. Indeed it is clear, from artefacts and documents going back to antiquity, that equal-arm beams were generally used for the precise weighing of valuable objects. Sadly, surviving examples are relatively scarce (in comparison with weights), probably because the balances were small and easily damaged.

Fig. 2. Folding balance for weighing coins, as used in the fourteenth century (0.9 × actual size) (private collection).

One type of equal-arm balance that is found throughout northern Europe is the small beam with folding arms, as shown in Fig. 2. Several have been found in England, including an example from Roche Abbey in Yorkshire which was accompanied by two late fifteenth century coin-weights. So we can be fairly confident that folding balances were known and used for weighing gold and silver in later medieval England. Other types of balance were also used, but very few have survived, possibly because beams that were made of iron have rusted away.

Measuring the mass of an object with an equal-arm balance requires a set of weights. The weights must be graduated according to some known standard and, ideally, there should be some visible indication of their trustworthiness. In the Roman and Islamic empires several methods of achieving this aim were employed, but in England the first significant step towards issuing weights marked with a sign of authority did not occur until the thirteenth century. In fact the objects concerned were not true weights, but rather poises for use with a steelyard, or auncel, as discussed above. They were globular, with a copper-alloy casing filled with lead, and they were decorated with a number of shields of arms (Fig. 3). The first attempt to give a systematic account of them was made by Dru Drury in 1926. On the basis of the heraldry, he suggested a connection with Richard, Earl of Cornwall, the younger brother of Henry III and a man of many parts, among them the administration of the coinage from 1247 until 1259. Numerous isolated finds of these objects were reported in the archaeological literature after Drury’s article appeared, but many different shields of arms were found, and the picture became confused.

![Fig. 3. A thirteenth-century steelyard weight, with four shields (actual size) (after Dru Drury 1926, Pl. IV).](image)

A significant advance was the result of metallurgical analysis undertaken by Brownsword and Pitt in 1983. They found that the more elaborate examples (which they called Type A) were all made from copper-alloy that has a high zinc content, and was not common in England at that time. Furthermore, these examples all display at least three of the four shields in the following list.

1. The three lions (leopards) of England.
2. A rampant lion, the emblem of Richard as Count of Poitou.
3. A double-headed eagle, the device of the Hanseatic merchants, with whom Richard had a close relationship.
4. A rampant lion in a border of bezants, the emblem of Richard as Earl of Cornwall.

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7 Steuer 1997.
8 Rigold 1978.
9 Dru Drury 1926.
10 Brownsword and Pitt 1983.
The remaining examples (Type B) were made from a leaded-bronze alloy with a low zinc content, and were decorated with a variety of shields, some of them quite nondescript.

On the basis of this dichotomy, we can make some reasonable deductions about these auncel weights. The first group (Type A) were produced by the specific authority of Richard of Cornwall, at some point in the period from about 1250 until his death in 1272. They were intended to further his ambitions by supporting the interests of the Hanseatic merchants and, by association, the use of the auncel as a means of weighing. Richard’s aims were partly successful, because he became king of the Romans (Germans) in 1257, and the Hansards subsequently acquired important privileges for their operations in England. But auncel weight was never generally accepted, and it remained a subject of controversy for many years. The Type B imitations of Richard’s weights were produced in this later period.

The relevance of this episode is that when sets of weights intended for use with an equal-arm beam were introduced, they adopted some of the features of Richard’s weights. The weights themselves were shaped like shields, a feature that is only found in England. They were decorated with heraldic emblems, including those that appear on the auncel weights, but with the significant exception of the Hanseatic device. Two examples decorated with the arms of England are shown in Fig. 4.

Fig. 4. Weights bearing the arms of England: probably fourteenth century (actual size) (private collection).

The weight on the left is made of lead, and the one on the right is made of bronze. Bronze examples are very rare, but their existence tends to confirm that the weights had some official status. Weights of this type occur in various sizes: the two illustrated here represent one-half of a ‘commercial pound’. They were clearly intended for weighing heavy goods, rather than money, but their precise metrological significance is beset by the difficulties that will be discussed in the rest of this paper.

Several other quasi-official designs are known. The main ones (Fig. 5) are the lion rampant, the quartered arms of England introduced in 1340, and the crown and lis (as on the coin-weights of 1422). Many unofficial types are also found, some of them with very simple and nondescript designs. Indeed, in some regions shield-shaped weights seem to have continued in

use until the nineteenth century. Sadly, the only attempt to give a coherent account of the series is a very tentative one published about ten years ago.\textsuperscript{12}

Of course, the weights shown in Figs. 4 and 5 were not intended for weighing coins or bullion. They are, however, a pointer to the contemporary smaller objects that appear to have been intended for that purpose, and which will be described later. One of the aims of this paper is to provide a framework for the identification of these objects, while avoiding as far as is possible the traditional fallacies of historical metrology (see Appendix 1).

A few more remarks are needed to complete the background. It is worth stressing that the act of weighing, on its own, is not sufficient to establish that a coin is a true one. The coin must also be assayed to determine its fineness, that is, the proportion of precious metal that it contains. Fortunately there are good reasons why the assaying process can be set aside for the purposes of the present study. One reason is that, throughout the period under review, the fineness of English coins (unlike foreign ones) was not altered. Another reason is that assaying was only ever practised at the highest levels of finance, and was not part of everyday commercial life.

Finally, there are a few rather atypical objects that ought to be mentioned briefly. A number of examples survive of a distinctive weighing device, which we now refer to (possibly incorrectly) as a ‘tumbrel’ (Fig. 6). It seems to have been intended for the simple purpose of distinguishing between a genuine silver penny and a false one, although more complex uses have been suggested. The weight-variations of the ‘genuine silver penny’ throughout the fourteenth century may explain why these devices are rare. At the time of writing, fifteen of them are listed on the Portable Antiquities website, and most of those are fragmentary. Other relevant finds are the sets of nested cup-weights (Appendix 2). They were clearly used for weighing small and precious objects, but it is convenient to defer discussion of them until after the metrological framework has been considered.

\textsuperscript{12} Biggs and Withers 2000.
2. Weight and money at the beginning of the fourteenth century

In order to identify the purpose for which a weight-object was used, one important clue is the object’s own weight. Unfortunately, the identification of fourteenth-century English weight-objects by this means is subject to almost all the complicating factors that one might imagine:

- There were several different systems of weight-standards.
- The systems changed in the course of the century.
- Artefacts are often in poor condition and not reliable evidence.
- Objects found in England may be ‘not English’.
- Documentary evidence is scarce, and rarely explicit.
- The leading authorities do not agree on the details.

In the face of such difficulties, it may be wise to begin with a few basic remarks. Just as weight is a measure of quantity, so money (in one sense) is a measure of value. In this sense, the traditional money units

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12 \text{ pence} = 1 \text{ shilling}, \quad 20 \text{ shillings} = 1 \text{ pound},
\]

are just a notation for counting multiples. In isolation no one can say what it means for a thing to be worth one penny, only that twelve things each worth one penny are collectively worth one shilling, and twenty things each worth one shilling are worth one pound. Money in this sense is designated by the term money-of-account. A more substantial function of money, and the one that mainly concerns numismatists, is as a mechanism of exchange. Here money is represented by special objects, such as coins, that can be exchanged for other objects of all kinds. It is convenient to establish an identity between the money-of-account and the money-of-exchange, and in medieval England this was achieved by the coin we call a penny.

However, the measure of value and the mechanism of exchange were not the only functions of money, even in medieval times. Not only was a penny-object exchangeable for a penny-worth of goods, it was accepted in settlement of tax or rent, and thus it played a fundamental role in the social hierarchy. In particular, the dominant position of the king was made manifest by the power to extract coins from his subjects, and that enabled him to pursue his own, usually warlike, purposes. This social function of money was the reason why the king and his ministers were constantly engaged in attempts to regulate the coinage.

