# ANCIENT METAL RELIEFS

Recent publications of material from American excavations and American museums have focused attention on the techniques of metal relief in antiquity. Especially provocative have been the discovery by Miss Richter and Miss Milne, *à propos* of a new hammered silver phiale, that the repoussé technique was invented by Pheidias and Polykleitos in the fifth century B.C. (all previous metal reliefs having been hammered into matrices [1]) and the identification of a class of clay impressions from metal reliefs by Mrs. Thompson, following the excavation of many such impressions in Athens.[2] The present paper is an attempt to see these pieces in relation to some others from Greece, northern and southern Italy, and the provinces, and to suggest some tests for recognizing the various types of reliefs, some observations regarding their prevalence, and the technique of their commercial duplication. My observations, be it said, are those of an archaeologist, not of a metallurgist, and are offered in the hope of saving the time of another archaeologist.[3]

The methods of raising a pattern or picture in relief on a metal background are: cold tooling, hammering into a matrix, repoussé or hammering free-hand, and casting. These processes are not mutually exclusive. Almost any combination of them is possible. Cold tooling is almost always combined with another technique. Even among the other three techniques combinations are frequent and have done much to baffle our efforts to recognize the ancient methods. Similarly, almost every fine modern piece is made by a combination of techniques. The beautiful situla from Tarentum, in Boston (Figs. 1, 2), illustrates this combination.[4] The main frieze is a fine example of repoussé. The handle attachments were cast and were joined to the rim by skillful sweating. Between the frieze and the rim is a decorative border of leaves which, unlike the main frieze, does not appear in negative on the back. This was made by a third technique, difficult to identify. Was it cold tooling?

Relief can be raised by cold tooling by cutting away the background as one would chip marble to make a marble relief. This is laborious. Examples of work done exclusively by cold tooling are rare, but as a supplementary technique on hammered, repoussé, or cast reliefs it is fairly common. Cold tooling can usually be recognized

[1] *A.J.A.*, XLV, 1941, pp. 363-398.

[2] *Hesperia*, VIII, 1939, pp. 285-316.

[3] I am indebted to Samuel Kirk and Son and to members of their staff for criticism of the pieces here presented and for the opportunity to observe modern silver repoussé in their factory.

[4] No. 03.1001. Pernice, *Gefässe und Geräte aus Bronze* (Winter, *Hellenistische Kunst in Pompeji*, IV), pl. V; *Jahrbuch*, XXXV, 1920, p. 91, fig. 6. On the piecing of the Boscoreale cups see Matz, in Bossert, *Geschichte des Kunstgewerbes*, IV, p. 258.

by the broad flat planes with sharply intersecting edges characteristic of chisel work, and the narrow incised line made by the point. Cold tooling is very apparent on most modern repoussé reliefs, the details of which are in large part cut from the front by metal tools.

A technique which may have been fairly common was that of hammering the metal by repeated blows of a small hammer into all the crevices of a matrix cut with the design in reverse. Strangely, very few of the ancient matrices can be recognized. A few of stone and of bronze still survive.[5] Others might have been of perishable material.[6] The matrix which Miss Richter deduced for the silver bowl in New York seems to have been of iron, and very well cut.[7] Miss Richter recognized the technique in this case because of double lines at various points, evidence of double hammering of the bowl. Another test for recognizing such a relief is that it may not be undercut.

A further test is that the design be repeated, for the matrix technique is the nearest which the ancients had to our modern technique of pressure stamping between positive and negative dies. Like that process, it naturally suggests duplication. It was known from very early times. Hammered bronze was a distinctive craft of the Villanovans of Italy (in contrast to the Etruscans, who were casters),[8] and crude designs such as concentric circles decorate the water vessels of this early people. The designs were repetitive, and probably were made in matrices. In Greece, low relief, already practiced by the Mycenaeans, was known again in the late geometric age, and exemplified a little later on the bronze reliefs from the Athenian Acropolis; even if we hesitate to commit ourselves as to the technique of the figures on these we can have no doubts about the decorative elements, palmettes and rosettes, repeated again and again, certainly made in matrices.[9] The " Argive " (really Corinthian) mirror handles of early times were made in matrices, the easy repetition serving to enrich their makers.[10] Coming down to later times, we may note two classes of Etruscan bronzes which were made by this means. First, consider a well-known group of Etruscan

[5] Blümner, *Technologie und Terminologie*, IV (1887), pp. 237 ff.; Curtius et al., *Ausgrabungen zu Olympia*, IV, pl. 26 a; Payne, *Necrocorinthia*, p. 222; *A.J.A.*, VIII, 1904, p. 440; Robinson, *A.J.A.*, XXXVIII, 1934, pp. 219-222, and *Classical Studies Presented to Edward Capps*, 1936, pp. 306-313. There is a bronze with six archaistic designs and figures in the Walters Art Gallery. It may be a matrix.

