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The Composition of the Copper Alloys used by the Greek, Etruscan and Roman Civilisations

2. The Archaic, Classical and Hellenistic Greeks

Paul T. Craddock[a]

This paper is the second dealing with the composition of copper alloys used by the Greeks. About 500 analyses of Archaic, Classical and Hellenistic objects are published here pp. 117–123 together with comments upon the alloys used. The data are arranged chronologically within broad limits and further subdivided typologically. The techniques of sampling and analysis are discussed in depth in the first part of this project (Craddock, 1976).

The development of casting technology is one of the principal features of bronze-working during this period. Our knowledge of Greek casting technology comes both from archaeological excavation and from a careful examination of the castings themselves. Evidence from these sources has been brought together here for the first time together with the comments of medieval, renaissance, and modern technical authors to attempt a coherent picture of the way the superb Greek bronzes were produced and adorned.

It was during this period that the Greeks started using mercury gilding on copper and bronze; and the techniques and range of gilded metal are discussed.

Discussion of the Results

Archaic Greek Statuettes

During the Archaic period the Greeks developed and expanded the economic prosperity which had begun in the Geometric period, and this is reflected in both the quality and quantity of the bronzework. By this time the Greeks had extensive trade with the Eastern Mediterranean, especially Egypt and the Levant and many of their artistic motifs and metal types were adapted and adopted by the Greek craftsmen. One of the most important technical innovations in Greek bronze technology was made at this time, the use of hollow casting, presumably introduced from the East, although the Greeks thought of it as their own invention. During the preceding Geometric period the bodies of the small statuettes of horses had been modelled in wax upon a wedge of clay, this was then invested and fired, the wax ran out and the bronze poured in around the wedge, which was then scraped out leaving the characteristic open hollow in the underside (Maryon, 1956). In the Archaic period the wax model was often made around a clay core which was supported within the mould by bronze or copper pins (inside the damaged Classical statuette of a youth, No. 1141, the pins can still be seen embedded in the core). Thus when the mould was fired and the wax ran out, the clay core would be left suspended, later to be again totally covered when the bronze was poured in. This method of casting meant that

[a] British Museum Research Laboratory, London WC1, England.

far less bronze was needed, and during the 7th and 6th centuries BC increasingly large hollow cast statuettes, and finally lifesize and colossal statues were produced, the latter replacing the earlier statues made of sheet metal on a wooden support (see *Greek Statues* section).

All the 62 statuettes analysed here are of bronze although No. 1006 has only 1% tin; they contain 1·0–16·5% tin with an average of 7·4% (Figure 1). Forty-eight of the bronzes contain more than 1% lead (Figure 2). The majority of these have less than 10%,

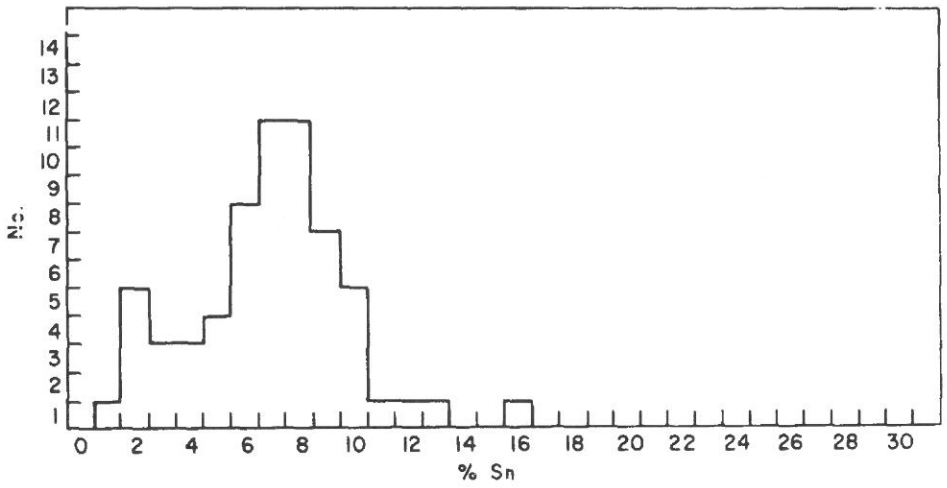

Figure 1. Tin content of Archaic statuettes.

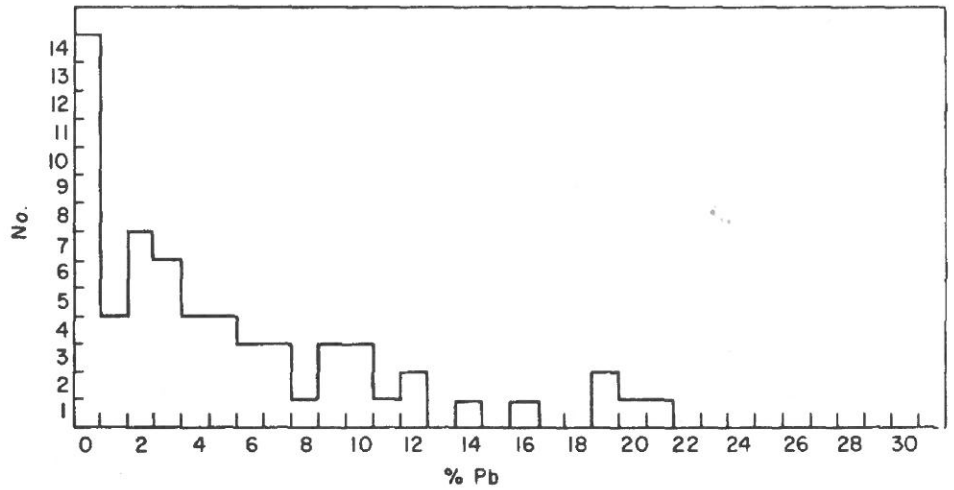

Figure 2. Lead content of Archaic statuettes.

although the lead content extends up to a maximum of 21·6%; lead is therefore far more frequently found than in previous periods, and must be looked upon as a deliberate addition to the alloy, although the distribution is scattered suggesting no specific lead content was preferred.

The two headed bull, No. 723, has 2·3% zinc, 2% arsenic, 1·4% antimony, and 1·0% iron, as well as 1·7% lead and 7·5% tin; and the statuette of a goat, No. 739, has 1·1% zinc, 0·7% arsenic and 0·8% antimony, as well as 16·5% tin. Both of these complex alloys are bronzes in which the additional elements do not replace the tin. Zinc, arsenic, and antimony occur in copper sulphide ores (Key, 1963; Muhly, 1976), and these metals should all be lost on roasting in air. The analytical results therefore strongly suggest that a

sulphide ore was being used, and that there was a failure to complete the roasting stage. The analyses of the components of the ploughing group, No. 851–4, show them to be of similar compositions as do the analyses of the two components of the Arybellos in the form of a shoe, No. 1132–3, but the identical horse finials, No. 996–7, have different compositions.

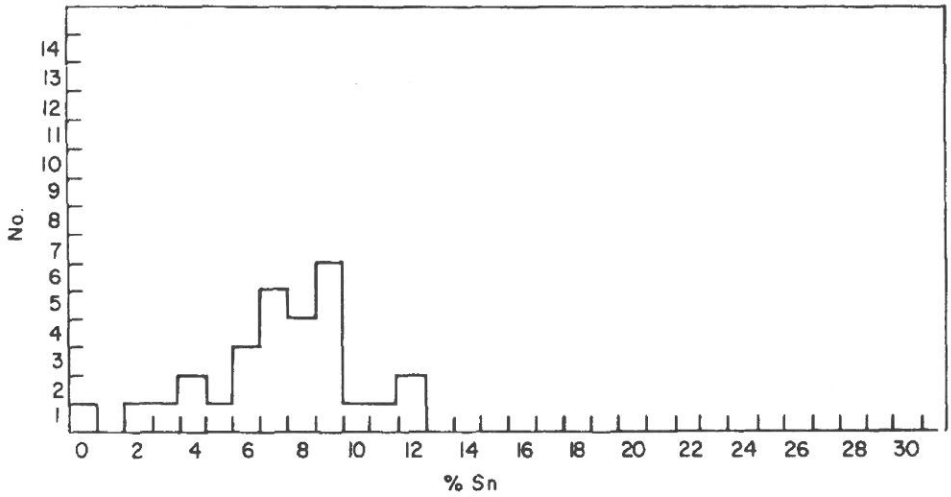

Figure 3. Tin content of Classical Greek statuettes.

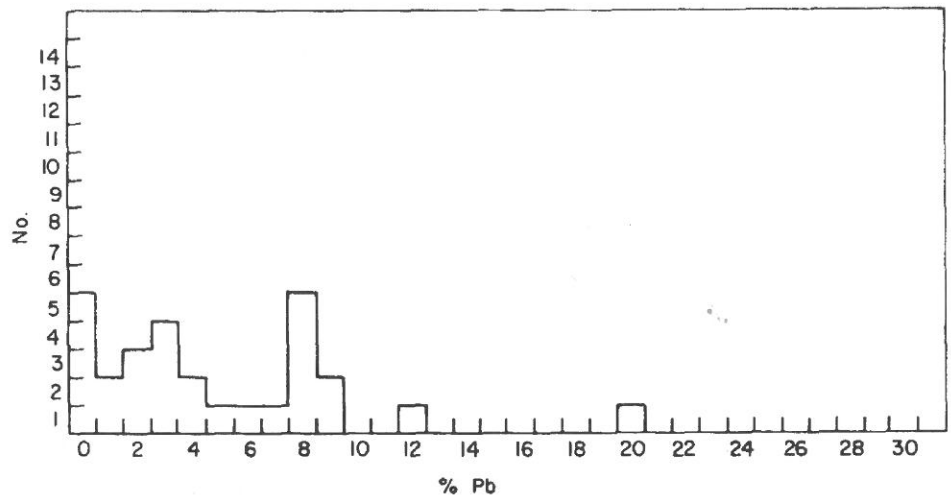

Figure 4. Lead content of Classical Greek statuettes.

Archaic Greek Decorative Bronzes

These alloys are all of bronze with 5·5–11·7% tin and an average tin content of 8·9% (Figure 3). Only 8 of the 23 bronzes have more than 1% lead, with a maximum of 8·9% (Figure 4). This is substantially less lead than was found in the contemporary statuettes, but is similar to the Geometric decorative bronzes, which also contained less lead than the contemporary Geometric statuettes. Bronze with more than a few per cent of lead is difficult to work after casting and many of the decorative pieces have been extensively worked, whereas relatively little work was done on the statuettes after casting.

Archaic Greek Mirrors

Only two mirrors and a handle were analysed. These were of bronze with approximately 10% tin, and little lead, and are similar in composition to the contemporary Etruscan mirrors and to the succeeding Greek Classical and Hellenistic mirrors.

Archaic Greek Vessels

The body of Greek bronze vessels was normally raised from sheet metal, and the cast handles were then either soldered or rivetted to the body. This means that the handles tend to be more substantial, and often survive better than the body of the vessel. In this work, five vessels with their four attached handles, and an attached base, together with five more separate handles were analysed. It is immediately apparent that the vessels are all of unleaded tin bronze, whereas the handles are usually quite heavily leaded. This was to be expected as it would have been impossible to raise the bronze without it tearing if it had been leaded. The hydra, No. 1108, has the handles rivetted to the body with copper rivets.

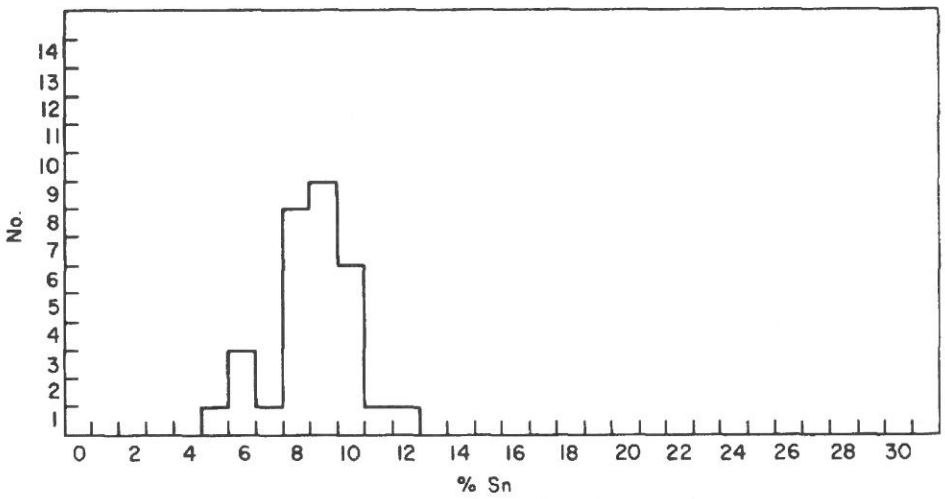

Figure 5. Tin content of Classical Greek mirrors.