In medieval monetary theory, a money-object like a penny was assumed to be a fixed quantity of a fixed metal. This meant that there was a direct link between money and weight, because the weight of a penny was a measure of the quantity of silver in it, and hence determined its value. The idea had been the basis of monetary transactions in Mesopotamia, long before the introduction of coinage. But in thirteenth-century England the concepts of money and weight had become thoroughly confused, because another link had been established: the use of the money-object as a weight-object.

This second link arose from the need to provide an objective standard of weight, and to make it widely available for comparison. Manuscripts on weights and measures dating from the eleventh to the thirteenth centuries mainly come from monastic sources, and most of them seem to be loosely based on the writings of Isidore of Seville (c.560–636). The problems of providing a manual of instruction for a large working monastery, using classical Latin terminology, gave rise to many questionable assertions. Attempts to translate these documents into modern English are fraught with difficulty, and should be treated with caution. However it is clear that, in addition to tables of relative units, expressed as multiples and subdivisions of pounds or ounces, the manuscripts propose two methods of establishing an absolute standard. One is to build the weight-system on naturally-occurring objects like grains of cereal, or chick-peas; this method is theoretical rather than practical, and will be discussed more fully below. The second method is to give an equivalence between a weight-unit and a common coin, which the older documents usually refer to by the vague term ‘denarius’. In some thirteenth century English documents ‘denarius’ is replaced by ‘sterling’, the silver penny, 240 of which made (in theory) a pound of silver. Thus it was possible to
regard the weight-object used for minting purposes, known to us as the Tower pound, as the reference for the weight-system.

This simple idea meant that the multiple units, such as shillings, could be used for weights as well as money. An example from the time of Henry II is an Assize of Bread that refers to loaves weighed in shillings. Other multiple-units, the Ounce and the Mark, derived from the Romans and Vikings respectively, were incorporated into the system, according to the rules:

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12 \text{ ounces} = 1 \text{ pound}, \quad 8 \text{ ounces} = 1 \text{ mark}, \quad 20 \text{ pence} = 1 \text{ ounce}.
\]

A good illustration of the contemporary orthodoxy is provided by some extracts from the Account Book of Beaulieu Abbey, dating from about 1270. For example, we read that... *reddit compotum de .iij.d.ob de pullis venditis.* This says that 3½ pennies were received for chickens sold; the pennies were real objects, money-of-exchange. On the next page we find the penny used as a measure of value: ... *una libra piperis valet .vj.d.* In other words, a pound of pepper is worth 6 pennies. No problems are created by the assumption that an accounting penny is identical with a penny-object, since the implication is that 6 penny-objects could be exchanged for the pepper. The problems arise when we look for a definition of the ‘pound of pepper’. Although the Beaulieu book is silent on this particular matter, the White Book of Peterborough Abbey, a similar manual written around the same time, fills the gap: *En letuaris e confeciuns la liver est de xii uncis; en tutes autre choisis la li. est de xv uncis. La unce de tote chosis est de xx deners en peys.* So there were two pounds, one of 12 ounces (= 20 shillings) and one of 15 ounces (= 25 shillings). We can be fairly sure that the same rules operated at Beaulieu, because in the Table for the Forge we find ... *viginti quinque solidi sterlingorum ponderant unam libram ferri.* Thus iron was one of the *autres chosis* (other things), and one pound of it was equal in weight to 25 shillings in sterling pennies (300).

Clearly, the intention was that pennies should be used as standard weight-objects. Unfortunately a hint of circularity had crept into the system: the penny was a certain weight of silver, but weights were being measured in pennies. Possibly this was the reason why officialdom resorted to the alternative method (mentioned above) of formulating a basis for standards of weight. The Tractatus de Ponderibus et Mensuris is a quasi-official declaration on the subject of weights and measures. It dates from around 1300, but much of the content is also found in earlier manuscripts. The document begins with a bold assertion: *Per ordinacionem totius regni Angliae fuit mensuris domini Regis composita, videlicet, quod denarius Anglicanus qui vocatur sterlingus, rotundus et sine tonsura, ponderabit triginta duo grana frumenti, in medio spice.* Some commentators translate the word *ordinacionem* as ‘consent’, which makes it sound suspiciously like what we now call spin: we all agree that a penny is 32 grains, don’t we? Even if the translation is ‘ordinance’, it still looks like an attempt to justify the existing situation by means of a bogus theory. The mass of a sterling penny was originally determined by the fact that 240 of them were equal in weight to the standard Tower pound. Obviously it was not possible to provide every citizen with copies of the Tower pound, and other methods of verifying the weight of a penny, such as the tumbrel (Fig. 6), were unreliable. Thus recourse was had to a legal fiction. Using the names of seeds for small weight-units had been common practice since ancient times, and it is no surprise that the word ‘grain’ was used to denote a small unit of weight in England. But that grain-unit was 1/24th of a penny-unit, not 1/32nd. This problem was fudged in the Tractatus by the use of the words *grana frumenti* (grain of wheat), allowing the interpretation that the other grain was in fact a

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14 Hocke y 1975, 246.
15 Hall and Nicholas 1929, 11: ‘In drugs and spices the pound is 12 ounces; in all other things it is 15 ounces. The ounce of every thing is 20 pence in weight.’
16 Hockey 1975, 263: ‘25 shillings in sterlings weigh one pound of iron’.
17 Hall and Nicholas 1929, 9: ‘By ordinance for the whole realm of England the measures of the lord King are determined, thus, that the English penny, called a sterling, round and without clipping, should weigh 32 grains of wheat from the middle of the ear.’
grain of barley. But, in the English context at least, it is hard to take seriously the suggestion that weight-standards could be constructed and replicated by using tiny seeds. That would be analogous to theological speculation about angels on pinheads.

Even if it had been consistent, the thirteenth century money-and-weight system was inherently unstable, and by the end of the century it had begun to wobble. The main reason was that more than 240 pennies were being minted from each Tower pound of silver. It is thought that a slight increase had long been allowed, and the indenture of 1279 states clearly that the number should be 243. Although the change is slight, and probably not detectable in most practical situations, the consequences for the system of expressing weights in money-units are plain.

The underlying reason for abandoning the rule that 240 pence make a pound was that silver as a commodity had uses other than as coinage, and consequently a value that fluctuated. A consequence of this was that dealers in silver bullion were accustomed to using weight-systems other than the Tower-weight. In his Pratica della Mercatura of the early fourteenth century, Pegolotti says that in London they have two ways of weighing silver, one by the mark of the Mint in the Tower of London... and the other by the mark of the workers of the Goldsmiths' trade in London, which is heavier in that this larger mark is greater by five and one-third tower sterlings, where there are 20 sterlings to the ounce and 8 ounces to the mark.

Although there are good reasons for accepting Pegolotti's figures, we are here bordering the realms of controversy, and it is worth noting that there are other candidates for the weight-system used by English goldsmiths at this time. The French-troy weight-system was based on the mark of Troyes, and was almost certainly in use in parts of France in the middle of the twelfth century. The English goldsmiths were strongly influenced by their French counterparts; they would surely have been familiar with the French-troy standard, and may indeed have adopted it as their own measure at some point. But Pegolotti referred to its use only in Paris and Bruges. He stated explicitly that its mark exceeded the Tower mark by 8 sterling pence, that is, one part in twenty. So the rule was:

\[ \text{French-troy mark} = \text{Tower mark} + \frac{1}{20}. \]

The fact that French-troy weight had a 21:20 relationship with Tower weight is fundamental to the arguments of Nightingale. She believes that the Tower system was introduced at the mint in 1158, and its magnitude was based on the French-troy standard. If the mint received silver by the French-troy weight, and paid for it in coins minted by the Tower weight, there would be a profit of one penny for each 20 penny-weights received. This practice would of course indicate that both weight-systems were known and used at the mint at that time. Lyon takes issue with some of the conclusions that Nightingale draws from this suggestion. Fortunately, the debate does not seriously affect the flow of the story that is being told in this article.