[6] Probably the reliefs which were to cover such early wood objects as the chariot in the Metropolitan Museum and the plates which dressed the wood cores of the earliest statues were hammered over their own permanent wood backings. See Buschor, *Altsamische Standbilder*, II, figs. 74, 77; Ducati, *Storia dell' Arte Etrusca*, II, pl. 65, fig. 200, and Walters, *Catalogue of the Bronzes in the British Museum*, pp. 59 f., no. 434.

[7] *A.J.A.*, XLV, 1941, p. 376.

[8] Randall-MacIver, *Atti del I Congresso internazionale Etrusco*, p. 51; *Bul. Pal. It.*, XXXVI, 1910, pp. 100 f.; Åberg, *Bronzezeitliche und früheisenzeitliche Chronologie*, I, p. 76; Matz, in Bossert, *Geschichte des Kunstgewerbes*, I, p. 194.

[9] Bather, *J.H.S.*, XIII, 1892-3, pp. 232 ff.

[10] Payne, *op. cit.*, p. 224. Lamb, *Greek and Roman Bronzes*, pp. 65 f.

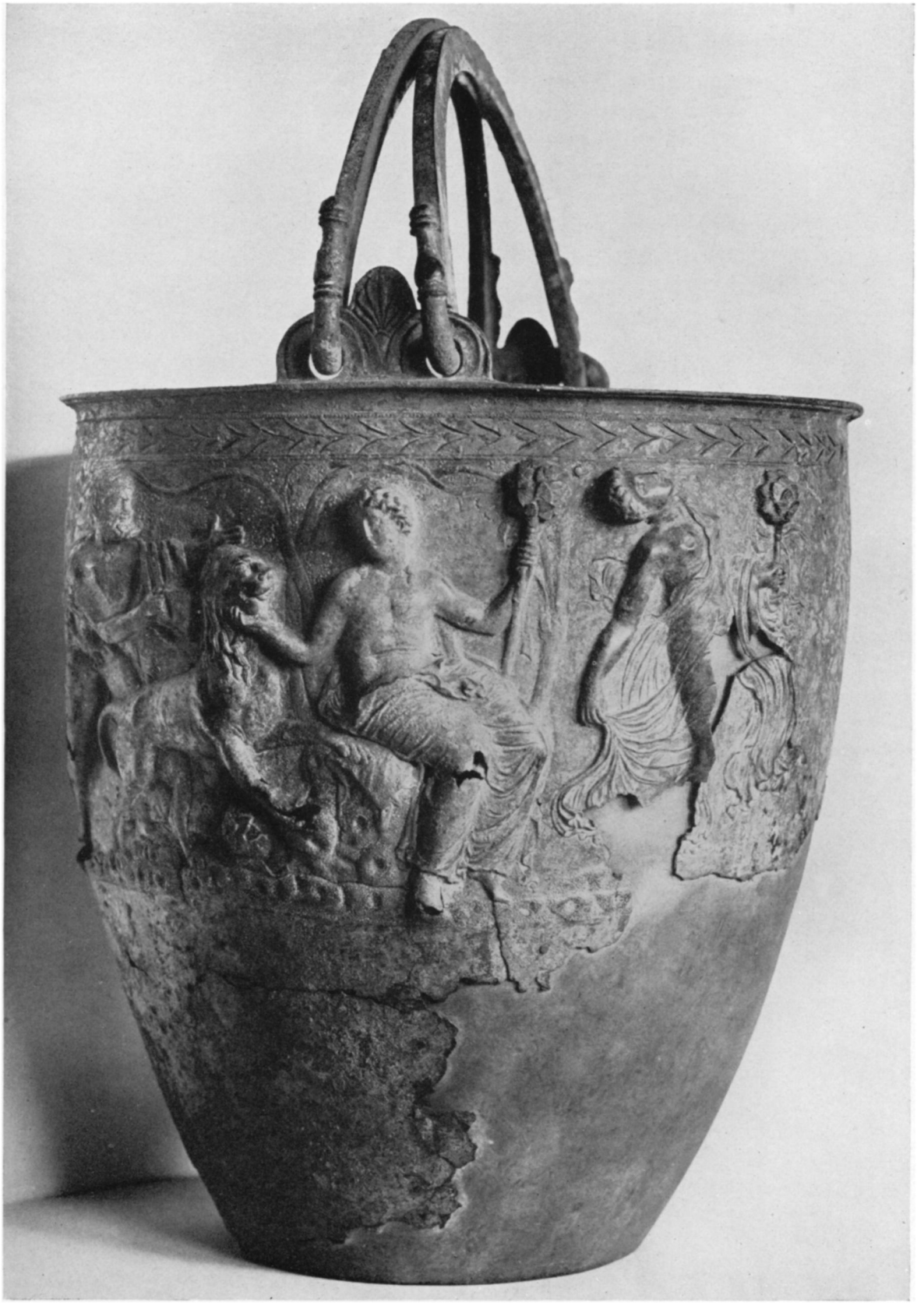

Fig. 1. Bronze Situla. Repoussé Decoration. Boston, Museum of Fine Arts

stamnoi, whose handles are always attached by plaques bearing certain standard designs.[11] Our Figure 3 shows a pair of handles from such a stamnos. The four plaques are of thin metal with silenes' faces in relief. The reliefs are identical. Moreover, there are any number of similar stamnoi handle plaques. These four reliefs lack the sharpness of detail which we associate with repoussé. It seems most probable that they were all hammered into the same matrix, and that the matrix was used again and again in the production of this highly commercialized ware. Another class is the Etruscan mirror covers decorated with relief. For example, at least three mirror covers with identical subject (a seated woman, a child, a youth and a bird) are known: one in the University Museum, Philadelphia, one in the Terme, and another in the Villa Giulia.[12] It would be rash to insist without very careful examination of all three pieces that they were made in the same matrix; but there is a good probability. Another example of repetition on reliefs of this type is furnished by two with Thetis bringing arms to Achilles. Their main designs are identical but the borders are different: one, a herring-bone pattern,[13] hammered into a matrix, the other, an egg and dart, incised.[14] A third subject of the mirrors is Dionysos and Apollo;[15] a fourth is a group of a man, a woman and a dog.[16]