Classical Greek Statuettes

In the century following the defeat of the Persians, Greek Art developed and prospered especially in Athens.

The Statuettes are mainly of leaded bronze containing 2·35–12·8 % tin with an average of 7·9 % (Figure 3). The exception is No. 1168 which is of copper. Only 5 of the 28 statuettes have less than 1 % lead, the others containing up to 20·5 % (Figure 4).

The statue of Athene, No. 226, has a separate base, No. 753, held by the original rivet. The base contains less tin than the statuette, and the rivet is of copper. The statuette of a youth, No. 1141, is damaged and one of the pins used to hold the core in place during casting is visible. It has a similar composition to the statuette but with less lead. The choice of composition of the pins can present the smith with a dilemma. If bronze of similar composition is used there is then a danger that, when the heated metal is poured into the mould, the pins will melt and the core will move thus ruining the casting. However if copper pins, which have a higher melting point than bronze, are used, the ends of the pins will show up clearly on the finished casting because they will have a different colour. Nowadays, and probably in antiquity, some colouring or patination was applied to the bronze to finish it, and this may have disguised the copper pins.

Classical Greek Mirrors

The majority of these mirrors have tanged handles, but during the 4th century BC cased mirrors were introduced in which a closely fitting lid protected the surface (Lamb, 1929). Occasionally a separate polished disc mirror was contained between a fitting base and cover.

The tin content of the mirrors varies between 5·4 and 12·3% with an average of 9·1% (Figure 5). This relatively high tin content is to be expected as the metal needs to be hard in order to retain a polished reflecting surface. The lead content of mirrors No. 278, 282, and 279, all of the 5th century BC from Camirus, is rather high and would impair the reflecting surface and make polishing difficult. Where mirrors have separate handles the composition is often different from that of the mirror itself; thus the separate tang, No. 290, has 7% lead but the mirror to which it is attached, No. 291, has only 0·28%, and similarly the handle, No. 485, has 16% lead but the mirror has only 0·55%.

Classical Greek Vessels

The compositions of these vessels are similar to those produced in the Archaic period. With the exception of the oinchoe, No. 1269, which is cast rather than raised, the body is normally of unleaded bronze and the handles contain considerable quantities of lead to aid their casting.

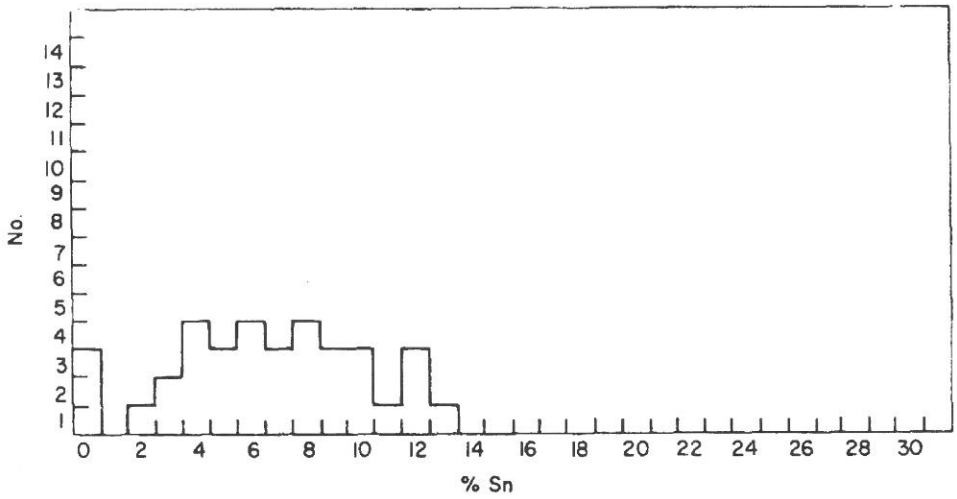

Figure 6. Tin content of Hellenistic statuettes.

Hellenistic Greek Statuettes

After Alexander's conquest of the Persian Empire (334–323 BC), Greek culture spread rapidly through the eastern Mediterranean and bronzes were soon being made in the Hellenistic style throughout the Near East.

With the exception of the brass figures No. 261–2, and the copper fragment of drapery, discussed below, the statuettes are of bronze containing 2·0–13·8% tin with an average of 7·6% (Figure 6). Only three of the statuettes contain less than 1% lead, the others contain varying amounts up to 30·5% (Figure 7). It can therefore be seen that many statuettes are highly leaded, and certainly more so that in preceding periods. The classical coins analysed by Caley (1939, 1970) were found to contain little lead, but those of the later Hellenistic period were frequently heavily leaded. Many contemporary Late Etruscan statuettes were also made of heavily leaded bronze. These heavily leaded bronzes were previously only known to have been used by the Romans (Caley, 1970), but it is important to note that they were also common alloys amongst the Greek and Etruscans.

The 1st century BC statuette group of Hermes leading a lady, No. 261, upon the trunion, No. 262, which held them to a large tripod now lost, are of brass with only small amounts of tin. The composition suggests they were made by the cementation process in which copper pellets were heated with charcoal and zinc oxide in crucibles. Typically

such a brass will contain 22–28% zinc, and little tin or lead. The group comes from Egypt and is believed to be Late Hellenistic, but could be of the Roman period. The composition is very similar to that of the 1st century BC Roman Republican coins which were also made by the cementation process. This group is the earliest known statuette of brass made by the cementation process. Coghlan & Parker (1975) have recently published the metallographic examination of a tripod from Cyprus which purported to be Roman, but of the 3rd century BC. However in this case the metal contained *c.* 30% zinc, the bowl was formed by spinning, and the patina was not genuine and these facts strongly suggest that the whole piece is modern.

The fragment of drapery, No. 660, is of copper with 3·0% lead. It is unusual for statuary bronze to be made of copper at this late period. Unfortunately the statuette itself is lost but it may be that the cloak was deliberately made of copper to give it a different colour from the figure. The practice of making the various parts of a statue or statuette in order to give different colours is well known (see *Greek Statues* section), and is mentioned by Pliny, who states, "the addition of lead to Cyprus copper produces the purple colour to be seen on the bordered robes of statues".

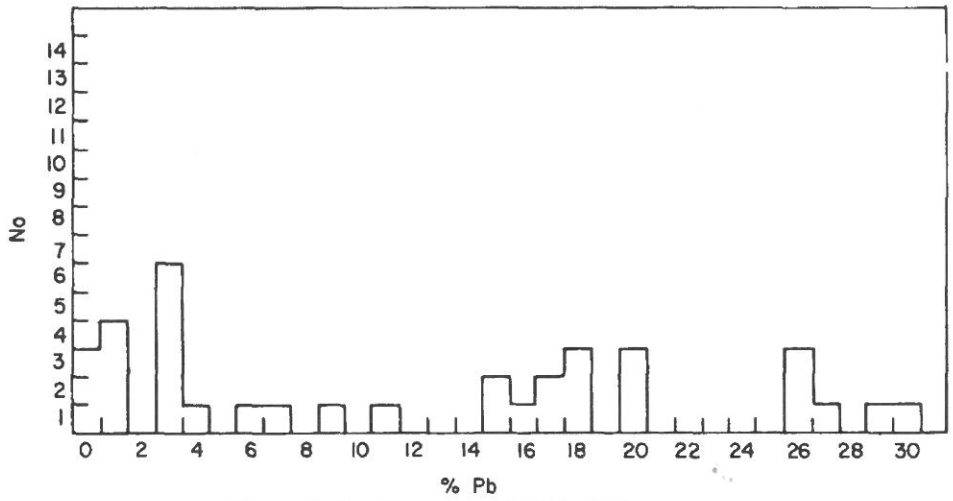

Figure 7. Lead content of Hellenistic statuettes.

Hellenistic Greek Mirrors

During the Hellenistic Greek period cased mirrors became common, although mirrors with tanged handles were still popular. The mirrors are of bronze containing 4·3–12·4% tin and an average of 9·2% (Figure 8). Eleven of the twenty-eight mirrors and cases have more than 1% lead with as much as 7·7% in one instance. However, some of the mirrors including No. 492 which contains 7·7% lead, have definitely been tinned and in these circumstances the lead in the body metal would not affect the reflecting properties of the surface. The process by which these and the Roman mirrors are likely to have been tinned will be described in a later paper. Other of the leaded Hellenistic mirrors may have been tinned but are now so corroded or have been so drastically cleaned that it is now impossible to establish this fact. Thus it seems likely that by the Hellenistic period there may have been two types of mirror, those that were plated, and those that relied on the polished surface of an unleaded tin bronze.

Hellenistic Greek Decorative Bronzes

Only seven ungilded bronzes were analysed in this category. They are of bronze, with 6·0–10·5% tin and an average of 8·6%. With the exception of No. 1106, which is relatively

large, they have only small quantities of lead in the alloy, again in notable contrast to the contemporary statuettes.

The gilt metalwork is all mercury gilded and the body metal is normally of copper or bronze with a low tin content; lead is only present in small amounts. These rings date from the 4th–1st century BC and would seem to be the earliest examples of mercury gilded copper (Marshall, 1907). Wooley (1938) found about three pounds weight of mercury amongst the sands at the Greek trading settlement of Al Mina in layers dated to the 5th century BC. There are gold workings near Al Mina and Wooley considered that mercury might have been used for extracting gold. This is a possibility but it could also have been used for the mercury gilding of copper and silver. The evidence for the use of mercury prior to the Christian era has recently been reviewed by Lins & Oddy (1975) from which it would seem that the knowledge and use of mercury was becoming widespread during the latter part of the 1st millenium BC. The source of the Greek mercury was probably

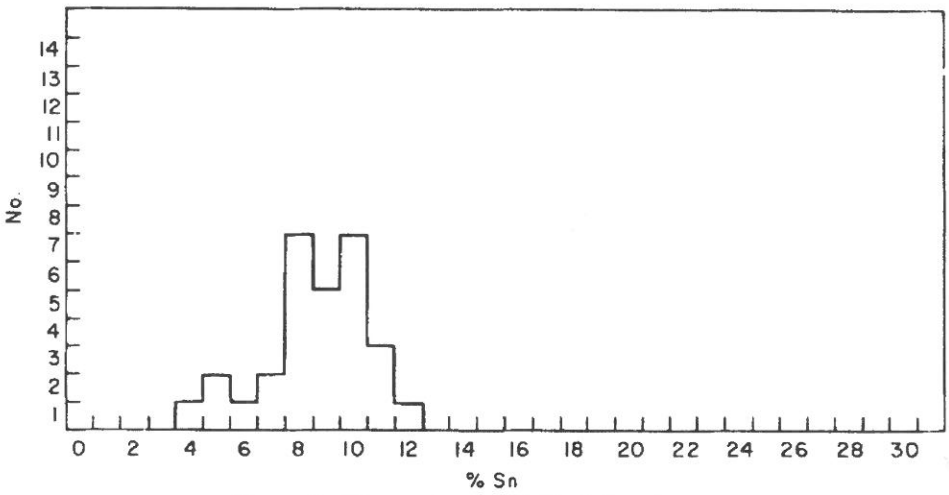

Figure 8. Tin content of Hellenistic mirrors.

from the Sizma Ladik region of Turkey where evidence of Roman mercury smelting has recently been uncovered (Barnes & Baily, 1972) from Suplja Stena near Vinca in Bulgaria (Forbes, 1971) or from Spain which is mentioned by Theophrastus and other classical authors as a source of mercury and which according to Vitruvius took over from Ephesus as the major supplier during the Roman period. Thus the knowledge and use of mercury seems to have grown during the Hellenistic period, but the gilding of base metal was restricted to small jewellery prior to the Roman period, when the more ostentatious taste of the Romans, so bemoaned by Pliny, encouraged the gilding of all decorative metal, furniture fittings, statuettes and statues.

From the analytical data, it is apparent that, even as early as the 4th century BC, the Greeks appreciated that copper was much more satisfactory than bronze for gilding. The reasons for this are as follows. The gold-mercury amalgam is spread over the cleaned surface of the metal to be gilded and heated to near the boiling point of mercury (357 °C) at which temperature most of the mercury evaporates leaving the surface gilded. Now lead, tin and zinc all form amalgams with mercury relatively easily, the saturated weight percentage of the three metals in mercury at 20 °C being: 2·15% for zinc, 0·62% for tin, and 1·3% for lead, whereas the figure for copper is only 0·00032%. Thus there is a danger of the first three metals forming an amalgam and being absorbed from the body metal into the gilding metal during the heating and therefore spoiling the finished gilding. Lead is especially likely to do this as it does not dissolve in the copper but is present in

separate globules, concentrated on the surface of the bronze, and would begin to melt at 327 °C, i.e. 30 °C *below* the boiling point of the mercury. Presumably it was to guard against these likely mishaps that the Greek and Roman metalsmiths normally used copper or a low tin bronze as a base for the gilded metalwork. Theophilus who was writing on technical subjects in the 12th century AD states "If, when it (the gilding) begins to take on a yellow colour; you see white spots emerging on it so that it refused to dry evenly, this is the fault of the calamine because it was not evenly alloyed or of lead, because the copper was not purged and refined free of it" (Theophilus).