It is however important to stress that the 'troy' system involved in the debate is the French-troy system described above. Confusion can arise because that system was not the same as

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19 Johnson 1956, 61; Mayhew 1992, 126.  
20 Evans 1936, 255: 'In London they have two ways of weighing silver, one by the mark of the Mint in the Tower of London... and the other by the mark of the workers of the Goldsmiths' trade in London, which is heavier in that this larger mark is greater by five and one-third tower sterlings, where there are 20 sterlings to the ounce and 8 ounces to the mark.'  
21 Evans 1936, 245.  
22 Nightingale 2008.  
23 Lyon 2006; Lyon 2008.  
the one that eventually emerged as the troy weight of England. The latter, which we shall refer to as the English-troy system, was also simply related to the Tower system:

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\text{English-troy mark} = \text{Tower mark} + \frac{1}{15}.
\]

The justification for this relationship will be considered fully in Appendix 1, but it is not controversial. Regarding the history, the view adopted here is the one that I originally put forward in 1990: that the English-troy standard did not emerge until the latter part of the fourteenth century. Connor’s claims about the antiquity of troy weight are not directly relevant, and in any case he has (with his collaborator Allen Simpson) broadly accepted my views on this point. This story will unfold in Section 3.

The third main weight-system in England at the beginning of the fourteenth century was the one used for heavy goods or avers de pois. (We shall use the term averdepois for this system, in preference to the later corrupt form, avoirdupois.) Forty years earlier the mercantile pound had been clearly understood to be 15 ounces (25 shillings), in relation to the Tower pound of 12 ounces (20 shillings). But when the penny could no longer be relied on, even if it was rotundus et sine tonsura, there could be doubt as to the magnitude of the ounce of which 15 made a pound. The result was confusion: a mercantile pound might well differ from 15 Tower ounces, but no one could be sure. The official efforts to remedy this situation will be described in the next section.

Thus far, all the assertions made about the various weight-systems have been relative. It is comforting to know that we can in fact be fairly confident about the absolute magnitude of the Tower pound, in the sense that it can be expressed in grams, the standard of mass that is currently used. Specifically, the Tower pound weighed approximately 350 grams (the detailed arguments are set out in Appendix 1). From this figure we can derive the gram-equivalents of the other measures of mass that were used in England at the beginning of the fourteenth century (Table 1) and, incidentally, the magnitude of the French-troy pound (367 g) and the English-troy pound (373 g).

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<th>Tower</th>
<th>Goldsmiths</th>
<th>Merchants</th>
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<td>Penny</td>
<td>1.46</td>
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<td>Ounce</td>
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<td>Mark</td>
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<td>12 oz. pound</td>
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<td>15 oz. pound</td>
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3. Changes in the fourteenth century

In the fourteenth century the uncertainty about mercantile weights began to worry the king and his council. They were not greatly concerned about the niceties of trade, but rather more about the role of weights and measures in the tax-gathering process. For example, if the king wished to impose a levy on each pound of pepper imported, it would be imperative to fix the standard of weight for pepper, otherwise the pepperers would simply arrange an increase in the magnitude of the pound and pay less tax.

In the reign of Edward II the Treasurer, Walter Stapledon, distributed standard weights throughout the Kingdom. The Liber Custumarum of 1321 tells us that the king’s weights and measures were compared with those of the City of London, with the result that the king’s weights were found to be ‘deficient’ relative to those of the city. Since no examples of these weights are known, it is futile to speculate on the implications of this record, except perhaps to remark that the deficiency reported (2½d. in eight marks) is about 0.2 per cent and not very significant.

27 Riley 1860, 382.
In 1340 commissioners of weights and measures were sent to all parts of the country. They became very unpopular, and were abolished in 1344. However they were revived in 1352, and in 1357 the statute 31 Edw.III c.2 authorized the issue of new standards. Some weights survive at Winchester that probably belong to this issue (Fig. 7).

All the Winchester weights are decorated with the quartered shield of arms and a crowned C. They are fairly consistent among themselves, and when they were weighed in 1927 they were found to correspond closely to multiples of a pound of rather more than 450 g. Various explanations for this magnitude have been suggested: it may have been 15 Goldsmiths ounces, if Pegolotti’s figures are accepted, or it may have been chosen to agree with one of the many pounds used by England’s trading partners. The most significant point is that it is clearly too large for the earlier mercantile pound of 15 Tower ounces (438 g).

An obvious question is: why should we even consider the possibility that a Goldsmiths weight-standard could have been used for heavy goods? To answer this question we must consider a new feature of fourteenth-century metrology: the involvement of the City of London and its livery companies in the regulation of weights and measures. The companies mainly concerned were the Goldsmiths and the Grocers.

By the thirteenth century the leading London goldsmiths had progressed from being simply craftsmen, and were men of substance accustomed to playing a major role in the affairs of the City and the Kingdom. One such man was Gregory de Rokesley, for many years mayor of London and, in the 1280s, warden of the royal mints and exchanges. Men like Rokesley would have been involved in the discussions that resulted in the statute 28 Edw.I c.20 of 1300, which declared that the fineness of all silver wares must be no worse than the coin. From the metrological viewpoint the statute contained two significant provisions designed to enforce this rule, both borrowed from Parisian practice. First, silver that satisfied the assay was to be marked by punching a special mark, a leopard’s head, on it. Second, the standard of fineness for the entire kingdom was to be kept by the Guardians of the Craft in London, and goldsmiths from other places were to come to London to ensure that their work conformed to it. These provisions were confirmed in 1327 when the Goldsmiths Company’s first royal charter was granted.

The Goldsmiths Company took its regulatory functions seriously, including the supervision of the weights used in their trade. It is recorded that in 1360 the Company caused the weights of all goldsmiths in the City to be ‘sized and standardized’. We do not know what the standard was, but an extract from Calendar of Plea and Memoranda Rolls may provide a clue. Here we read that in 1376 William Everard, goldsmith, was called to answer certain charges, one of them being ‘that he used one weight called “Troye” for buying and another less weight called “goldsmith’s weight” when selling’. This is the first known use of the term troy in the context

Fig. 7. A 7 lb. weight from Winchester (0.5 × actual size) (Winchester City Museum: WINCH: LM 1334).

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28 Connor 1987, 129.  
31 Reddaway and Walker 1975, 33.  
32 Thomas 1929, 228.
of an English weight-system. The word subsequently appears in the Goldsmiths records for 1387, and it was used regularly in official documents thereafter. The statute 2 Hen.V c.4 of 1414 mentions the 'Pound of Troy' explicitly. It is possible that these uses of the word refer to the old-established French-troy system, but it seems much more likely that the explicit appearance of a new term coincided with the introduction of a new standard, the English-troy system. In 1417 the Goldsmiths Company acquired a new pile of standard weights, but they have not survived to give us an answer. The earliest definite record from which the magnitude of English-troy units can be inferred is the statute of 1526 which authorized their use at the mint in place of the Tower units. That document states clearly that the ratio between the Tower system and the English-troy system was 15:16. The fact that there are no records of a significant change in the weight-system for precious metals between the 1380s and 1526 is further evidence for the view that the English-troy standard was used throughout this period.

The second half of the fourteenth century was notable for political turbulence. The country was riddled at all levels of society by factions, most of which were driven by self-interest. The City of London was deeply involved. Its dominant interests in money and trade became intricately linked with national policy, against a background of violence and political intrigue. The Goldsmiths Company played its part, with its special interest in the regulation of the trade in precious metals. But there was another trade, equally if not more important, the trade in 'heavy goods' or *avers de pois*. Here regulation was the business of the Grocers Company.