We may class as hammered-into-matrix reliefs all those whose designs can be shown to have been frequently repeated. It is not surprising that our examples from the later period are Etruscan. Naturally, after the discovery of repoussé, hammering into a matrix was uncommon among Greek workmen, for the new technique was superior.

The repoussé technique was invented by the Greeks of the great age, and, essentially unchanged, is still in use. Without any matrix, the sheet of metal, bedded in something soft like pitch, is hammered bit by bit into the desired relief. First one side is so treated; then the sheet is reversed and the other hammered. With this technique the Greeks surpassed themselves. They made what we think Greeks should have made—works of complete originality, each individual, each exquisite. Only a real artist can make repoussé reliefs, and only a Greek artist ever enjoyed making almost impossibly high reliefs. His relief usually was decidedly undercut, and his fabric very thin. Many reliefs still are filled with a clay-like material which was added

[11] Riis, *From the Collections of the Ny Carlsberg Glyptothek*, II, 1938, p. 167, note 1; Jacobsthal and Langsdorff, *Die Bronzeschnabelkannen*, p. 48, note 1; Marconi, *Dedalo*, XIII, 1933, pp. 274 f.; Neugebauer, *Bronzegerät des Altertums* (Schaal, *Bilderhefte zur Kunst und Kulturgeschichte*, II), pl. XXII, 1. Also Richter, *Greek, Etruscan and Roman Bronzes*, p. 126, nos. 249, 250 (our Figs. 4 *a* and 4 *b*) and p. 32, nos. 50, 51 (both sets now in the Etruscan room); and Worcester Art Museum, Schaefer Collection, no. 1434, *a* and *b* (our Fig. 3).

[12] University Museum, no. M. S. 1665. Villa Giulia, no. 51391, formerly Castellani Collection.

[13] From Toscanella. Walters, *Catalogue of Bronzes*, p. 125, no. 728.

[14] From Praeneste. *Monumenti dell'Instituto*, XI, pl. VIII, 2.

[15] Gerhard, *Etruskische Spiegel*, I, pl. XXI, 2. Also, Villa Giulia, no. 51392.

[16] Villa Giulia, nos. 17028 and 51390.