Hellenistic Greek Bronze Vessels

Six handles and a rivet were analysed. They were of bronze with the exception of No. 1311, which is of copper with 2% arsenic. This alloy is most unusual for the 4th century BC, and may represent the re-use of prehistoric metal.

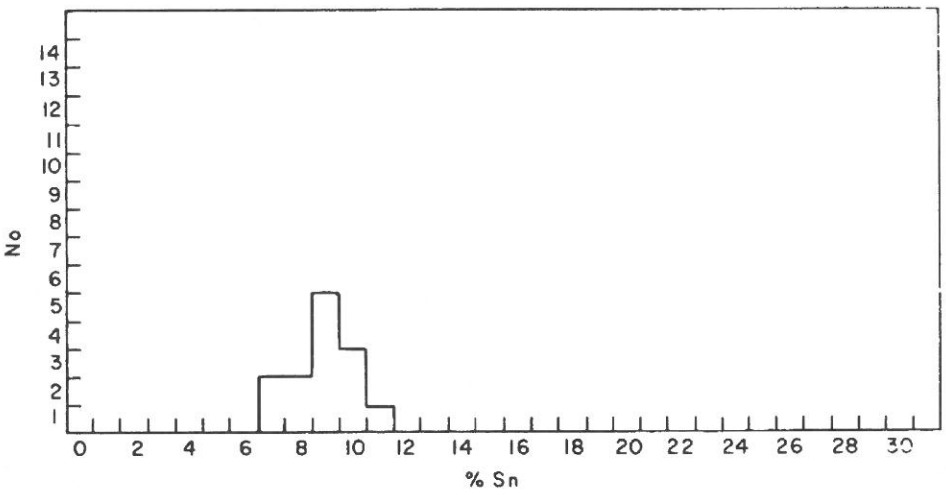

Figure 9. Tin content of Greek armour.

South Italian Greek Bronzes

Greek colonies were established in southern Italy from the late 8th century BC onwards. The Greeks in the West prospered for the next 500 years until they were absorbed by the rapidly expanding Roman Republic. The cities of the Greeks in Italy had many workshops and produced their own bronze although the style and decoration were very much dominated by metropolitan Greek art.

The statuettes were typically made of leaded tin bronze. Only 2 of the 24 pieces have under 1% lead. These relatively high lead contents match the contemporary Etruscan compositions more closely than those from Greece itself. Similarly, the statues seem to be leaded at an earlier date than those in Greece. This will be more fully developed in a subsequent paper.

Three examples of statuary bronze were examined; these include a 5th century BC arm, 14 fragments of a lifesize statue of a warrior from Anzi, and a curl from a lifesize statue of the Hellenistic period. Curls normally have the same composition as the head to which they are attached (see *Greek Statues* section), and thus are a fair indication of the composition of the statue as a whole. All three statues were of leaded bronze. The 14 samples from the large statue have similar compositions with the exception of piece No. 6, and are important as they show the range of composition to be expected in a large casting of a leaded bronze (Craddock, 1976). Piece No. 6 is obviously different with higher lead, lower tin and a little cobalt, and must represent a repair.

The drapery from the statue has a key pattern and copper has been hammered into the undercut channels of this design. A spectrograhic analysis showed the copper to be pure apart from a trace of nickel, iron and silver.

The mirror, No. 638, is of unleaded bronze with 10% tin, whereas the handle and statuette which adorn the mirror are leaded bronzes with rather less tin.

Greek Bronze Armour

These pieces range in date from the 7th to the 4th century BC and have all been raised from sheet bronze, in a similar fashion to the contemporary vessels. They are all of bronze with 7·1–11·4% tin and an average of 9·4% (Figure 9). They contain only traces of lead, which in high concentrations would be inimical to cold-working the metal. The contemporary arrowheads (see *Miscellaneous Greek Bronzes* section) often have much higher tin contents, or in one case arsenic, and this would make the metal harder than the armour. This suggests that some of the arrowheads may have been intended to be armour piercing.

Greek Statues

Before the introduction of hollow casting in the 7th century BC large or lifesize statuary was made of sphyrelaton work in which bronze plates were hammered and chased to shape and held together by rivets often on a wooden support. Very few examples of this survive. There are the figures of a man and two women from Dreros, Crete, although we know from Pausanias of others which seem to have been made in this manner and which had survived until the 2nd century AD. These include the statue of Zeus Hypatoi near the temple of Athene Chalkiockos at Sparta.

The process of hollow casting seems to have been introduced to Greece during the 6th century BC, and rapidly became popular. The traditional inventors of bronze casting are Rhoecos and Theodorus, who were also supposed to be the first modellers in clay, and to have introduced hollow casting to the Peloponnese in the 7th century BC. These discoveries have been linked together to make Rhoecos and Theodorus the first Greeks to build piece moulds invested with clay and with clay cores. More realistically they or some nameless craftsmen learnt the process of hollow casting in Egypt or the Levant at this time, but they may well have improved upon the methods they were taught, since the subsequent Greek statues include iron armatures for support, and are superior castings to contemporary pieces in the East. However, there is no question of the Greeks actually "inventing" the process of either hollow casting or of casting lifesize statues as both had been practiced in the Near East and Egypt for hundreds of years before.

The techniques by which the Greeks made their large castings are reasonably well known both from the excavated remains of foundaries and the study of the surviving bronzes themselves.

By careful examination of statuary bronze such as the Chatsworth Apollo (No. 45) and the leg of the warrior from Anizi (No. 1) Haynes (1962, 1969) has been able to show conclusively that the statues were made by piece moulding. This is to be expected since it would be difficult, if not impossible, to cast a lifesize statue in one piece. It was therefore much more sensible for the artist to create his statue in wax or clay and invest this with clay or plaster to produce a negative. This could then be cut into convenient pieces for casting and removed leaving the original intact for further copies, or to use again should the first casting fail. If one had details such as the hanging curls it could be difficult to remove the mould, so these pieces were removed before the original investment, and cast separately by the lost wax process and hard soldered to the completed bronze head. The fired clay, or plaster negative was then lined on the inside with wax or strips of clay to the thickness of bronze required. When this had been done the sections

of the lined mould would have been reassembled and the space left filled with liquid clay to form the core. The outer mould would then be separated and the lining be removed, and the mould reassembled around the core. If the mould was of clay the casting could proceed, if it was of plaster it would be necessary to prepare a clay mould by casting wax into the plaster mould with its clay core, removing the plaster negative mould and investing the wax positive with clay and firing to harden the clay and remove the wax. Cellini gives a detailed account of piece moulding in his *Autobiography*. A detailed practical account of modern statue casting is given by Mills & Gillespie (1969).

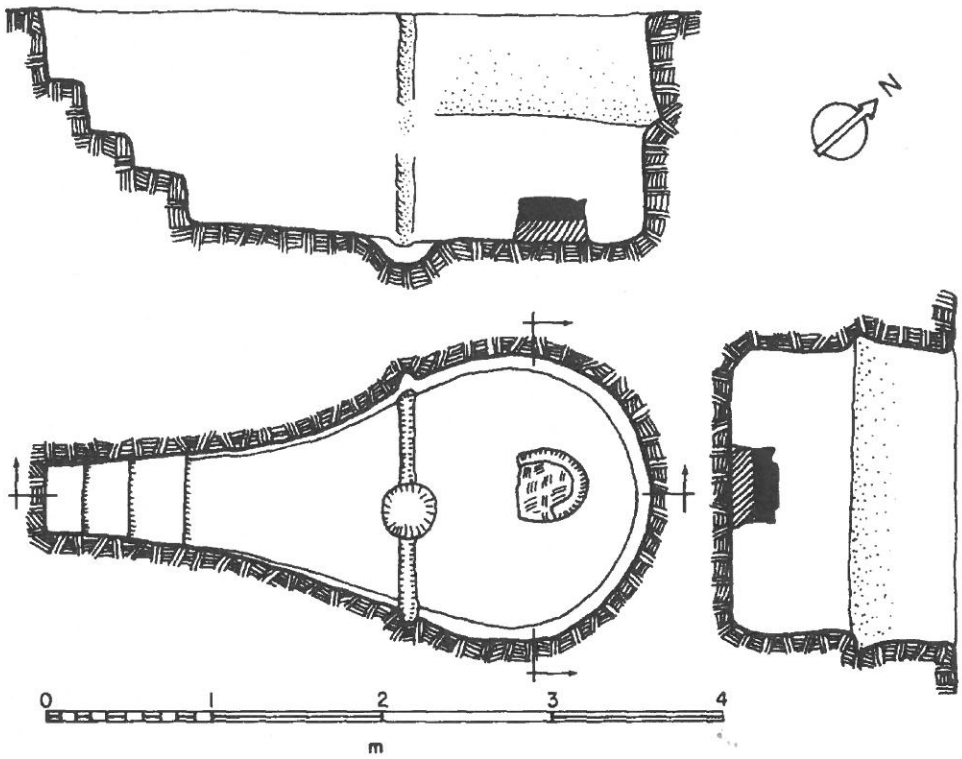

Figure 10. Casting pit on west slope of Areopagus. (Couresty of the American School of Classical Studies at Athens.)

Due to the great weight of the components of large statues and the need to support the moulds firmly during casting, it was usual to build the moulds in specially dug pits, and these, often filled with foundry debris, have survived to be discovered by the archaeologist. Probably the most complete series to be uncovered were those in the Athenian Agora (Thompson, 1948, etc.). Beneath the Thesion temple was found a large pit of the 4th century BC cut to a depth of 1·65 m into bedrock and then lined with mud bricks. This had subsequently become filled with the debris of casting: ashes, fragments of many moulds, and most interesting, terracotta pipes through which the molten metal was led from the furnace on the edge of the pit down into the mould. This pit was clearly associated with a permanent foundry that was cleared away when the temple was built. There were other casting pits in the area dating from the 6th, 5th and 2nd century BC, but these were less substantial, and built for temporary use only, almost certainly for casting the cult statues for the temples which overlay them. In the 6th century pit to the south of the temple of Apollo was found the remains of the mould of just one casting: a lifesize statue of Apollo, clearly the cult statue. Dating from the 5th century BC was a small irregular pit containing the remains of just one or possibly two statues. An especially well preserved

casting pit of the 2nd century BC is illustrated in Figure 10. There were traces of burning in the bottom of the pit around the plinth of broken terracotta and tile. This plinth was channelled, presumably to collect molten wax pouring from the mould during the *in situ* firing. The filling of the pit included many pieces of mould from a life-size statue. These pits dug specially to contain moulds for the on-site casting of the large cult statues of the temple have their counterpart from medieval Christian cathedrals and abbeys, where such pits were dug to cast the bells. With large castings such as statues or bells it is clearly more practical to cast the metal on site, rather than to work in a central workshop and have the problems of subsequently transporting the finished products. The casting pits, and their fillings, are very similar for both statues and bells, and the medieval writer Theophilus has left us with a very detailed account of how they should be used.

The unfired mould would have been built up on the plinth and then fired. This also melted out the wax between the mould and core and heated the mould to red heat. This was necessary to stop the incoming metal solidifying too quickly before it had penetrated the mould and to lessen the temperature difference between the mould and the molten metal which could cause the mould to crack. When the mould was at red heat the fire would be quickly extinguished and the pit packed with soft earth around the mould. This was to give the mould support. It must be remembered that the clay mould was very friable and pouring a great weight of molten metal into it was a hazardous operation. (Note in Figure 10 the shallow trench and slots in the bottom and side of the trench pit to take shuttering so that the amount of earth needed to surround the mould could be lessened.) The copper would be melted in a furnace by the side of the pit, and when the copper was molten the tin would be added. This is clearly stated by Theophilus, and again with good reason. It is important that the metal poured into the mould is well above its melting point in order that it should fill the mould before it solidifies; but how was the temperature to be measured without a pyrometer? Copper melts at 1083 °C but a 10% tin bronze melts at about 950 °C. Thus, if the tin was added to molten copper and the temperature of the resulting alloy brought back to the temperature of the molten copper it would produce a bronze at more than 100 °C above its melting point and introduce a satisfactory safety margin (modern bell founders cast at a temperature of about 1100 °C). The molten alloy would then be led into the red hot mould through the terracotta pipes, or by using crucibles if pipes were not available. After the casting had been made and allowed to cool the mould would be broken and the statue section removed for cleaning up and assembly. The techniques by which the metal components were joined in antiquity have been studied by Lechtman & Steinberg (1970), but may be usefully summarized here. There were two basic types of metal joins used. First there were mechanical joins in which the pieces were fitted together and held by crimping or rivetting. Second there were metallurgical joins in which either the sections were soldered together with a metal alloy of lower melting point, or fusion welding was achieved by pouring superheated metal of the same composition onto the join and thus supplying sufficient heat to the edges of the join to melt them. All of these methods have been observed on ancient statues.