A society of grocers of London had been formally constituted in 1345, as the Fraternity of Pepperers of St Antonin. Like the goldsmiths, the leading grocers were men of substance, with interests in the trade in wool and other commodities, and the Fraternity soon grew into one of the most powerful of the livery companies. From 1373 the name 'Company of Grocers' was used, and in 1377 the company obtained a royal charter that confirmed their long-established control of the Great Beam, where heavy goods were weighed. Another royal charter, granted to the City of London in 1383, confirmed the grocers' role in the regulation of the trade in heavy goods. Not only did they have control of the Great Beam, they were also authorized to 'search and size' the weights used in the grocery trade. Thus they had acquired rights and responsibilities similar to those enjoyed by the goldsmiths for the trade in precious metals.

The question naturally arises: what were the weight-standards enforced by the grocers at this time? They could not have been based on a pound of 15 Tower ounces, since that had been superseded by a heavier pound by 1357, if not before. Sharpe's *Calendar of Letter Books* for the City records that in 1372 an order was made 'that no one sell, grocery, . . . etc. except by the Guildhall weight, viz., fifteen ounces to the pound'. The significance of this statement is that in 1372 the mercantile pound still comprised 15 ounces. However, the division into 15 parts is a clumsy one, especially for weighing with an equal-arm balance. In that context binary subdivisions – halves, quarters, and so on – are more natural, and it seems likely that, at some point in the 1370s or 1380s, a definite decision was made to redefine the ounce so that 16 of them made a pound. This change could have been introduced without altering the magnitude of the pound, and hence without the need for new standards and statutes. On the other hand, given that the Grocers played a leading role in the regulation of mercantile weighing, we should expect to find some record of the change in their archives. The absence of an explicit record can be explained by the fact that the archives were tampered with in the vicious political intrigues of the time; indeed there are no archives at all for the years 1359–73 and 1378–80. Fortunately, the fact that a transition did occur can be inferred from the archives that have survived. The archives for 1386 and 1397 both contain records concerning the hand-over of the Company’s

33 Reddaway and Walker 1975, 54. Further evidence is provided by entries in Exchequer Rolls (Devon 1837). Some rolls from the reign of Edward III (pp. 185, 201) speak of ‘goldsmiths weight’ while in the reign of Henry V (pp. 322, 370) ‘troy weight’ is specified.
34 Reddaway and Walker 1975, 112.
37 Sharpe 1905, 300.
38 Nightingale 1995, 214.
affairs to a new set of wardens. In both cases the records refer to sets of ‘weights of brass’ belonging to the Company, and in 1386 the list of the smaller weights is as follows: ‘half-a-pound, quarter and half-quarter, 1 ounce, half-an-ounce, and the punch for marking the weights.’ In 1397 the list is similar, but the half-quarter is replaced by ‘two ounces’. This seems to be clear evidence that a pound of 16 ounces was in use.

Another significant fact to emerge from these records is that the Grocers were using a punch to stamp weights, as a sign that they had been checked and agreed with their standards. This is the first reference to a mark for weights analogous to the hallmark used by the goldsmiths to indicate silver that had passed the assay. It heralded a system of inspection and verification that was to continue, in various forms, up to the present day. Weights, of lead and bronze, that seem to date from the relevant period have a crown stamped on them (Fig. 8). Since the grocers were acting under the provisions of a royal charter, it is possible that the crown was used as their verification mark. Similar weights are found in all parts of the country, which suggests that the mark was also used by local officials under the authority of the statute 13 Rich.II c.4 of 1393. It is worth noting that this use of a crown, stamped as a mark of official approval, predates its use on the coin-weights of 1422.

The regulatory system for averdepois weighing was consolidated in 1429. The statute 8 Hen. VI c.5 declared that weighing must be done using an equal-arm balance, no ‘turn of the scale’ should be allowed, and the weights used must be ‘sealed’ to show that they were correct according to the standard. Surviving artefacts suggest that the crown punch-mark continued to be used until the reign of Henry VII, when it was superseded by a mark that combined a crown and a letter h in the Lombardic style.

In summary, the fourteenth century witnessed the introduction of two new weight-systems in England (Table 2). The old Tower system was used only at the Mint, where it survived until 1526. The new English-troy and averdepois systems were anomalous, but long-lived. For centuries the English were amused, bemused, and confused by a troy pound that was smaller than an averdepois pound, and a troy ounce that was larger than an averdepois ounce. Nevertheless, it was not until comparatively recent times that rationality was allowed to triumph over anomaly.

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39 Kingdon 1883, 66, 79.
40 Nightingale 1995, 178.
TABLE 2. Gram-equivalents of weight-systems at the end of the fourteenth century

<table>
<thead>
<tr>
<th></th>
<th>(Mint)</th>
<th>(Goldsmiths)</th>
<th>(Merchants)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tower</td>
<td>Troy</td>
<td>Averdepois</td>
</tr>
<tr>
<td>Penny</td>
<td>1.46</td>
<td>1.55</td>
<td></td>
</tr>
<tr>
<td>Ounce</td>
<td>29.2</td>
<td>31.1</td>
<td>28.4</td>
</tr>
<tr>
<td>Mark</td>
<td>233</td>
<td>249</td>
<td></td>
</tr>
<tr>
<td>12 oz. pound</td>
<td>350</td>
<td>373</td>
<td></td>
</tr>
<tr>
<td>16 oz. pound</td>
<td></td>
<td>454</td>
<td></td>
</tr>
</tbody>
</table>

4. Checking silver coins

From the eighth century onwards the silver penny was the only coin that circulated to a significant extent in England. Its mass varied quite significantly, between about 1.0 g and 1.7 g. In the twelfth century the theoretical value was set at 1.46 g (240 to the Tower pound), although in practice the value was slightly smaller. Throughout this period there were numerous occasions when a payment had to be made, or an account settled, by handing over a large number of pence. The payment could be checked by simply counting the coins, but for many purposes it would have been necessary to check by weighing as well, and accurate sets of weights for this purpose would have been needed. The variations in the mass of the penny would imply a relatively quick turnover for these objects.

Objects of this kind have been found regularly in archaeological excavations, and more recently many of them have appeared on the market and have passed into private collections. One of the first numismatists to take an interest in them was David Rogers, whose collection of lead weights was published posthumously in 2000. Many such lead weights are nondescript, but a few of them are strongly diagnostic. For example, from the Viking period there is a dome-shaped weight that clearly indicates a mass of half a mark, about 100 g at that time.42 A square weight, with the design of the board used in the game of nine-men’s-morris, corresponds almost exactly to a Tower mark (233 g).43 There are numerous similar objects, mainly cast in lead, that may well have been used for the purpose of checking coined silver or bullion. Indeed, given the widespread use for commercial purposes of the auncel, which does not require sets of weights, it must be presumed that most weights of this type were used either for silver, or for other precious objects such as silk or spices. An analysis of these objects, fuller than that given in my notes on the Rogers Collection, is much needed.

For the period under consideration here it is sufficient to focus on objects that have a clear and visible connection with the sterling penny, because they bear a representation of a king’s head like that found on the coins. The dating of these items is facilitated (in theory at least) by the changes in the mass of the penny. After the indenture of 1279, which declared that 243 pennies should be minted to the Tower pound, there were minor variations, followed by significant changes in 1344, 1351, and 1411 (Table 3).