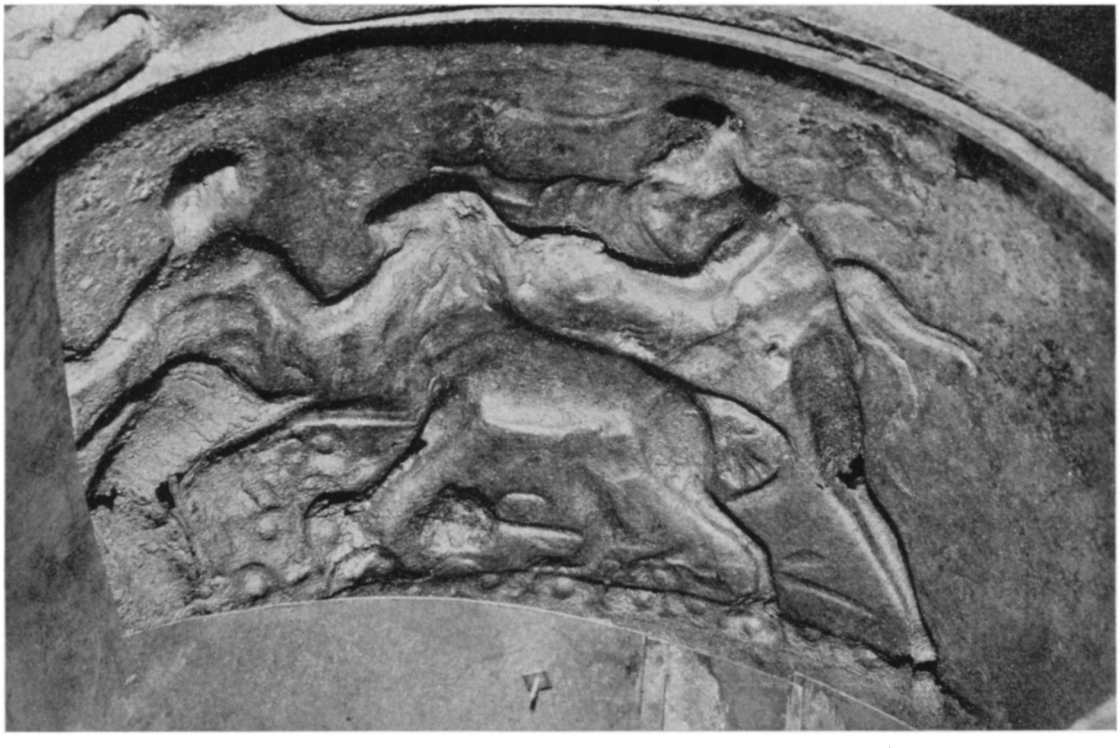

Fig. 2. Back of Part of Figure 1

Fig. 3. Handles of Etruscan Stamnos, with Hammered Plaques. Worcester Art Museum

for strengthening. Because of the thinness of the fabric, the design is perfect in reverse on the back.

One of the most interesting repoussés is an unfinished piece in the Metropolitan Museum (Figs. 5, 6).[17] A young athlete is clearly defined and well modeled as far as torso, head (nearly in the round) and thighs, but he lacks arms. For some reason, perhaps the tearing of the sheet across the thighs, the artist ceased work. His next task would have been to raise the arms on what is now blank background. Significantly, the figure is in the proportion and style of Polykleitos, one of the "inventors" of repoussé, and I see no reason to doubt that it is contemporary with him.

Probably very early in the history of repoussé were produced the two reliefs which were found at Olynthos.[18] These pose certain problems. The relief is not as high as in most repoussé, and the drapery is not as sharp as one would expect from that technique. The hard outlines of the figures are unusual in repoussé (but equally unusual in hammered work). It is possible that these reliefs were hammered in matrices, but I am inclined to think that they represent an early and rather timid attempt at repoussé, and that they were made a considerable time before the close of the fifth century.

More brilliant and daring repoussé reliefs were made at the very end of the fifth century: the Siris bronzes, now in the British Museum, the reliefs found at Praeneste in the Villa Giulia (Fig. 13), some of the Vounitza mirrors in the Metropolitan, and a relief from Paramythia in the British Museum. In these the relief is not only higher but also freer. The artists were becoming progressively more at ease with the new technique.

A relief of remarkably fine design, as well as of good craftsmanship, is on the cover of a mirror in Baltimore, which may date from as early as the end of the fifth century B.C. (Figs. 7, 8).[19] It has become detached, so that its back may be studied. All the details of the drapery and of the goose and wreath can be followed on the back, except the smallest lines of the wings, which were incised. The head is in three-quarter view, with very slight undercutting of the nose and clever foreshortening of the cheeks.

Typical repoussés decorate the cover of a fourth-century Greek mirror in Baltimore (Fig. 9).[20] Figures of a woman and of a man in Asiatic dress, each on a rocky seat, were made separately, and set to face one another, representing Aphrodite and Paris, or Aphrodite and Adonis, or Dionysos and Ariadne.[21] The thin bronze is worn

[17] Richter, *Greek, Etruscan and Roman Bronzes*, pp. 138 f., no. 280. It was considered Roman, and to have had legs and arms made separately.

[18] Robinson, *A.J.A.*, XXXIII, 1929, p. 72, fig. 20; *Excavations at Olynthus*, X, pl. IV.

[19] Walters Art Gallery, no. 54.1160. Purchased, 1929. Said to be from Greece. Diameter, 6 inches (.152 m.).

[20] Walters Art Gallery, no. 54.1170. Diameter, 6⅜ inches (.162 m.). Repaired.

[21] Cf. Walters, *Select Bronzes, Greek, Roman and Etruscan* (British Museum), pl. XXVII; Richter, *Greek, Etruscan and Roman Bronzes*, pp. 265 f., no. 766. The compositions of these are totally distinct.