To increase the realism of the statue, details such as the lips, nipples and eyelashes would be made of copper. The eyelashes were normally of sheet copper but the lips might be of sheet copper keyed into the main casting, as for example on the Chatsworth Apollo, or they might be cast separately as for example on the Head of a Berber, or the Head of Sophocles. It should be noted that castings of "copper", used either for the colour effect or to aid subsequent mercury gilding, often contain a small amount of tin to make the metal flow more easily and to deoxidize it. Castings of pure copper, such as the lips of the Berber, are rare in classical antiquity. The eyes and teeth of the statue were often represented in other materials and the statues were coloured or patinated. This aspect however lies outside the present study but is discussed by Walters (1899).

No matter how carefully the metal is protected from the atmosphere with charcoal whilst molten, some oxygen will dissolve in the metal and form cuprite. In modern bronzes this oxygen is taken up by zinc or phosphorus added for that purpose, and readily dissipated as zinc oxide or as phosphorus pentoxide. However tin does not have this affinity for oxygen or the ability to dispel it from the casting and the oxides can remain to spoil the surface. Gas may also be introduced to the metal from an incompletely baked core (see Mills & Gillespie, 1969, for a modern discussion of gas holes, their causes and treatment).

Although tin does deoxidize the molten alloy, it is not as efficient as other metals, such as zinc, and prior to the introduction of zinc into statuary bronze, the surface of the casting was frequently seriously marred by gas holes. Some of these could be filed or chiselled away, but others were more serious and necessitated cutting out the affected areas and inserting a patch, such as that from the Head of Sophocles No. 1059. The patch could be held in place by undercutting the sides and hammering the metal into place or soldering. If the repair or patch was larger it was often fusion welded to give a stronger neater repair. Even so the repair had to be subsequently carefully cold-worked by scraping, filing and polishing in order to conceal the edges of the metal patch as much as possible.

Very few examples of Archaic bronze statuary have survived and even fewer have been analysed. The 6th century BC statue of Apollo from the Piraeus, now in the National Museum at Athens has been analysed by Varoufakis (1971), who found it to contain copper with 10% tin and only traces of other metals. Several fragments of Archaic statuary have been analysed as part of this project, such as the locks of hair which survived the destruction of lifesize statues at Corfu, (Nos. 633–4), Calymnos (No. 625) and Ephesus (No. 699), and fragments such as the leg, No. 628. All are of bronze with only small amounts of lead.

The head of the Chatsworth Apollo, No. 45, the curl, No. 1400, and the leg, No. 46, from the Louvre which may belong to the same statue are the only examples of 5th century BC Greek statuary bronze analysed in this project. All three are of bronze with only small amounts of other metals. The Chatsworth Apollo was found complete at Tarnassos, Cyprus in the 18th century (Haynes, 1968) but was believed to have been melted down with the exception of the head. However the leg, also from Tarnassos, has a very similar composition, especially in the rather unusual trace of gold which occurs in all three samples, and this suggests that the leg and head may well have belonged to the same statue originally.

The 4th century BC Hellenistic statues such as the head of a female, Hypnos, and a Berber are of unleaded tin bronze. The other late Hellenistic statues include two of unleaded bronze, and three that are heavily leaded. The left hand, No. 48, is believed to be from the same statue as the head of Aphrodite, No. 2; the fact that they have similar compositions supports this hypothesis. The analyses of four statues of the 5th-4th century BC have been published by Caley (1970) showing that they are all of unleaded bronze with about 10% tin, similar to those published here. The analyses are unfortunately all 19th century and too much confidence cannot therefore be placed in them. However in each case lead was looked for and not detected, and the total for the analyses adds up to about 100% leaving little room for much lead even if it had somehow been missed on the initial analysis. Thus statuary bronze was unleaded in Greece until the 4th century BC, even though many of the contemporary statuettes were leaded. One of the main advantages of using leaded bronze is that it makes the molten bronze more mobile, and it is often assumed that the use of leaded bronzes and hollow casting, where a more mobile metal is required, were connected. However, the analytical data show that the Greeks invariably used unleaded bronze for their large hollow castings at least until the

later Hellenistic period. The use of heavily leaded bronze seems to start in the 3rd century BC, when many of the copper base coins which have previously been unleaded were heavily leaded (Caley, 1939, 1970). There appears therefore to be a close connection between the alloys used for statues and coins by the Greeks and since both coiner and statue makers would require large quantities of metal, they may well have used the same stock for their copper.

Miscellaneous Greek Bronzes

This section includes a series of weapons and everyday items not covered by the previous sections. These have a wide range of composition but in general the objects of sheet metal, such as the embossed sheet, the strigils, the ladles and the strainer ladle and the funnel, are of unleaded bronze. An interesting exception to this is the famous fragment of Geometric tripod from the Ashmolean, Cat. 377, published by Boardman (1961). The ring handle has been previously analysed and found to contain 95% copper, 1·3% lead, a trace of tin, 0·008% silver, 3·46% iron, 0·049% nickel, 0·0048% bismuth and a trace of zinc (see Boardman, 1961), and therefore only the other components of the tripod were analysed here. The most interesting feature is the presence of large amounts of iron in each component whether it is of copper or bronze. This strongly suggests that the same copper was being used and that the smith was making up his own alloys from one piece of copper, which in this case had a very distinctive composition. Thus, unmodified copper was used for the bowl, the handle and the strut, and bronze was used for the rivet and the cast stag. Iron does not form a solid solution with copper, and its presence here is almost certainly accidental. Since it would have made the metal brittle and difficult to work the smith could not have mistaken this iron-rich copper for normal bronze, and indeed added tin to the metal where required. In order to facilitate the removal of waste material from the furnace whilst smelting copper it is useful to convert the sands and silicates into a liquid slag which can be run off, and this can be done by adding iron oxides which act as a flux and vitrify the silicates. However, under the strong reducing conditions some of this iron may itself get reduced and accidentally incorporated into the copper. This question has recently been discussed in detail by Cooke & Aschbrenner (1975).

The 4th century BC coin die of Cyzicus is made of bronze with 17% tin and only traces of other metals. This alloy would produce the very hard bronze necessary for a coin die used to strike the design onto the blanks. Bronze seems to have been the usual material for Greek and Roman coin dies (Sellwood, 1976), but a few of iron are known. A coin die of Hadrian from St Albans, England, now in the Department of Coins and Medals, British Museum, analysed by Plenderleith also had a high tin content. The alloy was found to be copper with 14·5% tin, 6·6% lead, 2·81% zinc and traces of other metals. This too would produce a suitably hard alloy for the repeated striking which the die had to endure.

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ARCHAIC GREEK LAB N CAT / REG	STATUETTES DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AL	CO	AS	BI	ZN
1121 A. 1907.518	FEMALE	90.0	.02	9.1	(TR	.075		.150			1.10	.0040	
739 REG 1951 6.6.5	GOAT	81.0	.06	16.5	.080	.100	.800	.020			.700		1.10
1136 A. 1937.237	SATYR	89.3	.07	9..	.045	.050	.250	.005			.100	.0400	
995 CAT 252	LION	87.5	.09	12.	.020	.020		.010		.002	.300		
26 REG 1907 12.1.257	HAnk	91.0	.12	8.0	.020	(TR)	(TR)	.010		.022	.1500	(TR)	
710 REG 1951 6.6.2	WOMAN	90.0	.25	8.6	.025	.050		.025		.015	.2000		
230 CAT 193	APHRODITE	87.5	.40	13.	.040	.050		.330		.250	.0300	(TR)	
91 REG 1951 6.6.8	HORSE	94.0	.40	6.3	.010	.500	.200	.060		.025	.0500	(TR)	.050
1118 A.G. 406	GRYPHON FINAL	89.5	.50	8.6	.120	.012	.550	.030			.0500	.015	.002
711 CAT 201	WOMAN	89.5	.50	8.6	.020	n.d.	.050	.130			.8000		
1003 REG 1929 10.16.1	MAN	92.0	.52	5.7	.050	.350	.170	.015		.005	.6000		
1006 REG 1939 6.10.1	MAN	92.5	.70	1.0	.030	.030	.030	.010		.005	.1000	.020	
28 REG 1871 2.5.224	GRIFFIN TEGHINAL	91.0	.95	6.7	.034	.150	.250	.720		.025	.6000		
92 CAT 139	LION	86.0	1.03	10.8	.210	.230	.400	.040			.1900		
945 REG 1907 12.1.258	BIRD	88.5	1.20	8.8	.040	.020	.010	.060			.3500		
723 CAT 168	TWO HEADED BULL	83.5	1.70	7.5	.110	1.00	1.40	.010			2.000	(TR)	2.30
1137 A. 1971.880	LION	89.5	1.90	9.7	.015	.025		.040		.025	.0700	.006	.010
1004 REG 1913 11.13.6	LION	85.5	2.10	10.0	.170	.060	.015	.030		.002	.8000	1.40	
1105 A.G. 407	GRYPHON FINIAL	88.0	2.20	8.8	.095	.190	.045	.030		.015	.3000		
750 REG 1951 10.12.1	MAN	87.5	2.20	9.6	.050	.350	.070	.065			.4000	(TR)	
942 REG 1955 4.1.1	SPHINX	93.5	2.30	3.2	.050	.050	.170	.025			.5700		
736 CAT 227	SPHINX	90.5	2.50	5.9	.120	.040	.020	.030			.3000		
1128 A. 1923.187	LION	87.5	2.60	10.2	.300	.040	.025	.030		.040	.2000	.080	
1113 A. 1911.51	LION MASK	87.5	2.60	9.0	.045	.020	.100	.070		.020	.1000	.025	
730 REG 1868 1.10.177	BULL	87.5	3.10	8.9	.025	.060		.045		.010	.3500		
726 REG 1946 11.29.1	MAN	92.0	3.2	4.5	.130	.280	.200	.090			.1000	.100	
1337 A. 1878.196	FIGURE	86.0	3.40	8.8	.050	.300	.050	.060		.020	.1500	.030	
729 REG 1909 5.22.1	**BULL**	**90.5**	**3.60**	**6.1**	**.005**	**.060**		**.01**	**.020**	**.06**			
27 REG 1929 8. 1.1	**GRATER**	**90.5**	**3.61**	**3.6**	**.037**	**.050**		**.14**		**.08**	**(TR)**		
734 REG 1958 10.27.5	**HORSE**	**90.0**	**3.80**	**7.6**	**.025**	**.030**		**.06**	**.030**	**.02**	**(TR)**		
738 CAT 141	**COW**	**86.5**	**4.20**	**7.3**	**.150**	**.370**	**.50**	**.50**		**1.0**	**.050**		
1119 A.1888.1432	**SEATED SPHINX**	**88.5**	**4.40**	**6.6**	**0.38**	**.230**	**.10**	**.06**	**.007**	**.55**	**.050**		
95 REG 1928 1.17.7	**GOAT**	**88.5**	**4.50**	**6.2**	**.025**	**.140**	**.15**	**.03**	**(TR)**	**.10**	**(TR)**	**(TR)**	
1116 A.1890.223	**KOUROS**	**87.5**	**4.80**	**7.4**	**.005**	**.011**		**.01**	**.040**	**.10**	**.005**		
998 CAT 495	**WINGED GODDESS**	**83.5**	**5.30**	**9.5**	**.120**	**.050**	**.10**	**.170**	**.030**	**.20**	**.470**		
727 CAT 1616	**HORSE RIDER**	**91.0**	**5.40**	**2.6**	**.050**	**.055**		**.031**	**(TR)**	**.05**			
90 CAT 1811	**HEIFFER**	**86.0**	**5.50**	**7.3**	**.040**	**.290**	**.22**	**.045**	**.005**	**.15**	**(TR)**	**.110**	
25 REG 1856 6.26.503	**GRIFFIN TERMINAL**	**86.5**	**5.60**	**4.9**	**.080**	**.080**	**.75**	**.25**	**.045**	**.10**	**.100**		
96 REG 1929 10.16.6	**WARRIOR**	**83.5**	**6.20**	**9.3**	**.020**	**.110**	**.15**	**.04**	**.040**	**.10**	**(TR)**	**.070**	
1114 A.1971.889	**SPHINX**	**83.0**	**7.00**	**8.7**	**.45**	**.060**	**.13**	**.10**		**.25**	**.075**		
879 CAT 253	**VOTIVE WHEEL**	**85.0**	**7.20**	**5.3**	**.015**	**.150**		**.025**	**.010**	**.07**		**.010**	
1123 A.G.416	**ATHENA**	**89.5**	**7.20**	**2.3**	**.020**	**.015**	**.04**	**.040**	**.006**	**.50**	**.007**		
732 CAT 218	**MAN**	**85.5**	**8.80**	**5.9**	**.015**	**.100**		**.015**		**.07**	**(TR)**		
1130 A.1919.19	**GOAT**	**83.0**	**9.20**	**7.2**	**.070**	**.300**		**.06**	**.040**	**.85**	**.180**		
1122 A.FORTNUM.89	**WARRIOR**	**83.0**	**9.60**	**7.3**	**.020**	**.025**	**.02**	**.02**	**.030**	**.23**	**.030**		
93 REG 1900 7.27.2	**GODDNESS**	**86.5**	**9.80**	**2.7**	**.050**	**.050**	**.15**	**.05**	**(TR)**	**.20**	**(TR)**		
233 CAT 198	**APHRODITE**	**83.0**	**10.0**	**4.5**	**.040**	**.310**		**.40**	**.005**	**.60**	**.100**		
725 CAT 3208	**APIS BULL**	**79.5**	**10.2**	**10.7**	**.060**	**.180**	**.05**	**.08**		**.30**	**.020**		
65 REG 1824 4.40.2	**GRYPHON TERMINAL**	**81.0**	**10.7**	**6.8**	**.045**	**.200**	**.30**	**.01**		**2.0**		**(TR)**	
735 REG 1900 7.21.3	**BULL**	**77.5**	**11.6**	**11.2**	**.035**	**.065**		**.05**	**.030**	**.015**			
143 CAT 143	**RAM**	**77.5**	**12.0**	**10.9**	**.065**	**.240**	**.30**	**.015**		**.10**			
1104 A.G.415	**WARRIOR**	**78.5**	**12.7**	**7.7**	**.055**	**.400**		**.04**	**.030**	**.27**	**.050**		
224 CAT 200	**FEMALE**	**78.0**	**14.9**	**7.1**	**.030**	**.030**		**.15**	**(TR)**	**.02**			
1306 A.BROWN LOAN	**LION**	**76.5**	**16.8**	**6.0**	**.007**	**.220**	**.08**	**.016**	**.085**	**.30**	**.005**	**.025**	
733 REG 1923 4.18.1	BULL	75.0	19.2	5.3	.030	.040		.03		.20	.020		
108 REG 1951 3.29.1	MOUSE	76.5	19.6	3.3	.035	.050	.1	.21	.005	.10	.100		
109 CAT 228	SPHINX	76.0	20.0	2.5	.040	.170		.06	(TR)	.30	.150		
196 CAT 209	APOLLO	71.0	21.6	8.3	.020	.080		.06	.030	.30			
852 CAT 180	PLOUGH GROUP (MAN)	92.5	5.50	2.1	.035	.015	.02	.08	.005	.40	.050		
851 CAT 180	PLOUGH GROUP (PLOUGH)	90.5	6.30	2.1	.035	.020	.04	.055	.003	.30	.080		
854 CAT 180	PLOUGH GROUP (REAR OX)	91.5	6.50	2.2	.030	.015	.02	.085	.010	.20	.060		
853 CAT 180	PLOUGH GROUP (OX)	90.5	6.80	2.3	.035	.017	.035	.045	.005	.03	.070		
997 REG 1873 8.20.165	HORSE FINAL (1)	91.5	.380	7.9	.015	.060	.035	.03	.005	.11			
996 REG 1873 8.20.165	HORSE FINAL (2)	88.5	4.45	6.6	.040	.220	.03	.04	.010	.10		.015	
132 A.1967.1274	ARYBALLOS(HEEL)	85.0	6.00	7.1	.035	.250		.05	.050	.15	.070	.060	
133 A.1967.1274	ARYBALLOS(SOLE)	86.0	6.30	7.0	.040	.250	.08	.06	.050	.25	.070		

