

VI.—*Silver in Roman and Earlier Times : I. Pre-historic and Proto-historic Times.*  
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SILVER in comparison with gold is of rare occurrence in nature in the metallic state. It is not found in the sands and gravels of rivers, but has to be sought for in mountain regions, where it is embedded in mineral veins. In these veins, too, it rarely occurs at the surface, like copper in the Lake Superior district of America, or in the outcrops of veins, as there, where it may once have been present as metal, it has usually been converted into chloride, by the traces of chlorine as sodium chloride invariably present in rain. Its occurrence is hence limited to the deeper deposits, where the ores are but little altered, and even there it is almost always in the form of delicate filaments or thin leaves, and very rarely massive, so that, without being first melted, it could not be fashioned into the simplest objects. An exception to its occurrence in these forms is found in the Kongsberg mines in Norway, where large masses, ranging in weight from 68 lb. to 1,537 lb. avoir., have been taken from the underground workings. For the above reasons silver has played no part in the culture of early man, and indeed it has never been found, as we shall see later, in association with his remains until subsequent to the time when he had first become acquainted with copper or bronze.

The ores from which the metal was first obtained were undoubtedly either ordinary lead ores, in which it is always present, or silver ores associated with lead ores.

In the absence of lead, the silver could not be easily extracted by any process until comparatively recent times, and although there is evidence that the Romans were acquainted with true silver ores, yet, in order to obtain the metal, they were compelled to mix them with lead ores before smelting.<sup>1</sup>

The first and essential process, then, for the extraction of silver was that of smelting ores for lead, the product being always the latter metal containing the former dissolved in it in greater or less proportions. Therefore, it follows that the metal lead must have been known to man at least a short time before he became acquainted with silver.

<sup>1</sup> Pliny, xxxiii, cap. 31.

The chief ore of lead, galena, which always contains silver, is of very common occurrence, and in many localities is found in vast, almost inexhaustible, deposits, which, as the remains of ancient excavations show, once cropped out at the surface of the ground.

The ore, too, is of brilliant metallic appearance and of high specific gravity, characters which cannot have failed to excite the curiosity of primitive man. Its great brittleness, however, would render it worthless to him for any practical use, but if, as the late Dr. Percy has remarked, 'he were to throw it on his blazing wood fire, even he could hardly fail to observe the remarkable change it might thereby undergo. The hard brittle ore might in a greater or less degree be transformed as though by magic into soft malleable lead.'<sup>1</sup>

I think there can be no doubt that the discovery of the metal arose in this way and that the first silver-lead smelting furnace was the domestic fire.

This discovery must have very closely followed, if indeed it was not simultaneous with, the discovery of lead, for, if by chance a piece of lead was left in the camp fire for some time, the lead would be entirely dissipated, owing to oxidation and volatilization, and a small piece of silver would be left.

The indirect method by which alone the metal could be extracted from argentiferous lead ores must, however, have been a serious hindrance to its early production and may have delayed its discovery by primitive man until some time after he had become acquainted with lead. In the case of copper, the metal could be obtained from its ores at once by the single operation of smelting, but silver could only be first extracted in the form of argentiferous lead, from which it had to be separated by a second and tedious operation. There was, too, a further difficulty in the very small amounts of the precious metal which were present in the lead. In Britain this probably did not exceed 0.06 per cent. (about 20 oz. per ton), while in the very richest galenas, an example of which is afforded by a mine in the Karahissar district of Asia Minor, the amount only reaches 1.84 per cent. (about 600 oz. per ton). Ore of the latter richness is, however, of extreme rarity, and the amount of silver present in the majority of argentiferous lead ores is very seldom even as much as 0.15 per cent. (about 50 oz. per ton). It is hence clearly apparent what a large amount of lead has to be removed before the silver can be obtained.

On the other hand, it is just possible, but extremely improbable, that a lump of kerargyrite (silver chloride), an ore of occasional occurrence in the outcrops of veins, might have been treated by Bronze Age man in the same way in which he was accustomed to smelt copper ores, or it might, by chance, have been embedded in his domestic fire; in either case he would undoubtedly have

<sup>1</sup> Percy, *The Metallurgy of Lead*, 213.

obtained metallic silver in one operation, as silver chloride is readily reduced by charcoal.

Of course, the discovery of the metal in the native state may have come first, as there are reasons for believing may have been the case in Spain, but it is only with the discovery of lead that the history of silver really begins.