TABLE 3. English silver pennies, thirteenth to fifteenth centuries

<table>
<thead>
<tr>
<th>Number per Tower pound</th>
<th>Mass in grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>243</td>
<td>1.44</td>
</tr>
<tr>
<td>266–270</td>
<td>1.32</td>
</tr>
<tr>
<td>300</td>
<td>1.17</td>
</tr>
<tr>
<td>360</td>
<td>0.97</td>
</tr>
</tbody>
</table>

The lead weights shown in Fig. 9 may be tentatively assigned to the period 1351–1411, when the penny weighed about 1.17 g. The square weight has been cast in a mould and it weighs 181 g, which is right for a mark of 160 pence. The hexagonal weight has been stamped with

41 Biggs and Withers 2000.
42 Biggs and Withers 2000, 22.
43 Biggs and Withers 2000, 27.
an impression of the king’s head, and the quality of the punch-mark suggests some official usage, which is consistent with our earlier remarks about punch-marking as a sign of verification. The object weighs 89 g, which is right for a half-mark of 80 pence. It must be stressed that although the identifications suggested above are reasonable, they are not beyond doubt. Quite generally, arithmetic can lead to several possible interpretations of an object’s function, a point which is discussed more fully in Appendix 1C.

As well as payments in marks or shillings, there were many circumstances where a payment in a small number of pence was required. For example, Beaulieu Abbey charged ¼d. per week to vendors at the market in Faringdon\(^\text{44}\) and this charge was probably collected in quarterly instalments of 3d. At Ipswich the charge for the customs ‘cocket’ issued to exporters of wool was 2d. Given the uncertain state of the coinage, such payments could well have been routinely checked by weighing. After 1351 the coinage was augmented by groats and half-groats, and so a weight for checking a payment of 4d. or 2d. could be regarded as a coin weight, in the strict sense of a weight for checking an individual coin. No documentary references to such weights are known, but a variety of small objects with designs resembling the portrait on the sterling coins have been found (Fig. 10).

The first of these objects is made of lead, with traces of gilding, and it weighs 6.77 g. Objects with the distinctive quadrilobe shape have been found, not only in England, but also in parts of France and the Low Countries. A few of them have the king’s head, and some also

\(^\text{44}\) Hockey 1975, 12.
have a fleur-de-lis (see Fig. 11). The piece shown here may represent 6d. at the 1351–1411 standard of 1.17 g. The second object is also made of lead; it weighs 2.38 g and is in almost pristine condition. It is said to have been found in the off-site spoil from the Vintry site near Southwark Bridge, but it is not mentioned in the published report. Could it be a weight for checking the 2d. charge for a customs cocket? The third object is bronze, weighs 6.52 g, and the king’s head has been stamped with a punch. It is known that weights of this kind were made in various locations in the Low Countries, for instance in Bruges, and this may well be a ‘Bruges type’. (The forthcoming publication of a collection of examples from several locations is eagerly awaited.) The weight shown here is rather light for 6d. at the 1351–1411 standard, but too heavy for 4d. at the 1279–1344 standard. The fourth object is also bronze, and weighs 3.98 g. The workmanship is fine, with the king’s head surrounded by fleurs and roundels. It is very slightly over-weight for the groat after 1411.

Only a few other objects similar to the ones shown in Fig. 10 have been published, and it would be invidious to attempt any kind of classification at this stage. Among the more distinctive pieces are some triangular bronze weights with the king’s head in the centre and fleurs in the angles. The distinguished numismatists Derek Allen and Adolphe Dieudonné thought they were intended for checking a gold coin, but they disagreed about the identity of the coin. It may therefore be permissible to suggest that they were intended for checking a payment of 3d. in silver, at one of the 1344–51 standards, or a groat at the post-1411 standard.

All the weights mentioned above were intended for weighing more than one penny. As far back as 1205 there is mention of weights for checking a single penny, although no examples of that date are known. From a later date there are a few extra-thick halfpenny coins, which may have served as weights for checking a penny. One of them, a silver object with the Short Cross class VIIIb3 design used from c.1244 to 1247, is illustrated in the Withers Corpus. But the evidence strongly suggests that checking the correctness of individual pennies was not common practice.

There are numerous weights that resemble in form those with the facing portrait of the king, but with different designs. Some of them were intended for checking gold coins, and these will be discussed in the next section, but others were probably used for weighing bullion. Goldsmiths expected to make a steady profit by trading in the precious metals, and for this reason they needed accurate weights, which could be graduated according to a weight-standard that differed from the coinage standard. Their methods may have been legitimate, or not, as in the case of William Everard mentioned in Section 3. In addition to sets of nested cup-weights (Appendix 2), the goldsmiths used small, flat, square or rectangular, weights. The latter were probably intended for weighing in pennyweights and grains, so their identification is complicated by the fact that a ‘pennyweight’ could mean different things at different times in the fourteenth century.

Fig. 11. Weights used by goldsmiths for checking coins or bullion (1.5 × actual size) (private collection).

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45 Drinkall and Stevenson 1996.
46 Based on work of G. Houben, revised by R. Holtman.
47 Biggs and Withers 2000, 48, no. 151; Withers and Withers 1993, 6–8.
48 Allen 1934.
49 Smith 1941, xxviii. A recent find (UKDFD, no. 19009) may be relevant.
50 Withers and Withers 1993, 6, no. 25.
The weights shown in Fig. 11 illustrate the problems of identifying weights of this kind. The first one, with a bifoliate crown, is made of lead and weighs 14.5 grams. Could it represent 10 pennyweights (half an ounce) at the Tower standard? The second one is similar in shape to one of the ‘sterling’ weights shown in Fig. 10. It is also made of lead and weighs 7.46 g. Its identification is further complicated by the fleur-de-lis motif, which is capable of several interpretations. The lis could indicate a French connection, such as the French-troy standard, although that does not mean that the weight originated in France. Alternatively, it could represent the Florentine lily, as depicted on the gold florin. In the next section we shall see several weights for which the latter interpretation is almost surely the correct one, but the mass of the second weight in Fig. 11 cannot be explained on that basis. However, the third object in Fig. 11 is almost certainly a weight for checking a gold florin. The metal is a copper-alloy, and the design is a simple lis in a lozenge bordered by dots. It weighs 3.17 g. Weights with this design have been found in several parts of England, for example York.51 Finally, there is a ‘Bruges style’ copper-alloy weight, stamped with a crown above the letters TP. The mass is 3.93 g. Suggestions as to the function of this piece are very welcome.

5. Checking gold coins

Although it is customary to think of fourteenth-century England as a time of war and plague, it can be argued that the introduction of a sound gold coinage was equally important in shaping the nation’s long-term future. An experiment in the time of Henry III had failed, and for several generations the English had been able to use only gold coins of foreign origin. In the twelfth and thirteenth centuries there were ‘bezants’, and from 1252, ‘florins’. In due course the original Florentine florin was supplemented by imitations, and there were also several French coins, including (from 1337) ecus of Philip VI.

By 1343 English merchants exporting wool to the Low Countries were being paid in florins. These coins had a special relationship with the Florentine bankers who financed both trade and warfare, and consequently the exchange rate for the florin was artificial and unfavourable to the English. It was clear that England must have its own gold coinage, or it would continue to be disadvantaged in the international markets, and that would affect the king’s ability to raise revenue. The first attempt was a coinage based on an imitation double florin of 7 grams, but it failed because it was seen as a sneaky attempt to cash in on the special features of the Florentine currency. However, within a year a completely new type was produced. It was called a noble, and its design (a ship) and its valuation (half a mark) were distinctively English. The noble was a success, and it continued to be minted for over a century, although its mass declined steadily. The changes, according to the Mint indentures52 are summarized in Table 4. The nobles were nominally .995 fine gold, and this was never altered.