ARCHAIC GREEK — DECORATIVE BRONZES

LAB. NO. CAT / REG	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
1199 A.1921.1250	BROOCH	93.0	.030	6.7	.160	.350		.020		.030	.20		
1202 A.1937.708	BROOCH	91.5	2.10	6.9	.025	.140		.030		.030	.20	.005	
1219 A.G.343	PENDANT	91.0	.500	7.7	.030	.170	.0450	.035			.05	.002	.015
1224 A.G.341	FIBULA	85.5	.100	8.2	.060	5.20	.0600	.025		.010	.40	.002	
1223 A.G.352	RING	88.5	1.50	8.3	.090	.050	.2800	.030		.010	.50	.080	
1222 A.G.362	RING	91.5	.050	8.5	.020	.055		.030			.30		
1221 A.G.363	RING	90.5	.450	8.7	.060	.800	.0700	.025			.20	.050	
1229 A.G.345	DRESS PIN	90.5		9.2	.004	.400		.005		(TR)	.11		
1358 A.1923.192	PIN HEAD	86.0	3.60	9.5	.007	.075		.040			.035		
1225 A.G.340	FIBULA	89.0	.200	9.8	.050	.100		.005			.45	.001	
1200 A.1921.1250	FIBULA	89.5	.100	10.0	.020	.100		.020			.25		
934 CAT 122	FIBULA	88.5	.800	10.0	.030	.075	.0200	.035			.15	.030	
1319 A.G.382	BROOCH	87.5	.060	10.8	.050	.120	.0500	.080			.30	.005	
1220 A.G.351	RING	87.0	.980	10.8	.050	.250	.0500	.040			.22	.035	.020
1320 A.NO REG.	BROOCH	86.5	.320	11.7	.060	.160	.0500	.020		.010	.03	.005	.015
1215 A.1923.192	DRESS PIN	84.5	6.80	8.0	.045	.030		.005			.03	.025	
1218 A.1923.192	PIN	85.0	6.60	8.0	.050	.080		.020			.10	.004	
1217 A.1923.192	PIN	89.0		9.1	.010	.620	(TR)	.160					.050
1214 A.1923.192	PIN	86.0	3.20	9.7	.015	.050		.050		.010	.10	.050	
1213 A.1923.192	DRESS PIN	85.0	5.20	10.0	.070	.270	.0400	.045		.040	.04	.003	
1216 A.1923.192	PIN	79.5	8.90	10.7	.060	.020		.015			.20	.003	
1227 A.G.346	DRESS PIN	93.5	.080	5.5	.020	.060		.130		.160			.005
1228 A.G.347	DRESS PIN	93.5	.380	6.0	.025	.090	.0300	.040			.16	.010	.003

ARCHAIC GREEK — MIRRORS

LAB N.CAT / REG	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
281 REG 1861 10.7.755	FLANGED MIRROR	91.00	.0500	8.900	.0150	.1700		.0130		.0100	.5000		
1277 A.1928.321	DISC MIRROR	89.70	.0500	10.80	.0150	.1900		.0200		.0080	.1200	(TR)	
207 CAT 245	MIRROR HANDLE	86.50	.7000	11.00	.0300	.0850		.1500			.0500		

ARCHAIC GREEK BRONZE — VESSELS

LAB N CAT / REG	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
1280 A.1971,879	DISH	88.5	.03	11.2	.030	.110		.0700			.2000		
1125 A.1888,751	HANDLE	85.0	5.40	8.1	.010	.015		.0150		.0250	.8000	.0050	
1282 A.1890,300	HANDLE	78.0	13.2	8.8	.080	.060		.0350		.0200	.1100	.0010	
1107 A.1965,288	HYDRA(HANDLE)	80.0	9.40	9.1	.027	.120	.0600	.0150		.0700	.4000		
1108 A.1965,288	HYDRA (RIM)	88.5		10.2	.005	.110	.0500	.0130		.0200	.3000	.0050	
1109 A.1965,288	HYDRA (RIVET)	98.0	.65	.5	.080	.150	.0250	.0250	.010	.0050	.3000	.0020	
1111 A.1956,1003	HANDLE(ATTACH.)	79.5	12.9	7.6	.012	.010		.0100		.0150	.1500	.0030	
1112 A.1956,1000	HANDLE(ATTACH.)	80.0	12.4	7.7	.010	.015		.0150		.0150	.1500	.0060	
1113 A.1956,1000	HANDLE	81.0	12.0	7.8	.010	.050		.0150		.0250	.1500	.0010	
1115 A.1956,1005	HANDLE	82.0	11.7	6.9	.012	.020		.0100		.0100	.0600	.0020	
1134 A.1890,222	HANDLE	87.0	.03	10.7	.050	.160		.0150			.1500	.0100	
1260 A.1879,375	OINCHOE(HANDLE)	89.0	.015	9.7		.080	.0010	.0250			.0250		
1261 A.1879,375	OINCHOE(RIM)	90.0		10.1	(TR)	.1700		.0100			.1000	.0010	
1262 A.1925,92	OINCHOE(HANDLE)	70.5	21.0	7.1	.035	.0300	.2500	.0200			.5000		
1263 A.1925,92	OINCHOE(RIM)	91.0	.03	7.1	.01	.3000	.0400	.0250		.0300	.3000	.0040	
1265 A.1874,182	OINCHOE(BASE)	77.5	15.0	8.4	.150	.1700		.0300			.3000		
1264 A.1874,182	OINCHOE(HANDLE)	77.5	16.2	5.6	.02	.0200		.0050			.0300	.0070	
1266 A.1874,182	OINCHOE(RIM)	91.0	.05	8.8	(TR)	.0900		.0150			.1500		

CLASSICAL GREEK STATUETTES

LAB NO. CAT / REG	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
762 CAT 215	ATHLETE	90.0	.05	9.3	.015	.07	.07	.015			.01		
719 REG 1873 8.12.179	BEARDED HEAD	85.0	.05	12.8	.050	.075		.02			.10		
1168 A.1933.1007	COW	99.5	.10	.6	.025	.010	.015	.03		.006	.03	.001	
101 CAT 1151	ICARUS FLYING	90.5	.170	8.6	.150	(TR)		.06		.01	.30	(TR)	.05
1158 A.1968.1179	BAG	95.0	.70	3.5	.055	.080	(TR)	.025			.20	.003	.003
715 REG 1909 6.19.1	WOMAN	87.0	1.10	9.6	.010	1.10		.02			.15		
711 REG 1922 7.12.1	MAN	88.0	2.0	8.5	.065	.025	.150	.05			.70		.10
1129 A.1971.884	COCKEREL	87.5	2.30	9.6	.015	.070		.03		.02		.02	
1131 A.G.117	WOMAN	88.5	2.40	7.9	.030	.650		.03			.25	.007	
177 CAT 921	APOLLO	81.0	7.10	12.7	.040	.05	.110	.06			.10	(TR)	
97 CAT 677	ATHLETE	85.0	3.60	11.0	.020	1.61	.230	.025			.20		.09
1163 A.1971.874	MAN	89.5	4.30	6.2	.050	.075		.01		.03	.10	.03	
747 CAT 470	WOMAN	84.0	4.30	10.9	.015	.055		.02			.10		
736 CAT 906	WOMAN	85.0	5.80	9.0	.030	.02	.05	.025			.05	(TR)	(TR)
713 CAT 524	MAN	89.5	6.10	4.2	.010	.025	.05	.01		.05	.45	(TR)	
765 CAT 539	WOMAN	84.0	7.80	8.6	.090	.320		.02		(TR)	.01	(TR)	
738 REG 1909 7.17.1	PALLAS ATHENE	83.0	8.20	8.1	.015	.085		.01			.20		
761 REG 1931 11.16.1	ATHLETE	84.0	8.70	7.2	.020	.04		.02		.0050	.30		
103 REG 1958 10.27.6	HORSE'S HEAD	88.5	8.45	2.35	.010	(TR)	.15	.03		(TR)	.20	(TR)	.04
1130 A.1971.877	WOMAN	85.0	8.80	6.0	.020	.06	.045	.025		.010	.75	.01	
1166 A.1933.472	BULL	86.0	8.90	5.3	.060	.02		.03		.025	.02	.007	
1136 A.1883.670	COCKEREL	81.0	9.20	9.2	.050	.03		.05		.008	.60	.05	
712 CAT 530	MAN	83.0	9.50	7.5	.025	.03		.025		.020	.10		
1162 A.1933.473	CALF	83.5	12.3	4.8	.050	.01		.015			.11	.006	
758 REG 1867 5.8.788	YOUTH	72.0	20.5	7.2	.450	.05	.10	.02		.005	.25	(TR)	
754 CAT 89	ATHENE (RIVET)	98.5	.90		.025	.35		.025	(TR)		.30		
226 CAT 89	ATHENE	86.5	3.10	9.2	.030	.05		.18		.010	.05		(TR)
753 CAT 189	ATHENE (BASE)	93.5	3.4	3.2	.04	.01		.03			.20	(TR)	
763 CAT 553	ATHLETE (BASE)	90.0	1.5	8.1	.065	.025	.05	.05				.15	
764 CAT 553	ATHLETE	89.5	3.2	6.4	.15	.180	.05	.04			.10	(TR)	
1140 A.G.414	YOUTH (PIN)	90.5	.20	8.2	.005	.025		.002		.008	.40	.07	
1141 A.G.414	YOUTH	91.5	1.4	7.6	.01	.04		.03		.04	.20		