Before proceeding further, it will be useful to consider the conditions bearing on the conversion of silver objects and native silver into silver chloride.

Silver objects which have been buried in the earth for a long period of time are almost always coated with a white or greyish crust of varying thickness. In some cases no unchanged metal, or only a thin core, remains, and although the original form of the objects may be more or less completely retained, others have lost all form and become shapeless masses. The substance into which the metal has been converted is silver chloride, and its formation is the result of the prolonged action of soluble chlorides, chiefly of sodium chloride in the presence of the oxygen of the air.

The source of the sodium chloride is not far to seek, as it is present in all rain, being in largest amounts in maritime regions, more especially during storms, when the spray from the sea may be carried to great heights in the atmosphere and descends in the rain.

Further, it has been shown recently that 'freshly collected rain-water or dew always contains a mixture of nitrites and nitrates'.<sup>1</sup> Now, as these substances have the effect of accelerating the action of sodium chloride on silver, it is rather surprising that any silver object buried in the ground, unless protected by a layer of clay or otherwise, should have escaped conversion into chloride.

In the following table are given the results of a series of determinations of the amount of sodium chloride in rain by Professor E. Kinch in the laboratories of the Royal Agricultural College, Cirencester:

#### SODIUM CHLORIDE (COMMON SALT) IN RAIN, CIRENCESTER.

<i>Periods of six months ending</i>	<i>Rainfall in Inches.</i>	<i>Sodium Chloride. Grains per Gallon.</i>	<i>Sodium Chloride. Pounds per Acre.</i>
1887, March 31	15.62	1.106	55.83
" September 30	9.51	0.3104	9.53
1888, March	13.06	0.4142	17.48
" September	14.78	0.3346	15.97
1889, March	15.13	0.3922	19.17
" September	15.52	0.24	12.03
1892, March	17.38	0.404	22.69
" September	13.73	0.242	10.74
1893, March	11.80	0.333	12.70
" September	8.35	0.4005	10.80

<sup>1</sup> Paper by Professor B. Moore, Royal Society, 13th December 1917.

At Florence the amount of chlorine ranged from 0.168 to 24.177 mg. per litre (0.118 to 16.92 grains per gallon), whilst at Antignana near Leghorn it reached the high figure of 21.106 gm. per litre (81.739 grains per gallon), i.e. 270 pounds of sodium chloride were deposited per acre for each inch of rain.

The extraordinary extent to which this conversion of the metal silver into chloride can be effected, even during historical times, is forcibly illustrated by the find of Roman denarii at Hengistbury Head, many of which have been completely transformed into shapeless masses of chloride.<sup>1</sup>

The complete conversion of the metal into chloride in the comparatively short period of seventeen centuries was partly due to the thinness of the coins, but chiefly to the large amount of sodium chloride which would be found in the soil where they were buried, in proximity to the sea.

As silver is so readily converted into chloride, under the conditions mentioned above, that only a whitish or greyish mass may remain after long burial, not necessarily retaining the original form of the object, it is not impossible that some may have been overlooked by excavators unless specially sought for. Hence the absence of objects of silver in the early part of the Bronze Age does not prove with absolute certainty that the metal was unknown to the men of that remote period.

I propose to consider first the occurrence of silver in the remains of the primitive races in Europe and Britain during their stages of Bronze and Early Iron Age culture, although the metal was known and in extensive use among the peoples of the Eastern Mediterranean regions and of Western Asia in much earlier times.

On the influence of those peoples the advance in civilization of the inhabitants of North and Western Europe was dependent, and the introduction of the use of silver, in fact the diffusion of the metals, except gold, had the same origin.

Silver has not been found, to my knowledge, with any of the remains of man in the Palaeolithic stage of culture, neither was it known in the Neolithic stage, although in the chambered tumuli of the latter gold is of occasional occurrence. In Europe it is not until we reach the Bronze Age that we meet with any even of the simplest objects of the metal, and indeed in the earlier part of the Iron Age its occurrence is rare.