<table>
<thead>
<tr>
<th>Coin</th>
<th>Value</th>
<th>Number per Tower pound</th>
<th>Mass in grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>1344</td>
<td>‘florin’</td>
<td>72d</td>
<td>50</td>
</tr>
<tr>
<td>1344</td>
<td>noble</td>
<td>80d</td>
<td>39½</td>
</tr>
<tr>
<td>1346</td>
<td>noble</td>
<td>80d</td>
<td>42</td>
</tr>
<tr>
<td>1351</td>
<td>noble</td>
<td>80d</td>
<td>45</td>
</tr>
<tr>
<td>1411</td>
<td>noble</td>
<td>80d</td>
<td>50</td>
</tr>
</tbody>
</table>

Although the needs of international trade were the original motivation for the minting of nobles, half-nobles, and quarter-nobles, it was not long before these coins began to circulate internally.53 The result was that the gold coins were subject to the same malpractices as had

51 Pirie 1986, Pl. XVIII, no. 244.
53 Lloyd 1977, 113.
traditionally been worked on the silver coins. In 1379 Parliament set up a commission to consider what should be done. The members reported individually, and they made various suggestions about revaluation,\textsuperscript{54} none of which were implemented at that time. But they all agreed that gold ought to pass by weight. This was a sensible precaution which must have occurred to all those who dealt with gold, and it is reasonable to assume that weighing nobles was already common practice in the 1380s.

As has been noted, gold coins were always weighed using an equal-arm balance, which requires separate weights. So we might expect to find some evidence of these weights, and indeed, there are a number of square or rectangular objects that seem to be relevant. They depict a simple representation of a ship, the main feature of the coins (Fig. 12).

These weights are made of lead, some of them possibly of pewter. We cannot be precise about their dating, for a combination of reasons. The mass is variable, as might be expected given the several issues of the noble noted in Table 4. But some variation can also be attributed to the fact that the weights themselves are not in pristine condition, and possibly also to the fact that an allowance for wear of the coins was made.

In 1990, when my earlier paper on medieval coin-weights was published in the \textit{BNJ},\textsuperscript{55} only very few weights of this kind were known. The Withers \textit{Corpus}\textsuperscript{56} contained about twenty of them, and a few more were published in 2000 as part of the Rogers collection.\textsuperscript{57} A tentative classification can therefore be attempted, although more examples would be useful. On the basis of the mass of the noble, it is reasonable to suggest the following categories (proportionate figures for half-noble and farthing-noble are understood):

- Weights over 8 g belong to the period before 1351.
- Weights between 7 g and 8 g probably belong to the period 1351–1411.
- Weights less than 7 g probably belong after 1411.

A few of the noble-weights have one corner deliberately removed.\textsuperscript{58} This may indicate that the weight was reduced when a new, lighter standard was introduced. Also, when the gold coins were being renewed in 1422 the bullion price of the 7 g noble had risen to 7s. 10d., and so nobles weighing only 6 g were worth the official ‘face-value’ of 6s. 8d., and were accepted at that value. One of the cut pieces weighs 5.99 g and may well be related to this procedure.\textsuperscript{59}

Parallel to the small lead weights for checking nobles, there are similar weights for checking foreign coins. Although the statute 17 Ric.II c.1 of 1393 specifically banned the circulation of

\textsuperscript{54} Bland, Brown, and Tawney 1915, 220.
\textsuperscript{55} Biggs 1990.
\textsuperscript{56} Withers and Withers 1993.
\textsuperscript{57} Biggs and Withers 2000.
\textsuperscript{58} Withers and Withers 1993, 9, no. 60; Biggs and Withers 2000, 47, nos 144–5.
\textsuperscript{59} Biggs and Withers 2000, 47, no. 145.
foreign coins in England, there is ample evidence that foreign coins circulated before that date. Even if the statute of 1393 was strictly enforced (and that is questionable) foreign coins would have been treated as bullion, and weights for checking them would still have been used by goldsmiths and others involved in the bullion trade.

Fig. 13 shows two French écu coins and some associated weights. The écu à la chaise of Phillip VI was minted from 1337 onwards. The obverse represented the king enthroned, accompanied by a shield with four or more fleurs-de-lis in an irregular pattern. This coin was certainly familiar to the exporters of wool by 1343, and there is evidence from the Close Rolls that it had become part of the English circulating medium by the 1360s. It is thought that part of the enormous ransom of John II in 1360 was paid in these coins and, although some of them found their way to the mint to be recoined as nobles, some may have been used to pay directly for enterprises such as Lionel of Clarence’s expedition to Ireland. These coins must eventually have passed into general circulation. The écu à la chaise was originally minted at just over 4.5 g, but its mass was decreased periodically. It was not produced after 1353, being replaced in the 1360s by a new gold coin, the franc à cheval. In 1385 Charles VI re-introduced the écu, with a simpler design. The obverse depicted a crown above a large shield, and on the shield were three fleurs-de-lis arranged symmetrically. This coin was to become common throughout Western Europe. The original mass was 3.9 g but that was gradually decreased, as was the fineness. These variations are not very helpful in dating the weights shown in Fig. 13, and even the more obvious clue of the number of lilies on the shield is not foolproof. In fact the square weight on the left, which has only three lis, weighs 4.55 g and is arguably the earliest, since the others weigh 3.77 g and 3.72 g.

In addition to French coins, the Florentine florin was well-known to the English: for example, the customs accounts for the port of Lynn in 1303–5 record the importation of a significant number of them. By the middle of the century florins would have been familiar in many aspects of trade, and it is no surprise to find weights for checking them, of the same type as those for the nobles and ecus (Fig. 14, on the left). The mass and fineness of the florin remained constant for a long period, at 3.5 g and nominally pure gold. This fact ought to aid recognition of weights intended for checking the florin, were it not for the confusion created by the use of the lis motif for other purposes.

It is rather more surprising to find similar weights for checking a much less well-known coin, the peter (pieter d’or) of Joan and Wenceslas as rulers of Brabant, produced from about 1374 onwards. St Peter was the patron saint of Louvain, and on the coin he is shown holding up a book and key, a design which appears on the weights shown on the right in Fig. 14. There is no obvious reason for the circulation of these coins in England. One very tentative sugges-

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Footnotes:
60 Lloyd 1977, 113.
61 Ormrod 1987, 630.
62 Lloyd 1977, 100.
tion is that when the wealthy clothworkers of Louvain were expelled by Wenceslas in 1383 they brought large quantities of peters to England with them.

The object of coin-weights is to combat the problem of coins that have been mutilated in some way. However, the use of such weights creates a secondary problem, because the weights themselves may be mutilated. Lead weights are particularly susceptible to ill-treatment, and it has been suggested that the cross-hatching found on the reverse of some of them (Fig. 15) was intended to discourage malpractice.

However, the interests of the owner of a weight are not usually served by reducing it. Cross-hatching also appears on the reverse of contemporary pilgrim badges and, in any case, this simple device would clearly be ineffective as a sign of correctness. Thus when unrest about the state of the gold coinage came to a head in 1420/1, a more satisfactory guarantee of accuracy was needed. By that time the Mint and the Exchanges were in the hands of goldsmiths based in London. The arrangements for the appointment of these persons to provide coin-weights have been discussed elsewhere; it was a classic example of turning poachers into gamekeepers. The features of the weights (Fig. 1) reflect the experiences of the fourteenth century. First, there are royal marks of authority, echoing those used in the verification of trade weights, and by the goldsmiths. Second, the weights are round, not square, indicating that they were made at the Mint, where the production of round objects was traditional. Third, they were made of bronze, not lead, so that tampering was more difficult. These features contributed to a long and useful life for the coin weights of 1422.

6. Summary and conclusions

The evidence described above provides several new insights into the numismatic history of later medieval England. This is partly the result of the increasing amount of artefactual evidence, and partly the result of better understanding of several associated areas, where clarification of detail illuminates the whole picture.

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6 Biggs 1990, 72–3.
The period considered was a time of transition, in terms of both coinage and weight-standards. The old Tower pound continued to be the standard for coinage, but it was no longer a universal measure. New weight-standards were introduced, both for the trade in goods and for the trade in bullion; they were different from each other, and the Tower system. The importance of the standards was reinforced by an increased emphasis on the regulation of weighing procedures, and visible signs that weights had been verified.