CLASSICAL GREEK MIRRORS

LAB. NO. CAT / REG	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
278 REG 1864 10.7.346	TANGED	85.0	8.70	5.40	.0900	.0200	.8000	.1100		.0200	1.000	.1000	
282 REG 1864 10.7.526	TANGED	90.0	3.00	6.30	.1000	.1200		.0300		.0200	.2000	.0300	
508 CAT 291	MIRROR CASE	90.0	1.90	6.40	.0200	.3300		.0650		.0100	.1500		
274 REG 1864 10.7.354	TANGED	94.0	.10	6.40	.0050	.1000		.0100		.0100	.4000		
510 CAT 294	MIRROR CASE	90.5	.70	7.60	.0200	.0900		.0750		.0100	.3000		
1287 A.1885.488	TANGED	89.5	.80	8.40	.0220	.0350	.0800	.0150			.3000		
279 REG 1864 10.7.343	TANGED	83.0	6.20	8.50	.0850	.1500		.0500		.0200	.1000	.9200	
286 REG 1864 10.7.344	TANGED	92.0	.50	8.60	.0250	.1000		.0400		.0100	.5000		
511 CAT 292	MIRROR CASE	89.0	.21	8.80	.0100	.1000	.0200	.0600		.0350	.5000		
288 REG 1864 10.7.353	TANGED	90.5	.30	8.80	.0200	.2300		.0500		.0200	.4000		
277 REG 1864 10.7.352	TANGED	90.0	.05	9.00	.0200	.3300		.0200		.0100	.6000		
506 CAT 301	MIRROR CASE	90.5	.34	9.10	.0200	.1100	.0700	.0700		.0100	.2000		
280 TOMB F286	DISC	88.0	.15	9.10	.0050	.0600		.1600		.0300	.5000		
1312 A.1923.372	TANGED	87.0	2.60	9.20	.0500	.3000	.0400	.0300		.0150	.2500		
287 TOMB F.252	TANGED	88.5	.15	9.50	.0200	.8000		.0800		.0200	.1300		
283 REG 1864 10.7.341	TANGED	90.0	.40	9.70	.0200	.2300		.0200		.0150	.2000		
509 CAT 298	MIRROR CASE	88.5	.25	9.80	.1100	.0900		.0600		.0150	.3000		
472 REG 1967 12.13.2	TANGED	89.5	.28	9.90	.0200	.2700	.0500	.0250		.0050	.6000	.1000	
285 REG 1860 10.7.342	TANGED	90.5	.40	10.2	.0020	.1400		.1000		.0100	.4000		
514 REG 1913 10.18.1	DISC	89.0	.08	10.6	.0150	.1400		.0200		.0100	.1000		
298 REG 1867 5.8.379	TANGED	88.0	.10	10.6	.0700	.0200	.3000	.0400		.0100	.2000		
289 REG 1901 6.9.12	TANGED	87.5	1.30	10.7	.0200	.0700		.0700		.0400	.4000		
284 REG 1864 10.7.345	TANGED	90.5	.13	10.9	.0650	.2500		.01000		.0100	.1000		
527 REG 1867 12.13.1	TANGED	88.0	.10	11.7	.0500	.1600	.0500	.0400			.0600		
464 REG 1967 12.13.3	TANGED	85.5	.61	12.3	.0200	.3400		.0300			.1200		
290 REG 1904 7.8.2	TANG	86.0	7.0	5.8	.0300	.0300		.0400		.0100	.4000	.0400	
291 REG 1904 7.8.2	TANGED MIRROR	88.0	.28	10.2	.025	.260		.035	.010	.40	.030		
462 REG 1967 12.13.4	HANDLED MIRROR	91.0	.60	8.1	.020	.60		.045	.005	.07			
463 REG 1967 12.13.4	HANDLE	90.5	.90	8.5	.015	.030		.035	.010	.07			
484 REG 1967 12.13.5	HANDLED MIRROR	89.5	.55	8.9	.040	.460	.1000	.050	.010	.50			
485 REG 1976 12.13.5	HANDLE	77.5	16.0	5.5	.050	.030	.1000	.040	.060	.50	.150		
501 REG 1856 6.25.11	PILLAR MIRROR	91.0	.065	9.3	.015	.106		.040	.010	.40			
500 REG 1856 6.25.11	PILLAR	88.0	.05	10.8	.150	.020	.0500	.020	.010	.40	(TR)		
1292 A.1885.470	HANDLED	90.0	.10	8.8	.013	.60		.040		.15	.020	.04	
1286 A.1885.470	HANDLE	89.0	.03	11.2	.050	.40	.0600	.015					

CLASSICAL GREEK BRONZE VESSELS

LAB. NO. CAT / REG	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
1151 A.1972.1975	HANDLE	87.0	3.90	8.1	.012	.140		.020		.050	.10	.006	.002
1101 A.1952.234	HANDLE	74.5	20.8	5.3	.025	.045	.10	.025		.020	.10	.010	
1102 A.1960.1634	HANDLE	75.5	15.4	8.7	.055	.025	.10	.025		.015	.20	.010	
94 M.T. 947	LION HANDLE	85.0	5.20	10.3	.008	.100	.15	.010		.005	.15	(TR)	
1267 A.1888.488B	OINCHOE	93.0	.02	6.8	.070	.150	.09	.015			.10	.001	
1272 A.B.201.OF	OINCHOE HANDLE	89.5	.05	11.0	.050	.200		.006		.010	.40	.002	
1300 A.1948.99	SITULA (RIM)	88.0		11.7	.030	.150	.11	.010			.07		
1310 A.1973.1059	SKYPHOS HANDLE	85.5	5.00	8.4	.045	.430	.07	.080		.025	.07	.050	
1084 FILE.3690	OENCHOE (HANDLE)	85.5	.310	11.0	.013	1.50	.025	.070		.080	.70		.10
1083 FILE.3690	OENCHOE (HANDLE)	85.0	.600	10.3	.017	1.30	.02	.050		.030	.50		.10
1085 FILE.3690	OENCHOE (NECK)	87.5	1.0	11.7	.010	.850	.03	.030		.020	.60	.002	
1268 A.1889.1008	OINCHOE (HANDLE)	90.0	5.50	3.7	.025	.050		.040		.030	.02		
1269 A.1889.1008	OINCHOE (RIM)	82.0	8.20	9.7	.020	.140		.015		.040	.30		
1270 A.1879.373	OINCHOE (HANDLE)	92.0	.10	8.5	.050	.075	.05	.020					.003
1271 A.1879.373	OINCHOR (RIM)	92.0	.05	7.9	.050	.110	(TR)	.007					.003
1295 A.1948.100	BOWL (FOOT)	86.5	4.50	8.0	.035	.080	.04	.015			.40		
1296 A.1948.100	BOWL (HANDLE)	87.0	4.90	7.8	.027	.210	.05	.025			.50		
1297 A.1948.100	BOWL (RIM)	88.0	.11	10.5		.120		.180		.020	.40		
1301 A.1948.101	HYDRA (BASE)	86.5	3.40	8.5	.005	.060	.09	.040		.040	.60	.003	
1302 A.1948.101	HYDRA (HANDLE)	88.0	3.40	8.7	.015	.080	.05	.050		.120	.40		.013
1305 A.1948.101	HYDRA (HANDLE)	87.0	2.90	8.2	.022	.090	.05	.045		.120	.35	.002	.013
1304 A.1948.101	HYDRA MAIN HANDLE	86.5	3.75	8.13	.015	.120	.06	.045		.110	.30		.010
1303 A.1948.101	HYDRA (RIM)	87.0	.30	9.8	.070	.770	.10	.025			.20		

HELLENISTIC GREEK STATUETTES

LAB. CAT / REG	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
270 FILE 3206	OSTRICH	91.5	.23	6.80	.030	.150		.09		.020	.10		.03
768 CAT 272	APOLLO	86.5	.50	11.7	.140	.140		.02			.015		
1307 A.LOAN.144.1974.345	GRIFFIN	88.5	.87	8.8	.050	.300	.05	.03		.120	.15		
1105 A.1971.1156	GODDESS	84.0	1.50	13.8	.035	.075		.02		.050	.18		.02
1146 A.1971.890	SATYR (VASE)	88.0	1.70	9.8	.055	.050		.03			.10	.003	.06
635 CAT 1084	APHRODITE	86.5	1.75	12.5	.065	.140		.11			.01		
202 CAT 273	MASK OF APOLLO	83.0	3.20	12.7	.090	.280	(TR)	.03			.15		.25
105 REG 1865 1.3.42	LION SPOUT	87.0	3.65	8.40	.030	.110		.07		.010	.05		
947 CAT 280	VENUS	86.0	3.70	10.6	.040	.025	.04	.02			.085		
660 REG 1857 12.20.350	DRAPERY	95.5	3.80	.3	.025	.280		.05		.060	.50		
1009 CAT 1639	SATYR	91.5	3.90	4.6	.070	.075	.11	.005			.08		
636 CAT 1453	ALEXANDER	82.0	6.40	10.7	.055	.140	.07	.09		.020	.10	(TR)	
651 1955 10.8.1	VESSEL	87.0	7.60	10.6	.050	.290		.05		.020	.05		.62
769 CAT 277	DISCOURI	81.5	9.10	9.3	.050	.30	.10	.04	(TR)		.05	(TR)	.80
653 REG 1926 4.15.32	DWARF DANCER	81.0	11.5	6.9	.080	.30		.09		.020	.09		.20
1154 A.1888.1478	LION HEAD SPOUT	76.0	15.3	7.3	.015	.290	.02	.05		.170	.18		
14 FILE 3090	GODDESS	83.2	15.5	1.05	.080	.20	.20	.04		.015	.05	.320	
766 R.P.K.2.2.	BUST OF GIRL	78.0	16.8	6.9	.130	.020	.15	.03			.08	(TR)	
102 REG 1930 6.17.4	EROS FISHING	76.0	17.3	6.0	.040	.280	.20	.05		.002	.15		.20
1139 A.1937.234	HORSE	73.0	17.4	9.3	.070	.030	.10	.045		.060	.17	.150	
1047 FILE 3556	DANCING GIRL	78.0	18.5	3.2	.060	.020	.09	.015			.12	(TR)	
677 REG 1824 4.97.13	SATYR	69.5	18.8	8.5	.035	.030	.03	.080		.020	.04	(TR)	
1156 A.1971.870	DWARF	72.0	20.5	5.8	.050	.035		.02			.10	.005	.03
1309 A.1937.306	ARM	72.0	20.8	7.3	.050	.055	.12	.05		.020	.25	.015	
1149 A.1971.873	YOUTH	69.0	26.0	4.9	.045	.010	.07	.06			.10		.01
104 REG 1953 11.21.1	EROS	68.0	26.5	5.5	.030	.110	(TR)	.09		.005	.30	(TR)	.03
770 REG 1922 7.11.1	ALEXANDER	63.0	29.2	5.9	.040	.060	.07	.03			.02	(TR)	.02
767 CAT 279	APHRODITE	65.0	30.5	3.0	.10	.020	.15	.050			.09	(TR)	
262 CAT 836	HERMES (BASE)	72.0	3.40	.50	.060	.170		.060			.70		23.4
261 CAT 836	HERMES (BODY)	69.0	3.80	.70	.030	.150	.10	.090			.20		26.3
1066 CAT 282	APHRODITE (BACK)	87.0	1.40	8.0	.050	.750	.12	.050			.10	.005	.08
1068 CAT 282	APHRODITE (HEAD)	69.0	22.3	6.8	.045	.550	.10	.050		.007	.12	.002	.07
1065 CAT 282	APHRODITE(R.HEEL)	68.0	21.0	7.2	.055	.280	.12	.040			.15	.001	.06
1061 CAT 282	APHRODITE(L.HEEL)	65.0	29.5	6.2	.040	.290	.15	.050			.050	.002	.06
1067 CAT.282	APHRODITE(L.ARM)	79.5	13.0	8.3	.035	.085	.10	.100					
1071 REG.1824.1.97.13	SATYR(R.ARM)	82.0	10.4	7.7	.050	.020	.07	.070		.007	.09		
1072 REG.1824.1.97.13	SATYR(L.HEEL)	71.0	20.1	8.4	.070	.010	.05	.087		.065	.15		
1073 REG.1824.4.97.13	SATYR(R.TOE)	71.0	20.1	8.3	.025	.040	.05	.100		.005	.30		
1070 REG.1824.4.97.13	SATYR(BODY)	70.5	20.5	8.5	.070	.160		.080		.060	.15		
1069 REG.1824.4.97.13	SATYR(NECK)	69.5	21.1	8.3	.025	.035		.100		.050	.20		
1110 A.1886.1143	MAN(BODY)	85.0	1.10	12.8	.070	.030		.025		.005	.50	.008	
1111 A.1886.1143	MAN(BASE)	85.5	1.40	10.1	.040	.025		.015		.005	.25	.005	
1177 A.1971.886	CROUCHED FIGURE	77.0	18.8	4.1	.130	.120	.13	.06			.15	.007	
		79.5	18.0	1.9	.01	.10	.05	.05			.30		.45