Silver objects are still rare in Europe north of the Alps in the epoch of La Tène, except in certain districts which possessed argentiferous ores, notably Hungary, Bosnia, Transylvania, and certain regions of the Alps. In these districts a great number of silver fibulae has been found; several are of large dimensions, but they are not of earlier date than La Tène II (Déchelette). To

<sup>1</sup> Bushe-Fox, *Excavations at Hengistbury Head*, 25, 75.



the La Tène period the few silver objects obtained from the Lake-dwellings have also been referred. When we reach Roman times, objects of Greek and Roman art and of native production, with barbaric copies of classical ornament or designs, are not uncommon even as far north as Scandinavia.

Before proceeding to the consideration of the occurrence and uses of the metal in the chief divisions of the ancient world, I will cite briefly the discoveries which have been made in some rather isolated localities in Europe.

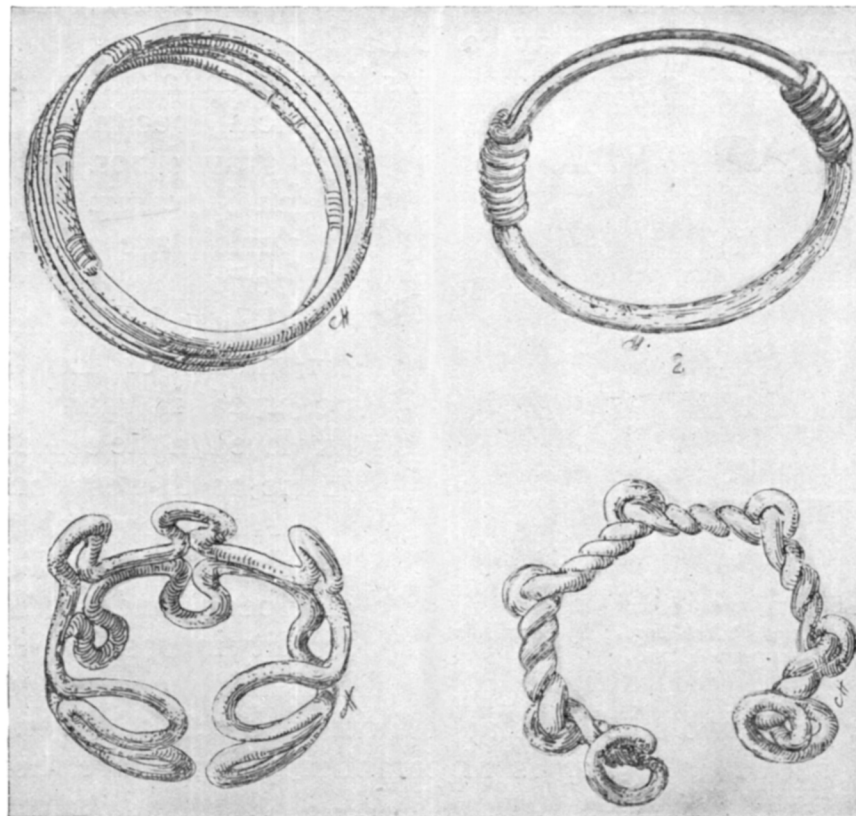


Fig. 1. Silver bracelets, Ornavasso, North Italy.

In the remains found in the cemetery of Remedello Sotto, in the province of Brescia, which have been attributed to the Eneolithic period of culture (the period in which stone had only in part given way to metal as a material for making implements and weapons), ornaments of metal, even of copper, are rare, yet they include a long pin of silver.<sup>1</sup> This pin is about 7 in. in length, T-headed, its head being nearly 2 in. long. It is of finer workmanship than any of the other metal objects, and was in all probability not indigenous work

<sup>1</sup> Peet, *The Stone and Bronze Ages in Italy*, 263.

but had been introduced from abroad. It is placed by Montelius among objects to which he gives the date 2100–1950 B. C.<sup>1</sup>

In the neighbourhood of Lago Maggiore, to the north of the Lepontine Alps, were two important Gaulish settlements during the La Tène period, Ornavasso in the Italian province of Novara, and Giubiasco in the Swiss canton Tessin. In the two cemeteries of Ornavasso which have been explored, one of La Tène II, the other of La Tène III, and the first century of our era, silver bracelets (fig. 1),<sup>2</sup> rings, fibulae, and other ornaments were found in considerable numbers, also some small silver cups. Most of the objects are of La Tène III, although some from their archaic form may be of La Tène II.

At Giubiasco similar small ornaments have been taken from the cemetery.