*a*

*b*

Fig. 4. Handles of Etruscan Stamnos with Cast Plaques. New York, Metropolitan Museum


Fig. 5. Unfinished Greek Repoussé Relief.
New York, Metropolitan Museum

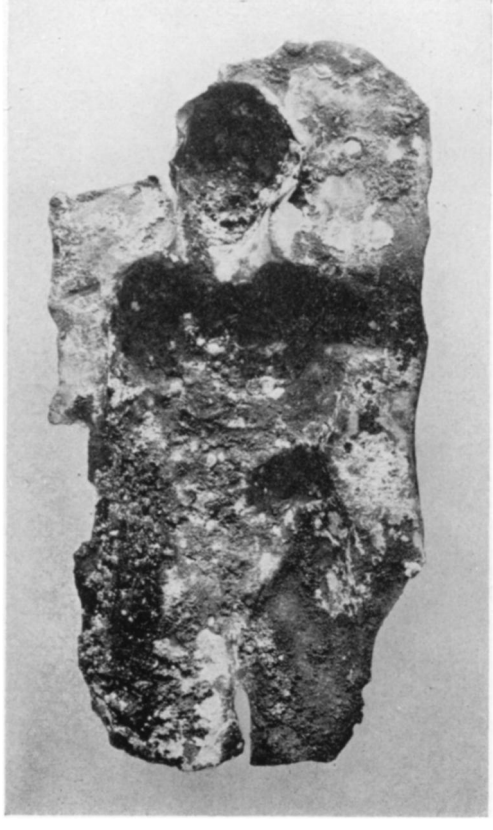

Fig. 6. Back of Figure 5

Fig. 7. Greek Mirror Cover with Repoussé Relief. Baltimore, Walters Art Gallery

Fig. 8. Back of Relief of Mirror Shown in Figure 7. Baltimore, Walters Art Gallery

through at a few points, such as the leg of the man and the lap of the woman, showing a clay backing. The heads are in side view and not quite complete, being slightly undercut.

A much more daring conception is that of another mirror, also in Baltimore

Fig. 9. Greek Mirror Cover with Repoussé Reliefs.
Baltimore, Walters Art Gallery

(Fig. 10).[22] A heavy, bearded man and a woman face each other across a tree, at the foot of which stands Eros. Apparently Herakles is interviewing a Hesperid before the tree of the golden apples. Missing from the relief but leaving recognizable traces on the background are the right leg of Herakles, his left arm, staff, and the drapery which hung at his left, and the right arm of the Hesperid. These parts served as

[22] Walters Art Gallery, no. 54.743. Acquired, 1926. Diameter, 7 11/16 inches (.194 m.). Damaged. Repaired.

transitions from the highest parts of the relief to the background; their absence reveals a clay-like backing. The bodies are nearly in the round. Though the bronze no longer remains on the backs of the heads, it is clear that they were in the round and made by repoussé, a clever artist working with his tool from inside and from outside the heads. The flowing drapery could have been made only in this way, too. On the theory that the "Farnese" type of Herakles which this mirror copies originated with Lysippos and in view of the technical superiority of this relief over the last we may date it within the Hellenistic period.

Let us look once more at the Boston situla, the main feature of which is repoussé (Figs. 1, 2). The scene is very clear on the inside (Fig. 2, reproducing in reverse a part of Fig. 1). The detail of the drapery across the knees of the seated figure is remarkably clear, the details of the heads are clear (much clearer than one might believe from the photograph where one can discern merely the nose, mouth, and chin of the seated figure), and the heads are undercut. Details which are missing from the back—the tree, the lion's mane, the ground, etc.—were added by cold tooling.

The repoussé technique was in vogue from the end of the fifth century through the fourth and at least into the third. Then it was gradually replaced by hollow cast relief. Cast relief in Greece and Italy is just as old as casting. This is not as old as hammering. Although the Mycenaeans and the Terremare peoples had cast bronze, the technique became unusual in Greece of the geometric age and in Italy of the Villanovans. Good casting began again with the dawn of the archaic age. Low relief was introduced almost immediately. During the Hellenistic age there was developed a technique of making very thin, hollow, cast imitations of repoussé, especially of very high repoussé. We do not know how generally the cast pieces replaced the others, but we note the scarcity of repoussé after the third century B.C. One is tempted to attribute the new technique of hollow cast relief to some Alexandrian craftsman. As examples of high cast relief we may cite the Hildesheim treasure, formerly thought to be repoussé,[23] and of low relief, cast I think, the delicate silver cups of the Augustan era in the Morgan Collection.[24] High relief, cast or repoussé, went out of fashion early in the Roman Empire to be replaced by cast low relief, solid.[25]

A little ancient casting was in moulds. We know of a few moulds for direct

[23] Ippel, *Guss und Treibarbeit in Silber* (*97 Winckelmannsprogramm*), Berlin, 1937, pp. 16 f.; Rodenwaldt, *Antike*, XIII, 1937, p. 185. Bronze example from Lake Bracciano, Walters, *Select Bronzes*, pl. XXXII (our Fig. 12); *Catalogue of Bronzes*, p. 40, no. 286, pl. VIII; Lamb, *Greek and Roman Bronzes*, pp. 175 f., pl. LXIV, b. The fragmentary silver kantharos found in Egypt, *Arch. Anz.*, 1907, cols. 362 f., figs. 3, 4, now in the Walters Art Gallery, is an example of very high cast relief, solid, made in the Hellenistic period.