In practice, large payments in silver coin and bullion were routinely checked by weight. When the requirements of foreign trade led to the introduction of gold coins, these coins were also widely used internally, and they suffered from the usual abuses. As a result, people soon began to check them by weighing, initially using square coin-weights made of lead. By the 1420s it had become clear that a sound gold currency had to be supported by the availability of more reliable weights: these were round, made of copper-alloy, and they were marked with official signs of authority.

APPENDIX 1. EVIDENCE BASED ON ARITHMETIC

The history of metrology and numismatics is littered with examples of conclusions drawn from unjustified assumptions about the mass of objects that no longer exist, such as the Tower pound. The classic scenario involves a single erroneous assumption, followed by a barrage of complex calculations carried out with spurious accuracy, as a result of which the original error becomes overlooked. A cautionary tale can be found in Munro's account of the work of Miskimin, on a subject closely related to ours.64 More generally, we must avoid the kind of heroic assumption that was once fashionable in archaeological circles: an object weighing 394.578 grams found in the Eastern Mediterranean does not 'prove' that a unit of that magnitude was in use in that area in the fourth century BC. Another pitfall is the old numismatic habit of expressing the mass of an object in troy grains—a folly that the present author was guilty of not so long ago.65 In theory any unit can be used for comparison, and for some purposes the English-troy grain is appropriate, but using it in complex discussions of medieval minting practices is confusing, to say the least.

A: The mass of the Tower pound

By a standard of mass we mean a physical object that is assumed to contain a fixed amount of matter. The mass of any other object can be measured by comparing it directly with the standard, but in practice the comparison is done by means of a chain of intermediate objects. In the twenty-first century the standard of mass is an object known as the International Prototype Kilogram (IPK). By working backwards it is possible to establish a chain of comparisons that links this object to the medieval weight-standards discussed in this paper, and thus we can assert with some confidence that the Tower pound was approximately 350 g, where the mass of the IPK is 1000 g.

1. Since 1963 the pound in England has been defined to be exactly 45,359,237 hundred-millionths of one kilogram. There are national standards of the pound and the kilogram, but the legislation states that their magnitudes are to be maintained by reference to the IPK. Between 1855 and 1963 the absolute standard was what is now the national standard pound, an object known as the Imperial Standard Pound (ISP). The ISP was compared with the IPK on several occasions, and the number 45,359,237 was chosen in 1963 because it was consistent with those comparisons, and had the additional property of being divisible by 7. (This meant that the troy grain, which was a legal unit equal to 1/7000th of the ISP, could also be expressed exactly in terms of the IPK.) In grams, we have

\[
\text{ISP} = 453.59237 \text{ g}
\]

2. The construction of the ISP was necessitated by the destruction of the previous standard in the fire at the Houses of Parliament in 1836. That standard was a troy pound, originally made by Joseph Harris of the Mint in 1758. We shall call it the Harris Troy Pound (HTP). It had served as the legal standard since a statute of 1824, which also provided that if the HTP were lost or destroyed, then it should be replaced by a complicated procedure involving a certain volume of water. When the commission charged with restoration considered the matter, they concluded that the statutory procedure was very unreliable, and that a much more accurate standard could be made by comparison with existing copies of the HTP, some of which had been preserved with great care. They also decided that the time had come for the troy pound to be replaced by an averdepois pound, which had been defined in the 1824 Act as 7000 troy grains, where 5760 troy grains made a troy pound. In other words, the mass of the new ISP was 7000/5760 of the extant copies of the HTP. These copies are assumed to have been correct to within one part in ten-thousand, or more, and so we have a close approximation for the HTP:

\[
\text{HTP} = (5760/7000) \times 453.59237 \text{ g} \approx 373.2 \text{ g}
\]

64 Munro 2000, 175–7. 65 Biggs 1990.
3. The construction of the HTP in 1758 also involved some minor uncertainty. It was based on comparison with several weights that had been kept in the exchequer since the reign of Queen Elizabeth, but these weights were not consistent due to loss of mass through use and oxidation, and no single one of them represented a troy pound. On the basis of the published reports it appears that the discrepancy was as much as one part in a thousand, and in the end an arbitrary decision had to be made. For this reason we can only state the mass of the HTP's hypothetical precursor, an Elizabethan Troy Pound (ETP), as an approximation with three significant figures:

$$\text{ETP} \approx 373 \text{ g}.$$  

4. In Elizabeth's reign there were several attempts to re-establish the 'ancient' standards of the kingdom, and after much confusion, standards of troy (and averdepois) weights were distributed in 1588. They were constructed on the basis of several sets of semi-official troy weights, including those in use at the Mint, and it is reasonable to assume that there was at that time a Mint Troy Pound (MTP) very nearly equal in mass to the ETP:

$$\text{MTP} \approx \text{ETP} \approx 373 \text{ g}.$$  

5. Finally, the MTP had been established by statute in 1526, which explicitly stated that the mint should use the troy pound in place of the Tower Pound (ToP), the latter being equal to 11¼ ounces, 12 of which made a troy pound. Since the ratio of 11¼ to 12 is the same as 15 to 16 this gives the equation

$$\text{ToP} = \frac{15}{16} \times \text{MTP} \approx 350 \text{ g}.$$  

The argument given above depends upon a single chain of comparisons, and any supporting evidence is very welcome. Some of the intermediate steps in the chain can be checked (but not verified beyond doubt) by looking at weights that are still extant. For example, several of the standards distributed to the counties in 1588 have survived in reasonable condition, and they are not inconsistent with the supposed mass of the ETP. Copies of the HTP are also still in existence, and they too are supportive. Further supporting evidence will be given in the next section.

B: International comparisons

We have argued that the absolute mass of the Tower pound, that is, its mass in terms of a physical standard that exists today, was about 350 g. This result is important for modern archaeologists and numismatists, because it helps to improve our understanding of medieval artefacts and the purposes for which they were used. But medieval merchants and bankers were concerned with the relative values of the weight-systems used at that time, because these were the basis of commerce and exchange. An insight that has emerged quite recently from the mists of historical metrology is that the relative values were usually based on simple numerical ratios. Indeed this was almost inevitable, given the limitations of arithmetic at that time. I have discussed elsewhere the constraints imposed by the methods and notation available to the medieval arithmeticians, in relation to Pegolotti's tables of exchange. A similar point is made by Williams in his account of the assaying process. Pegolotti's *Pratica della Mercatura* was a set of specific instructions for the routine tasks carried out by his employees, such as the statement that a French-troy mark should be equated to a Tower mark plus 8 sterlings. This result was a specific instance of the rule that the ratio of a Tower unit to the corresponding French-troy unit was 20:21. Converting such rules into practical instructions required complicated arithmetical processes, in particular long division, which suggests that Pegolotti and his assistants possessed a high level of arithmetical skill. The tables they produced could then be used in the daily routine of banking, by persons with a lower level of expertise.

At the end of the thirteenth century in North-West Europe there were numerous systems for weighing precious metals. Fortunately, the relationships between three of the systems can be established with a high degree of confidence, and from that basis most of the other systems can be derived. The three 'core' systems were: the London Tower system (L), the Paris Troy system (P), and the Bruges Silver system (B).

Fig. A1 illustrates the relationships between the mark-weights of the three systems. It is based on a fictitious unit, in terms of which the L-mark was 20 units, the P-mark 21 units, and the B-mark 16 units. The ratios between the real mark-weights were thus:


It is not suggested that the medieval arithmeticians thought and worked in the manner represented by Figure A1, but they must have based their calculations on the ratios that arise from it. All three ratios can be inferred from the instructions in Pegolotti's book, and in fact the 21:16 ratio is stated explicitly. The arithmeticians also had to cope with the different ways in which the three marks were subdivided. In London a mark was 8 ounces each of 20 penny-weights, in Paris it was 8 ounces of 24 denier-weights, and in Bruges it was 6 ounces of 20 esterlin-weights (Figure A2).