HELLENISTIC GREEK MIRRORS

LAB. NO. CAT / REG	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
1226 A.G.338	DISC	94.5	1.40	4.3	.020	.420		.040		.030	.30		
495 REG 1851 5.19.4	DISC	93.5	.10	5.7	.035	.400	.2300	.035			.08		
492 REG 1868 10.20.119	TANGED	86.5	7.70	5.9	.040	.350	.1000	.040		.025	.10		
513 REG 1940 7.7.2	MIRROR CASE	91.5	.06	6.8	.015	.190		.250		.010	.05		
1117 A.1971.1024	SUPPORT	82.5	11.1	7.1	.040	.070	.0600	.025		.007	.12	.033	
474 REG 1856 8.26.441	DISC	90.5	1.45	7.2	.020	.060	.0500	.030		.010	.15		
292 REG 1868 10.20.117	DISC	87.0	6.10	7.9	.030	.100		.040		.050	.20		
1359 A.1937.233	DISC	90.0	.90	8.1	.008	.050		.030		.040	.25	.002	
471 REG 1878 10.19.268	DISC	91.0	.06	8.1	.230	.180	.1000	.030		.010	.30		
515 REG 1923 4.22.1	MIRROR CASE	89.5	.45	8.5	.015	.750		.085		.060	.10		
1279 A.1971.891	TANGED	90.0	.65	8.6	.030	.310		.150		.090	.20	.002	
519 CAT 3211	MIRROR CASE	89.0	2.20	8.6	.020	.130		.090		.010	.20		
1373 A.1889.738	TANGED	88.0	1.70	8.8	.120	.220	.0500	.100		.150	.05	.002	.030
293 REG 1875 11.12.1	DISC	89.0	1.90	8.8	.020	.050		.050		.015	.40		
518 REG 1900 12.14.1	DISC	87.0	4.70	9.0	.015	.180		.050		.010	.10		
522 REG 1873 1.11.1	DISC	89.0	.08	9.0	.020	.250		.380		.030	.50		
516 REG 1910 4.13.16	MIRROR CASE	90.0	.10	9.7	.030	.180		.200		.010	.10		
487 REG 1910 1.6.3	MIRROR CASE	82.5	7.05	9.7	.170	.270	.0500	.060		.030	.05		
507 CAT 288	MIRROR CASE	90.0	.03	10.0	.170	.110		.040		.005	.40		
496 REG 1867 5.8.380	DISC	90.0	.20	10.0	.060	.200	.0500	.040			.50		
520 CAT 3210	MIRROR CASE	89.5	.75	10.1	.015	.170		.045		.005	.10		
460 REG 1872 6.20.29	DISC	89.0	.30	10.3	.020	.350		.025		.010	.25		
517 REG 1902 12.18.1	MIRROR CASE	89.0	.10	10.3	.350	.450		.030		.010	.25		
297 REG 1814 T343	DISC	88.5	.350	10.8	.015	.070		.030		.020	.40		
475 REG 1867 5.8.387	DISC	88.5	.05	11.4	.020	.170	.0500	.015		.005	.20		
466 REG 1856 8.26.495	TANGED	88.0	.05	11.5	.020	.300		.010			.10	(TR)	
512 REG 1922 9.6.1	MIRROR CASE	88.5	.02	11.8	.050	.270		(TR)			.10		
296 REG 1868 10.223	MIRROR CASE	87.50	.0500	12.40	.0050	.1400		.0500		.0100	.1000		
489 REG 1920 10.13.2	MIRROR (LID)	84.50	6.500	7.900	.0700	.2800	.1000	.0450		.0300	.1500		
490 REG 1920 10.13.2	MIRROR (CASE)	80.50	9.700	9.300	.0200	.0800	.1000	.0250		.0250	.1000		
488 REG 1920 10.13.2	MIRROR	87.00	2.400	10.50	.1800	.1700	.0500	.0400		.0300	.0500		

HELLENISTIC GREEK DECORATIVE BRONZES

LAB N CAT / REG	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
1507 RCAT.1291	GILT RING	99.5	.020		.055	.030	.07	.030	.120		.025		
1514 RCAT.1274	GILT RING	100.			.010	.100		.025	.007		.10	.001	
1510 RCAT.1296	GILT RING	99.5	.150		.10	.010	.05	.040	.020	.045	.40	.030	
1506 RCAT.1292	GILT RING	100.			.002	.010	.02	.015			.015		
1516 R.CAT.1272	GILT RING	99.5	.07		.010	.025		.020		.05	.03	.002	
1512 RCAT.1293	GILT RING	99.5		.1	.050	.130		.025			.02	.002	
1521 R.CAT.1258	GILT RING	100.		.1	.040	.160	.05	.015	.025		.15		
1520 .RR.CAT.1993	GILT BANGLE	98.0		.9	.015	.150	.10	.010	.040		.15		.012
1508 RCAT.1297	GILT RING	96.5	.450	2.2	.040	.130		.050		.08		.030	
1504 RCAT.1290.F	GILT RING	95.5	.50	3.6	.020	.008	.03	.040		.110	.30	.008	.030
1517 R.CAT.1275	GILT RING	90.5	.40	6.8	.025	.170	.07	.085	.010	.160	.45	.015	.006
1106 A.1966.687	VOTIVE RING	79.0	14.0	6.9	.035	.160		.060		.070	.13	.005	
1435 REG.1964-4-8-3	FIBULA	89.0	1.80	8.0	.020	.010		.025		.015	.05		
1433 REG.1964-4-6-2	FIBULA	89.0	1.30	8.1	.015	.035	.06	.060		.004	.02	.007	
1434 REG.1964-4-8-4	FIBULA	91.5	.10	8.5	.015	.100		.100		.010	.03	.015	
1437 REG.1911-11-19-263	FIBULA	88.5	3.0	8.6	.025	.050	.10	.030				.002	
1436 REG.1964-4-8-5	FIBULA	89.0	.70	9.2	.040	.210	.10	.010			.20	.008	
1501 OWN COLLECTION	BROOCH	89.3	.60	10.5	.070	.130	.20	.025		.004	.30	.007		.015

HELLENISTIC GREEK BRONZE VESSELS

LAB N CAT / REG	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
1511 A.1971.906	HANDLE	97.0		.2	.045	.360	.2000	.030			2.0	.010	
1556 A.NO REG.	HANDLE	87.0	.20	13.0	.012	.0600		.005					
123 REG 1840 5. 8.395	HANDLE	82.5	5.75	10.3	.085	.035	.0700	.320			.10		
125 REG 1971 9.10.2	HANDLE	87.0	2.0	10.8	.070	.100		.050		.015	.55		.02
124 REG 1971 9.10.1	HANDLE	86.5	.90	11.7	.040	.075		.060		.070	.60		
1547 A.1937.232	HANDLE	82.5	8.60	9.2	.008	.09	.0500	.020			.07	.001	
1546 A.1937.232	HANDLE(RIVET)	91.0	.06	7.5	.010	.20		.030			.25		

SOUTH ITALIAN GREEK BRONZES

LAB. NO.	CAT / REG	PERIOD	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
1323	A.1927.1995	ARCHAIC	SPEAR BUTT	90.5	2.40	5.6	.050	.220	.60	.10		.030	.30	.015	.10
1324	A.1885.685	ARCHAIC	SPEAR BUTT	92.0	.730	5.5	.040	.055	.10	.080			.25	.003	
1325	A.1927.1434	ARCHAIC	SPEAR BUTT	88.5	1.60	7.4	.060	.50	.40	.090			1.0	.025	
1326	A.1885.681	ARCHAIC	SPEAR BUTT	83.5	.70	12.1	.100	1.10	.15	.040		.040	.40	.800	.25
1327	A.1885.683	ARCHAIC	SPEAR BUTT	84.0	.870	13.	.043	1.0		.035		.055	.70		.015
637	CAT 303	HELLENISTIC	MIRROR (HANDLE)	89.5	7.20	3.9	.035	.04		.030		(TR)	.02		
638	CAT 303		MIRROR	89.0	.230	10.4	.030	.09		.035		(TR)	.05		
639	CAT 303		EROS FROM MIRROR	89.5	3.70	6.0	.050	.075		.020			.01	(TR)	
584	REG 1824 4.77.10	HELLENISTIC	ATTACHED CURL	87.0	3.80	9.0	.050	.095	.02	.280		.070	.08		
54	FILE 2459 TOWNLEY	CLASSICAL	RIGHT ARM	83.0	7.00	8.8	.060	.08	(TR)	.030		.010	.10	(TR)	
31	CAT 265 4	CLASSICAL	WARRIOR	82.0	6.60	8.7	.045	.17	(TR)	.030			.15		.05
15	CAT 265 6		WARRIOR	81.0	7.60	9.6	.060	.20	(TR)	.030			.25		.06
12	CAT 265 5		WARRIOR	85.5	4.57	9.2	.060	.21	.20	.040			.20		.04
11	CAT 265 3		WARRIOR	84.5	5.14	8.6	.060	.05	(TR)	.040			.20		.04
10	CAT 265 2		WARRIOR	85.0	5.25	8.9	.050	.15	(TR)	.040			.20		.05
9	CAT 265 7H		WARRIOR	85.5	5.50	9.45	.050	.61	(TR)	.040			.50		.06
8	CAT 265 7E		WARRIOR	84.5	5.15	8.75	.050	.22	(TR)	.040			.20		.04
7	CAT 265 7A		WARRIOR	84.5	5.36	8.75	.050	.24	(TR)	.040			.20		.04
6	CAT 265 7D		WARRIOR	80.5	12.7	6.6	.030	.13	(TR)	.050		.230	.30		.04
5	CAT 265 7F		WARRIOR	84.0	5.60	9.4	.040	.53	.15	.070			.30		.03
4	CAT 265 7G		WARRIOR	83.0	5.57	9.75	.040	.35	.15	.050		(TR)	.20		.03
3	CAT 265 7C		WARRIOR	85.5	5.67	8.4	.020	.26	.15	.040			.20		.03
2	CAT 265 7B		WARRIOR	84.5	5.34	9.4	.050	.29	.20	.040			.30		.05
1	CAT 265 LEG		WARRIOR	85.0	5.68	8.5	.070	.28	.15	.040			.40		.03
1115	A.1894.43	ARCHAIC	BEARDED MAN	87.5	.38	11.0	.010	.025		.020		.030	.20	.008	
1148	A.1971.924	HELLENISTIC	GIRL	87.0	2.50	10.3	.065	.08	.10	.050			.10	(TR)	.005
1100	A.1971.24	CLASSICAL	GODDESS	86.5	2.90	10.1	.017	.050		.040		.030	.10	.010	
1155	A.1929.115	CLASSICAL	FEMALE	90.0	1.0	8.8	.035	.260		.015		.015	.10	.005	
1007	CAT 286	HELLENISTIC	RECLINING FIGURE	88.0	1.40	10.0	.030	.110	.17	.005			.06		
1008	REG 1868 1.10.160	HELLENISTIC	WARRIOR	88.0	5.80	5.4	.045	.020	.065	.025		.005	.15	.150	
1010	REG 1856 5.12.6	HELLENISTIC	WOMAN	81.5	12.1	6.6	.060	.100	.10	.040			.15	.100	
1011	CAT 1454	HELLENISTIC	WARRIOR	87.0	9.25	4.2	.020	.080	.05	.010		.005	.12	(TR)	
731	REG 1971 3.23.1	ARCHAIC	HORSE'S HEAD	80.5	12.8	5.2	.050	.310	.15	.080		.050	.70	(TR)	
737	REG 1910 4.14.7	ARCHAIC	BULL	80.5	11.7	8.4	.070	.070		.040		.010	.20	.380	
746	CAT 582	CLASSICAL	YOUTH	79.0	13.6	8.1	.080	.025		.020			.35	(TR)	
748	CAT 493	CLASSICAL	GODDESS	88.5	.10	10.6	.030	.210		.020		.020	.60		
751	CAT 548	CLASSICAL	GODDESS	79.0	12.8	8.1	.020	.230	.15	.045		.070	.50	(TR)	.010
752	CAT 549	CLASSICAL	GODDESS	82.5	8.0	10.5	.010	.090		.030		.020	.01		
755	CAT 603	CLASSICAL	WOMAN	91.5	1.10	8.1	.085	.025	.10	.020			.05	(TR)	
757	CAT 515	CLASSICAL	MAN	87.0	1.10	10.2	.080	.50	.50	.040		.020	.70	.150	
640	CAT 1389	HELLENISTIC	SATYR	71.0	19.5	8.8	.030	.170		.020		.045	.35	(TR)	
99	REG 1925 7.14.1	CLASSICAL	DEAD GIANT	86.5	2.60	9.5	.070	.400		.080		.015	.05	(TR)	.050
759	CAT 202	CLASSICAL	GIRL	74.0	21.0	3.6	.40	.360		.030		.040	.30	.070	
760	CAT 201	CLASSICAL	GIRL	81.0	9.0	3.2	.035	.750		.030		.005	.40	(TR)	
999	REG 1904 7.3.1	ARCHAIC	HORSE	91.3	2.98	5.2	.060	.270	.07	.025	(TR)	.060	.10	.100	
1000	REG 1904 7.3.1	ARCHAIC	RIDER	93.0	1.55	4.5	.025	.100	.07	.015		.005	.08	.040	
1021	CAT 1249	HELLENISTIC	HERCULES (HANDLE)	83.5	8.90	6.5	.130	.220	.55	.20		(TR)	.30	.150	(TR)
1022	CAT 1249	HELLENISTIC	HERCULES (FIGURE)	84.5	8.50	6.2	.120	.230	.44	.020		(TR)	.35	.120	.035
862	CAR 252	ARCHAIC	VOTIVE AXE	67.5	26.0	6.3	.045	.015	.07	.070		.002	.03	(TR)	.040
1313	A.1879.376	ARCHAIC	DISH	94.5	.015	6.0	.025	.030		.020				.005	
1124	A.1891.411	ARCHAIC	HANDLE	89.5	1.30	6.7	.030	.030		.015		.010	.70	.025	
1147	A.OLDFIELD.56	ARCHAIC	HANDLE	85.0	4.80	10.3	.020	.030	.02	.015		.020	.12	.008	
1150	A.1891.222	CLASSICAL	HANDLE	84.0	.03	11.4	.050	.012	.045	.010			.03	.003	
76	C.&M.REG. 1927 7.1.1	HELLENISTIC	COIN DYE	80.0	.23	17.0	.180	.180		.140		.080	.050		
777	CAT 2567	HELLENISTIC	COUCH END (RIVET)	92.5	.30	7.2	.010	.075		(TR)			.010	(TR)	
776	CAT 2566	HELLENISTIC	COUCH END	89.5	.20	9.1	.005	.070		.090			.005		
775	CAT 2567	HELLENISTIC	COUCH END	86.5	.70	11.6	.005	.080		.010			.005		
906	CAT 2540	HELLENISTIC	LAMP (HANDLE)	86.5	1.90	8.4	.085	.60	.90	.260		.025	.60	(TR)	
905	CAT 2540	HELLENISTIC	LAMP (SPOUT)	86.5	1.70	8.7	.085	.60	.90	.300		.030	.80	.020	
914	REG 1926 4.17.54	HELLENISTIC	LAMP	73.0	21.6	3.9	.025	.020	.02	.070		.015	.30	(TR)	