[24] Metropolitan Museum of Art, *Augustan Art*, 1939, p. 18, fig. 42.

[25] A relief, apparently repoussé, in the Loeb Collection is called Roman by Sieveking, *Bronzen, Terrakotten, Vasen der Sammlung Loeb*, Munich, 1930, pp. 5 f., pl. 6. But is it certain that this is Roman? And is it certain that the Boscoreale treasure is all repoussé?

Fig. 10. Greek Mirror Cover with Repoussé Reliefs. Baltimore, Walters Art Gallery

casting of Graeco-Roman saucepans,[26] and await the publication of more material from a Roman shop in Athens.[27] Most of the casting was by the cire-perdue process. In this process a wax model is constructed and incased in a fireproof coating. Two holes are left in the case. It is then heated, so that the wax melts and runs out. Molten bronze is poured into one of the holes, filling the casing which formerly covered the wax, and solidifying as an exact bronze duplicate of the original wax model. If a hollow cast is desired, the wax model is made over a slightly smaller core, which remains when the wax melts out.

Although the wax model is always destroyed in casting metal, there are two ways by which the design may be repeated. If the wax model has been made in a mould, another wax model and a consequent other bronze can be made in the same way; or, from the finished bronze, an impression may be taken, in which it is possible to mould the wax model for the next bronze. Both methods were used by the ancients to duplicate the designs on their utilitarian bronzes.

Following the first method, the same kind of stone matrix which was used for making hammered bronzes could be used for moulding wax models for cast bronzes. Immediately after the development of casting, griffin heads for decorating cauldrons were cast with details in low relief.[28] There are many alike of these decorations. It is unlikely that the workmen modeled all the wax models freehand. It was demonstrated by Pernice that the majority of all ancient cast attachments with low reliefs were made by the cire-perdue process, each wax model receiving the relief from a mould. Although the earliest examples of the use of such a mould which Pernice found were some feet of Praenestine cists from the fourth century B.C.,[29] it is possible that they were used from the very beginning of casting, even from the days of the griffins.

The very mould which was used to impress the relief on the wax model for a cast object could also be a matrix. In at least one class of commercial wares we have the same type of attachment, cast and hammered, at the same time. Let us look once more at the handles of Etruscan stamnoi of the fourth century B.C., having handle-plaques, four plaques to each stamnos, decorated with a few standard designs, the commonest being the silene's head. Compare the cast example in the Metropolitan Museum of Art (Fig. 4 *a* and *b*) with the hammered example in the Worcester Art Museum (Fig. 3).[30] These two sets were not made in the same matrix. One would have to study all the examples of this very large ware to ascertain which cast and which hammered pieces used the same matrices. But can we believe that the workmen who made quantities

[26] Schreiber, *Alexandrinische Toreutik* (*Abhandlungen, K. Sächs. Gesell. Wiss.*, Phil-Hist. Klasse, XIV), 1894, pls. I-III.

[27] *A.J.A.*, XLII, 1938, p. 123.

[28] *Jahrbuch*, LIII, 1938, *Bericht über die Ausgrabungen in Olympia*, pp. 109 ff.

[29] *Jahreshefte*, VII, 1904, pp. 154-197.

[30] See above, p. 100, note 11.

of these plaques, all alike, were so incredibly stupid as to keep one series of matrices on one side of the room for hammering, another just like it on the other side of the room for moulding wax models for casting? Must we deny them common sense? [31]

Of the equipment needed for duplicating bronzes by the second method we have actual examples preserved. From Egypt of the Graeco-Roman period come numerous plaster moulds for making wax models. Each mould is in parts, which join perfectly.[32] Slightly different are the clay impressions, found at Athens, Corinth, and Tarentum (Fig. 11).[33] They are impressions of reliefs, and only of parts of reliefs, their edges being irregular. That these were taken from metal objects has been established by Mrs. Thompson, though none of the actual metal originals exists. It is equally probable that many of the objects made from them were of cast metal.

But first let us consider the vexed question of the use of part of the group, positive clay copies of relief.[34] A close parallel for these exists in the stamps for making Arretine pottery. At least one of the positive impressions from Athens has a back shaped into a handle,[35] as have all the impressions for Arretine ware. There is abundant material to show how the positive impressions were used at Arretium.[36] A series of them was selected and pressed into the inside of a clay bowl, still soft.

[31] Ippel (in Bossert, *Geschichte des Kunstgewerbes*, IV, p. 216, and p. 221, fig. 1) deduced that there must have been cast reproductions of Hellenistic architectural reliefs of hammered bronze. How would there have been enough reliefs to decorate houses if they were not made by quick cast reproduction?

[32] Edgar, *Greek Moulds* (*Catalogue général des antiquités égyptiennes du Musée du Caire*) pp. III ff. See also my article, " Some Bronze Statuettes from Graeco-Roman Egypt," to be published in *Art in America*.