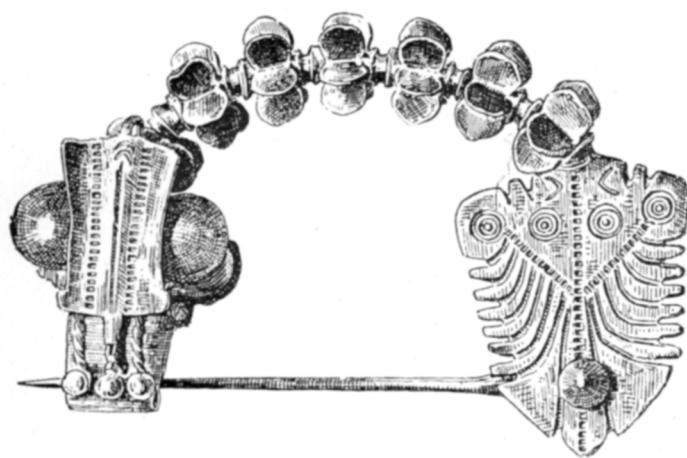


Fig. 2. Silver fibula. Strbci, Bosnia.  
(From Déchelette, *Manuel d'Archéologie*; by permission of M. Auguste Picard.)

Typical specimens of these from the graves nos. 87, 88, and 254, which I examined in the museum at Zurich, are all of the La Tène III period.

Silver fibulae, rings, and other ornaments of La Tène II also occurred in many of the graves explored in the cemetery of Jezerin in the north-west corner of Bosnia.

An important find of silver articles of the La Tène period has also been made at Strbci, another locality in Bosnia. They were contained in a cup of bronze and com-

prised six large and two small fibulae and other objects of silver. The former, one of which, shown in fig. 2,<sup>3</sup> is of complicated form, are more or less free imitations of classic models.

At Munsingen, Canton Berne, Switzerland, we have one of the most important localities in Europe for silver and gold articles of the La Tène period. Finger rings are particularly abundant. According to Déchelette,<sup>4</sup> the graves of the cemetery, of which over 200 were opened, have yielded a greater number of these rings than the whole of the other burials of that epoch elsewhere. But many fibulae, bracelets, and torcs were also found, some of La Tène I and others of a somewhat later type.

The site of the Hradischt, or stronghold of Stradonic, situated about twenty

<sup>1</sup> Montelius, *Journal of the Anthropological Institute*, xxxi, pl. xv.

<sup>2</sup> Déchelette, *Manuel d'Archéologie*, ii, 1094.

<sup>3</sup> Déchelette, *op. cit.*, 1348.

<sup>4</sup> Déchelette, *op. cit.*, 1265.

miles south-east of Prague, has yielded a very great number of fibulae, finger rings, and other small ornaments of silver, also numerous Gallic coins, none of which, however, appears to be older than La Tène III.

Here I may again state that all the localities mentioned above, where silver objects have been found, are in the immediate neighbourhood of mineral districts containing argentiferous ores or not far distant from them.

*Britain.* No object of silver undoubtedly belonging to the Bronze Age has yet, so far as I have been able to ascertain, been found in Britain.

Thurnam, in his account of the round barrows which he explored in Wiltshire and the adjoining counties, states:<sup>1</sup> ‘Ornaments of gold were found in seven of the Wiltshire tumuli, in four with unburnt and in three with burnt bodies. In most of these there were several objects of the precious metal, and altogether nineteen golden ornaments or sets of ornaments may be enumerated.’ No silver or leaden ornaments or objects were found, yet these tumuli are of the Bronze Age, when it might be reasonably expected that, as ores of lead containing silver were so abundant in this country, Bronze Age man would certainly have known and utilized these metals, more especially lead, as this metal is so much more easily extracted from its ores than copper.

In burials of the Early Iron Age gold is still met with, but silver is rarely if ever found. No remains of the furnaces of the earliest times have been found in Britain. Those employed for smelting lead ores in the Late Celtic period, from which alone silver could be obtained, have been quaintly described by Pennant.<sup>2</sup> ‘The ruder Britons, before their conquest by the Romans, had a very simple process. They placed the ore in a hole in the ground and mixed it with wood, which, being fired, proved sufficient to melt the lead out of the soft and kindly ores of this country; a small gutter communicated with a second hole into which the metal ran from the first. These artless slag-hearths are very frequent in our country, discovered by the quantity of scoria mixed with charcoal.’ The furnaces of an earlier period were doubtless of the same simple character.