GREEK BRONZE ARMOUR

LAB. NO. CAT / REG	PERIOD	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
1274 A.1963.3	ARCHAIC	HELMET	91.0	.20	8.5	.040	.130	.080	.040		.008	.20	.0020	
1275 A.877	ARCHAIC	HELMET	90.0	.02	9.9	.035	.150	.050	.050		.10	.15		
1.76 A.1881.90	ARCHAIC	HELMET	88.5		11.8	.002	.080		.110		.020	.10		.070
1585 CAT 2837	ARCHAIC	HELMET	89.0	.025	9.5	.025	.50	.030	.140		.80	.80		.015
1586 CAT.2818	ARCHAIC	HELMET	86.0	.03	10.2	.008	.450		.040			1.0		.360
1293 A.1885.464	CLASSICAL	HELMET	89.0		9.5	.016	.10		.012			.50		
1294 A.1885.463	CLASSICAL	BODY ARMOUR	89.5		10.0		.350		.050			.20		
1298 A.1948.97	CLASSICAL	BREASTPLATE	91.5		8.8	.008	.130	.110	.038		.040	.35		
1299 A.1948.98	CLASSICAL	GRIEVE	90.0	.08	9.6	.010	.380		.010			.30		
1387 CAT.2820	CLASSICAL	HELMET	92.0	.140	7.5		.10		.20		.10	.30		
1388 CAT.2820	CLASSICAL	HELMET (NASAL)	92.0	.08	7.1	.030	.10	.150	.080			.19	.0600	
30 CAT 2846	HELLENISTIC	CUIRASS	88.5	.160	10.7	.020	.080	(TR)	.035					
1273 A.G.478	HELLENISTIC	HELMET	90.0	.08	9.7	.050	.140	.070	.060		.025	.20	.0080	

GREEK BRONZE STATUES

LAB. NO. CAT / REG	PERIOD	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
625 REG 1856 8.26.509	ARCHAIC	LOCK OF HAIR	90.5	.120	8.7	.012	.170		.060		.015	.07		
699 REG 1856 8.26.510	ARCHAIC	LOCK OF HAIR	87.5	2.60	9.3	.035	.110	.03	.080		.020	.50	(TR)	.01
634 CAT 1913	ARCHAIC	LOCK OF HAIR	87.0		11.4	.005	.075		.040			.45		
633 CAT 1912	ARCHAIC	LOCK OF HAIR	88.5	(TR)	10.4	.005	.130		.010		.075	.40		.02
628 REG 1905 6.7.1	ARCHAIC	LEG	90.5	.080	8.6	.040	.030	.04	.015			.04		
1400 REG 1958 4.18.1	CLASSICAL	APOLLO (CURL)	90.5	.90	9.35	.058	.080		.030	.010	.004	.10		
46 FILE 2191		APOLLO (LEG)	91.5	.570	8.9	.080	.320	(TR)	.045	.040	.005	(TR)		.03
45 REG 1958 4.18.1		APOLLO (HEAD)	87.5	.02	10.4	.060	.020	(TR)	.030	.010	.005	.10		.01
58 FILE 1983	HELLENISTIC	FEMALE	74.0	19.0	5.8	.050	.500	.05	.050		.013	.15		
1380 CAT 267	HELLENISTIC	HYPNOS (L.EAR)	86.5	1.60	10.8	.040	.130	.20	.020			.10		
1379 CAT 267		HYPNOS (R.WING)	86.0	2.0	10.9	.030	.130	.15	.025			.05		
1378 CAT 267		HYPNOS (R.CURL)	86.5	2.20	11.4	.040	.120	.13	.025			.06		
1377 CAT 267		HYPNOS (L.CURL)	86.0	2.0	11.0	.040	.130	.13	.020			.10		
67 CAT 267		HYPNOS (HEAD)	86.5	1.60	11.1	.050	.060	.20	.030			.40		
1530 CAT 268	HELLENISTIC	BERBER (LIPS)	99.5	.150		.030	.040		.040		.0100	.10	.005	
29 CAT 268		BERBER (HEAD)	91.0	.160	7.95	.020	(TR)		.090			.30		
48 CAT 266	HELLENISTIC	LEFT HAND	59.0	35.0	6.9	.055	.100	.25	.040		(TR)	.10		
47 CAT 266		APHRODITE	67.5	26.0	5.6	.060	.100	.20	.055		(TR)	.20		
1059 CAT 847	HELLENISTIC	SOPHOCLES (PATCH)	81.5	12.0	6.7	.060	.015		.050		.0500	.12		
1058 CAT 847		SOPHOCLES (CURL)	91.5	.680	7.2	.011	.040		.025		.0300	.13		
1057 CAT 847		SOPHOCLES (CURL)	89.0	.03	10.0	.011	.040		.020		.0950	.20		
840 CAT 847		SOPHOCLES (LIPS)	97.0	.150	2.4	.050	.050		.030		.0300	.10		.01
21 CAT 847		SOPHOCLES (HEAD)	91.5	.270	6.75	.020	(TR)	.1	.030		.0300	.10		
568 FILE 3357	HELLENISTIC	MAN	74.0	16.3	7.6	.025	.070	.1	.050			.08		
106 REG 1928 4.16.1	HELLENISTIC	FEMALE HEAD	95.0	.60	4.85	.007	.130		.100			.05		(TR)

MISCELLANEOUS GREEK BRONZES

LAB No. CAT / REG	PERIOD	DESCRIPTION	CU	PB	SN	AG	FE	SB	NI	AU	CO	AS	BI	ZN
218 CAT 2774	GEOMETRIC	SPEARHEAD	90.5	.01	6.7	.010	.180		.020			.30		
1178 A.CAT.377	GEOMETRIC	TRIPOD (STAG)	90.0	.90	2.3	.009	6.60		.045		.110	.15		.015
1176 A.CAT.377	GEOMETRIC	TRIPOD (RIVET)	87.5	1.70	5.0	.007	6.10		.050		.080	.20		.050
1177 A.CAT.377	GEOMETRIC	TRIPOD (STRUT)	92.5	.950		.006	6.00		.050		.170	.15		.025
1179 A.CAT.377	GEOMETRIC	TRIPOD (BOWL)	91.0	.50	(TR)	.004	7.90		.050		.100	.10		.015
1246 A.1971.864	GEOMETRIC	VOTIVE AXE	88.5	.04	10.8	.020	.090		.040		.170	.20	.005	
1180 A.G.402	ARCHAIC	RIVET	98.5	.30	.95	.060	.600		.010			.30	.003	
1516 A.G.402	ARCHAIC	EMBOSSED SHEET	91.0	.10	9.0		.500		.010					
1291 A.1885.467.3	CLASSICAL	ARROWHEAD	46.0	43.5	9.3	.265	.070		.015			.150		
1290 A.1885.467.2	CLASSICAL	ARROWHEAD	65.0	20.0	13.9	.045	.180		.030			.350		
1289 A.1885.467.1	CLASSICAL	ARROWHEAD	65.5	19.3	13.4	.050	.040	.06	.025		.015	.40		
1288 A.1885.467	CLASSICAL	ARROWHEAD	64.0	15.4	19.5	.085	.080	.10	.015			.50		
1285 A.1885.473	CLASSICAL	LADLE	90.0	.05	9.8	.010	.150		.020		.010	.30	.003	
1281 A.1948.75	CLASSICAL	STRIGIL	88.0	.05	11.8	.030	.110		.030			.070		
1278 A.1885.727	CLASSICAL	LADLE	89.5	.26	8.7	.015	.190		.025		.150	.20		
1531 A.NO REG	CLASSICAL	ARROWHEAD	85.0	5.0	.05	.040	.750	.30	.350		.100	6.70	3.00	
1285 A.1885.466	CLASSICAL	SCYTHIAN PLAQUE	80.0	4.60	14.5	.015	.015		.010		.015	.250	.001	
1284 A.1885.487	CLASSICAL	LADLE, STRAINER	91.5	.04	8.8	.017	.150		.020		.015	.10		
928 REG 1915 7.14.1	CLASSICAL	SPEAR BUTT	74.0	17.0	8.1	.015	.050	.015	.010		.010	.07	(TR)	
1515 A.1932.440	HELLENISTIC	FUNNEL (HANDLE)	87.0		12.4	.015	.550	.08	.040					
1514 A.1932.441	HELLENISTIC	FUNNEL (EDGE)	88.0	.055	12.2	.004	.200	.05	.095					
1355 A.1884.336	HELLENISTIC	WINE STRAINER	85.0	5.70	8.0	.030	.200	.05	.030		.040	.30	.004	
1343 A.1948.75	HELLENISTIC	STRIGIL	86.0	.160	12.5	.020	.120		.016			.15		
925 REG 1959 4.16.1	HELLENISTIC	ARROWHEAD	84.5	8.40	5.6	.030	.220	.02	.030		.040	.12		
1542 A.NO REG	HELLENISTIC	PLAQUE	87.5	4.80	8.4	.090	.050		.090			.035		
927 REG 1912 4.19.4	HELLENISTIC	ARROWHEAD	74.5	16.2	7.8	.070	.020	.055	.010			1.70	.010	
926 REG 1912 4.19.3	HELLENISTIC	ARROWHEAD	74.0	15.1	10.3	.025	.065	.035	.020		.005	.180	(TR)	