[33] H. Thompson, *Hesperia*, V, 1936, p. 175; D. B. Thompson, *Hesperia*, VIII, 1939, pp. 285-316; Weinberg, *A.J.A.*, XLIII, 1939, p. 593, fig. 5; *B. Met. Mus.*, VII, 1912, p. 97, fig. 6 (our Fig. 11); Broneer, *Hesperia*, XI, 1942, p. 256, note 28; *Jahrbuch*, XLI, 1926, pp. 191 ff., and Bossert, *Geschichte des Kunstgewerbes*, IV, pl. XI, fig. 1. Cf. one of a group of Persian impressions on clay, *B. Met. Mus.*, XXXVII, 1942, p. 108, fig. 32. Another piece of the same class was found at Vulci and has been called a stone matrix, *Studi Etruschi*, X, 1936, pl. XV; XI, 1937, p. 108, fig. 1; *Historia*, IV, 1930, pp. 454-469. It belongs to the sixth century B.C. Without having studied the material, I hazard the guess that this is another clay impression *from* metal. The corners are incomplete, as would be unthinkable in a sculptured matrix, but usual in a clay impression. The depressions near the corners are not to collect molten metal, but are the marks of the nails which attached the original to a wood background. It is uncertain what this original was. Perhaps it was a chariot fixture, like the chariot fixtures recently acquired by the Metropolitan Museum, some of which have decorative figures of style not altogether different from the Vulci impression, *B. Met. Mus.*, XXIV, 1936, pp. 41 ff.; *Studi Etruschi*, XIII, 1930, pp. 433 ff.

[34] There are also plaster and bronze positives, Ippel, in Bossert, *Geschichte des Kunstgewerbes*, IV, pp. 223 ff., figs. on pp. 226 ff.; Ippel, *Der Bronzefund von Galjûb* (Pelizaeus-Museum zu Hildesheim, *Wissenschaftliche Veröffentlichung*, 2). The models from Galjûb give evidence of having been made up from parts cast in moulds. See also Rubensohn, *Arch. Anz.*, 1907, cols. 359 ff.

[35] *Hesperia*, V, 1936, p. 175, fig. 21, b.

[36] Very clear explanation and illustrations, Metropolitan Museum of Art, *Augustan Art*, pp. 19 f., figs. 43-45.

This clay bowl, dried and baked, then became the mould in which other clay bowls were shaped with the design in relief on the outside. A positive impression is evidence of a most advanced and complicated commercialization, for it was used for the quantitative production of moulds, in which the final objects were made, a quantity in each mould. The positive impression could, of course, also be used for copying by eye.