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67 Biggs 2009.
69 Evans 1936, 245.
70 Connor and Simpson 2004, Ch. 4; Munro 2000.
71 Evans 1936, 237.
The numbers in Figs A1 and A2 were sufficient for all calculations involving exchange between these systems, but there were significant problems about communicating the results. The Hindu-Arabic numerals may well have been known and used by the skilled arithmeticians who helped Pegolotti compile his instruction-manual, but in the daily business of banking and exchange everything had to be done in Roman numerals. Similarly, the instructions could not make use of the decimal notation for fractions, because it was not invented until the sixteenth century. Nowadays, after converting a Tower weight of (say) 53 ounces to French-troy units, we should express the answer as 50.4762 Paris ounces, but in the fourteenth century the answer had to be written as vi marks ii ounces xi den ob.

The three core weight-systems were not the only ones used in the fourteenth century. Some old ones persisted, and some new ones emerged. It is fortunate that the internal consistency of the London-Paris-Bruges framework enables us to link these other systems into a firm foundation. We shall discuss briefly four of these related systems: English-troy, London Goldsmiths, Bruges gold, and ‘the Little Mark of Flanders’.

As stated in Section A, when the English-troy system replaced the Tower system at the Mint, it was declared that the ratio between the two was 16:15. On the basis of Fig. A1, the ratio between the Tower and the French-troy systems was 20:21. Writing these ratios in the equivalent forms 64:60 and 60:63, it follows that the ratio between English-troy and French-troy was 64:63. Remarkably this was exactly the ratio obtained in 1742 when the Royal Society compared some actual weights. Another point of interest concerns the English and French troy ounces which, according to Fig. A2, must have been in the same 64:63 ratio. The numbers also tell us that the ratio of the B-ounce to the P-ounce was $\left(\frac{8}{20}\right) : \left(\frac{6}{21}\right)$, which is the same as 64:63. In other words, the English-troy ounce was identical to the Bruges silver ounce. This may have been coincidence, but given the uncertainty surrounding the adoption of the English-troy system, we must allow the possibility that it was deliberate.

There is some independent evidence for the absolute mass of the French-troy mark, partly from the so-called ‘pile of Charlemagne’ (actually dating from the fifteenth century) and partly from numismatic evidence dating back to the thirteenth century. That evidence provides a figure of approximately 245 g for the French-troy mark. Consequently we have, for the English-troy mark of 8 ounces,

$$(64/63) \times 245 \text{ g} \approx 249 \text{ g},$$

and for the Tower pound of 12 ounces

$$(12/8) \times (20/21) \times 245 \text{ g} \approx 350 \text{ g},$$
in agreement with the figures obtained above.

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The London Goldsmiths mark was, according to Pegolotti,\(^74\) larger than the Tower mark in the ratio 31:30. Combining this fact with the numbers given above, we can obtain its value in terms of the other core systems and their derivatives.

The region that we know as the Low Countries was even less of a political entity in the late middle ages than it is now. It not only contained important mints, such as those of Flanders, Brabant, Namur, and Hainault, but also major centres of international trade, such as Bruges. The fact that the Bruges weight-system for gold was not the same as the one used in that place for silver is only one of the complications that arise when we try to make metrological sense of the region.\(^75\) However, this particular problem is mitigated to some extent by the fact all authorities, including Pegolotti, agree that the Bruges gold system was the same as the French-troy system.\(^76\) Unfortunately, it cannot be assumed that the Bruges gold and silver systems were applied elsewhere in the region at any given period. There are several references to the ‘Little Mark of Flanders’, which is relevant because it underlies some important evidence on the fineness of the English silver coinage.\(^77\) The general picture seems to be that the basic weight-units, the ounce and the mark, were regularly increased in magnitude from the eleventh century onwards, in a game of metrological leapfrog. The Viking ounce (ora) was about 24.5 g, eight of which made a mark of 196 g. This was superseded, first by a mark of 216 g, and then by a mark of 233 g, the latter ‘mark of Cologne’ being effectively the same as the English Tower mark. Further increases led to the French-troy mark of 245 g and the English-troy mark of 249 g. But we cannot be sure about the dating or even the sequence of these events. The Little Mark of Flanders, and the division of the mark into only 6 ounces in Bruges, could be seen as evidence of attempts to retain some stability in the mad game of metrological manipulation.

C: Identification of multiple units

The identification of some of the objects described in Section 4 is an example of a metrological problem that has no definite solution. The underlying difficulty is quite easy to explain. We are asked to identify an object which, it is believed, was used for checking payments of a certain number of pennies. We know the object’s mass in grams, but we can only give a rough estimate of its date. For definiteness, let us suppose that the mass is 35 grams, and the period is ‘1300–1500’, so that according to Table 3 the mass in grams of the pennies being checked might have been any one of four numbers. The other unknown is the number of pennies represented, which is likely to have been a number that was expressible simply in terms of shillings or marks. For an object of 35 g, we might reasonably suggest 40d. (a quarter-mark), 36d. (three shillings), 30d. (2s. 6d.), or 24d. (two shillings). Thus the problem is to find \(p\) and \(x\) such that \(px\) is approximately 35, where \(p\) is one of the numbers 0.97, 1.17, 1.32, 1.44, and \(x\) is one of the numbers 40, 36, 30, 24. If we work out the 16 possible values of \(px\) it is no surprise to find that several of them are quite close to 35:

\[
\ldots, 34.56, 34.92, 35.10, \ldots.
\]

These numbers correspond respectively to 24 pence of 1.44 g, 36 pence of 0.97 g, and 30 pence of 1.17 g. Further progress towards identification must therefore depend on other factors, such as the condition of the object, its design (which is rarely specific), and the possibility (or otherwise) of a small tolerance. Lest it be thought that the figure of 35 g had been chosen to illustrate a particularly difficult case, it is worth noting that any value between 25 g and 50 g is within about 2 g of one of the 16 possible values. The general situation can be analysed quite simply in mathematical terms, but the example should be enough to make the point.

APPENDIX 2. NESTED CUP-WEIGHTS

The weights shown in Fig. A3 are examples of a very distinctive style, nested cup-weights. Sets of weights of this kind originated in Roman times, and were associated with weighing precious objects, such as those used in the goldsmiths’ trade. The style appears to have been revived in the twelfth century, and examples have been found in Germany, France, and the Low Countries, as well as England, Scotland, and Ireland. The characteristic features are the binary sequence of denominations, usually including \(\frac{1}{4}, \frac{1}{2}, 1, 2\) ounces, and the decoration with punched dots, including the bird’s-eye motif of a dot in a circle. They are made of a copper-alloy that we would now call bronze, and they fit together loosely inside a box that is itself a weight. The details of the design show a progression that can be traced up to the sixteenth century, when a more sophisticated method of construction was introduced.\(^78\)

The examples that appear to be the earliest are based on eight-ounce marks of about 200 g, 216 g, or 233 g, which suggests that they may have originated in an area where Scandinavian or Germanic standards prevailed. It will be recalled that the 233 g mark was the mark of Cologne, as well as the Tower mark of London. English finds mainly conform to the 216 g standard, although one from Salisbury is very close to an ounce on the English-troy

\(^{74}\) Evans 1936, 255.
\(^{75}\) Berck 1931; Wytels 1967; Munro 2000.
\(^{76}\) Evans 1936, 237.
\(^{77}\) Brand 1994, 73.
\(^{78}\) Holtman 1997–8.
CHECKING THE CURRENT COINS

A few later English finds are also consistent with this standard, and have punchmarks that possibly indicate official verification. The currently-available evidence regarding these cup-weights tends to confirm the general picture of metrological inflation, as mentioned in Appendix 1B. It is to be hoped that more finds will lead to more specific conclusions.

REFERENCES

Hall, H. and Nicholas, F.J. (eds), 1929. ‘Select tracts and table books relating to English weights and measures (1100–1742)’, Camden Miscellany XV (London).

79 Algar and Egan 2001, 125.