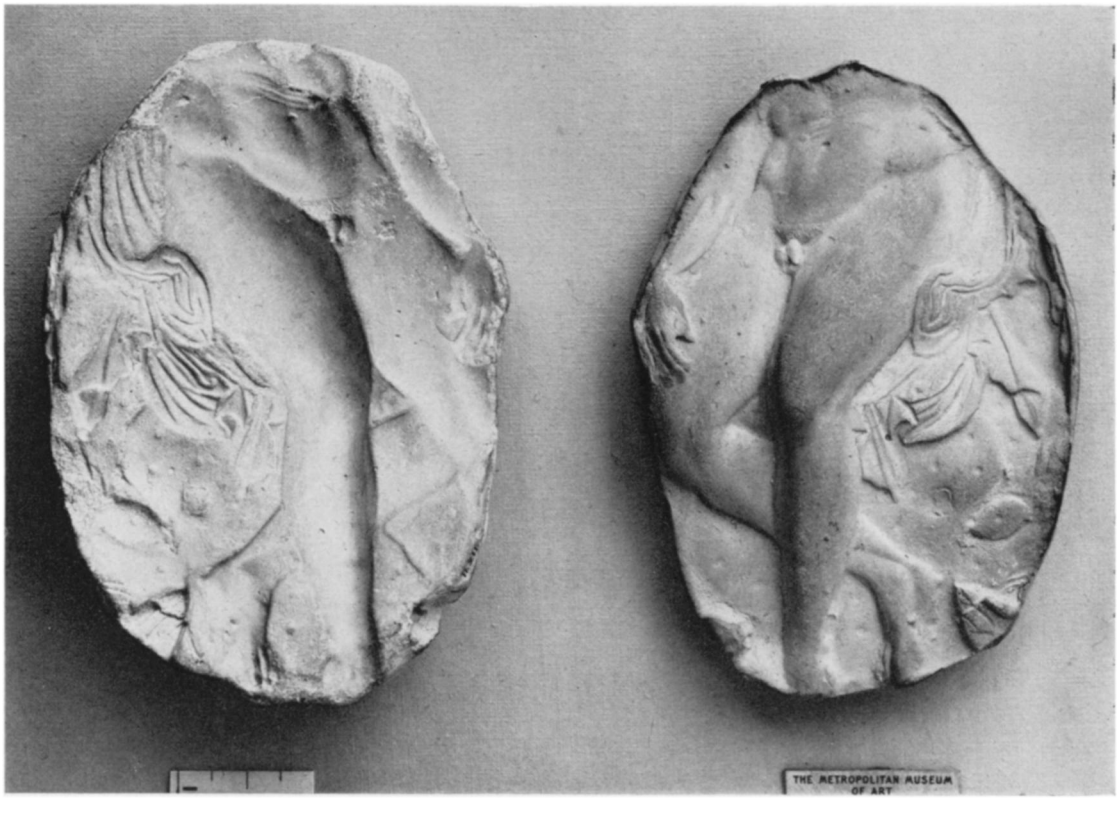


Fig. 11. Clay Impression from a Metal Relief, and Plaster Cast Made in the Impression. New York, Metropolitan Museum of Art

Every process known for making clay reproductions could also be used for making cast metal reproductions of repoussé metal objects. But instead of clay, wax was used in the second stage to make a model for the casting of another metal object. A workman took a clay impression of a fine repoussé object. He then took a piece of wax and shaped it into another object, using the clay impression as a mould with which to raise the relief design. The new object might or might not be of the same shape. A jug could reproduce the design of a mirror, and *vice versa*. He then cast a bronze or silver object after the wax by cire-perdue. If he wished to reproduce the relief in

Fig. 12. Hollow Cast Relief (after Walters).
London, British Museum

great quantity, he turned his impression into a positive,[37] fitted it with a handle, and used it to stamp the inside of many moulds. In the moulds he made many wax objects and used each as a model for casting.[38]

Clay impressions, then, were taken from repoussé reliefs and could be used, both the positive and the negative, to make reproductions either in cast metal or in clay. I believe that we may assume a continuous tradition of their use by casters from the fifth century to the end of the reign of Augustus, although some of the material is scant for each period and for each technique. From the great age we have many repoussé reliefs, many clay impressions, and some relief pottery. We do not have many fine cast reliefs from this period, but are tempted to imagine them, because some of the Athens impressions seem to be from armor. Why not cast imitations for more armor? From the Hellenistic age we have hollow cast relief, a few pieces of repoussé, no clay impressions, and more of the relief ware. We may imagine the missing Hellenistic clay impressions, because from the Augustan age we find hollow cast relief on objects actually made in sets and inscribed as such,[39] positive and negative impressions on clay, and the Arretine pottery which so clearly imitates metal work. From this later age I know of no repoussé. Were the Roman workmen copying old repoussé?[40] Or will we eventually identify the missing pieces?

Fig. 13. Repoussé Relief (after *Bolletino d'Arte*). Rome, Villa Giulia

[37] This could be done by pressing new clay against an impression which had itself been made by pressing against a finished metal object. It also could be done by pressing against the *inside* of a repoussé.

[38] Since the impressions were incomplete, retouching the wax by hand was necessary.

[39] Metropolitan Museum of Art, *Augustan Art*, p. 18.

[40] Miss Richter, *A.J.A.*, XLV, 1941, pp. 385 ff., believes that such a method was used for making the clay Calene bowls after an earlier silver prototype which had been made by hammering into a matrix. The normal method of making a clay copy of a contemporary hammered piece would be to mould the clay in the actual matrix, in accordance with the first method described above.

If only there were one complete series: repoussé relief, impression, fragments from the casing of the cire-perdue, and cast relief! There is no such extant series to be proof of my contention. Some idea of the imagined process and its results may, however, be gained by comparison of some works centering at the school of Tarentum. The seated male figure on the repoussé situla is from Tarentum (Fig. 1), and the Herakles from Praeneste might conceivably be Tarentine (Fig. 13).[41] The detached relief of a similar figure found at Lake Bracciano and of workshop unknown was cast (Fig. 12). The clay impression of part of another figure was taken from a repoussé and was found at Tarentum (Fig. 11). These reliefs are not identical. They were not made one from the other. In fact, the figure from which the impression was made faced in the opposite direction from the others. Yet they are so much alike that they illustrate how repoussé work would have been copied by casting.

In summary we may say that hammered relief was used throughout antiquity in Greece and Italy, but became uncommon during the great age in Greece; that repoussé was discovered in the second half of the fifth century and remained in common use at least until the third; that cast low relief was used at all times, but that hollow cast relief, low and high, was used only in Hellenistic and early Roman times. Cast reliefs were made in imitation of hammered reliefs with the aid of matrices which were also moulds, and from repoussé reliefs with the aid of clay impressions. There is reason to believe that such commercial duplication of utilitarian metalwork was general throughout antiquity.

DOROTHY KENT HILL

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[41] Della Seta, *Museo di Villa Giulia*, p. 451, no. 13221, pl. LIX; *Boll. d'Arte*, III, 1909, p. 196, pl. II (attributed to a school in Asia Minor); Lamb, *op. cit.*, p. 175.