*Scotland.* In Scotland, while there have been many important finds of personal ornaments and other relics of silver, some of great weight, others elaborately ornamented, the precise facts connected with the discovery of most are uncertain, but the character of the ornament, and in some cases the coins said to have been found with them, show that none is of earlier date than the Roman period and others are of Viking times.

*Gaul.* Silver is absent in Gaul in the remains of the Neolithic Age. Ornaments of gold have been found, but they are not common in the dolmens of Brittany, which have been attributed to the latter part of that period.

<sup>1</sup> *Archæologia*, xliii, 524.

<sup>2</sup> Pennant, *A Tour in Wales*, 61.

In the Bronze Age, more especially in the earlier part, gold ornaments and jewellery, often of a massive character, appear to have been comparatively abundant, yet even up to its close silver is of rare occurrence. Further excavations may hereafter bring more examples of its use to light. At present the only evidence we have that the metal was known to the men of that age is chiefly derived from the following objects, which according to Déchelette can undoubtedly be referred to that period:<sup>1</sup>

- (a) Simple silver pins with the head in the form of a loop. From a tumulus at Mouden-Bras, Commune of Pleudaniel (Côtes-du-Nord).
- (b) A spiral ring from a tumulus at Carnoët (Finistère).
- (c) Several rings from a 'dépôt' or hoard at Cury (Saône-et-Loire).
- (d) A bronze dagger with rivets of silver found at Cissac near Pauillac (Gironde).
- (e) A kind of collar associated in the finds at St. Vallier (Alpes-Maritimes) with an object which appears to be a fragment of a halberd, with bronze spirals and various pieces of ornament.

In Finistère there are deposits of argentiferous galena which, from the number of celts of lead that have been found in that district and in Loire-Inférieure, were evidently worked in the Bronze Age. The silver in the first-named objects (a and b) could hence have been obtained from them, and it is rather surprising that, with silver-bearing ores in their neighbourhood, so few examples of the use of the metal should have been found in the tumuli.

As regards the source of the silver of the rings (c) and the collar (e), Cury is not far distant from the mineral district of Puy-de-Dôme, and St. Vallier is equally near the ancient mines of l'Argentière (Hautes-Alpes).

The bronze dagger (d) is of the same type as those found by the brothers Siret at El Argar, and was probably imported from Spain.

In the Early Iron Age, the Hallstatt period, silver is still very rare, and remains so until near the end of La Tène, shortly before the incursion of the Romans.

In this connexion it may be remarked that the finds of silver recorded among the sepulchral remains of Champagne consist almost solely of considerable ornaments, bracelets, and rings.

A massive torc of exceptionally beautiful workmanship of the La Tène period, weighing 336.5 grm. (about 11.9 oz. av.), was, however, found at Vallon, near Freissinières (Hautes-Alpes).<sup>2</sup>

Much still remains to be worked out as regards the extent to which silver was in use when the Romans entered Gaul. If the evidence afforded by classi-

<sup>1</sup> Déchelette, *Manuel d'Archéologie*, ii, p. 365.

<sup>2</sup> Chantre, *Les Nécropoles du premier Âge du Fer des Alpes Françaises*, pl. vii, fig. 6.



cal writers is to be relied on, the Gauls were much richer in silver than is demonstrated by the actual finds of objects of the metal. According to Livy, P. Cornelius Scipio, in his victorious campaign in Gallia Cisalpina against the Boii, 191 B.C., obtained as booty the almost incredible amount of 2,340 pounds of silver vases of Gallic manufacture.<sup>1</sup>

Strabo states that the Ruteni and Gabales in Aquitania possessed productive silver mines.<sup>2</sup> In support of Strabo's statement, I may say that near Vialas (Dép. Lozère) and at one or two places in the same department and in Gard, in the regions occupied by the Ruteni and Gabales, there are ancient workings of considerable extent, and here litharge and by-products of the separation of silver from lead, as well as slags, have been found.

In addition to the ordinary uses of the metal, the Gauls were acquainted with and practised the art of silvering bronze, and although only a few examples have been found, we have the testimony of Pliny<sup>3</sup> that the people of Alesia made use of the process for plating ornaments for horses, yokes of oxen, and also for carriages and chariots.

The historian Florus mentions the silver chariot which carried Bituitus, king of the Arverni, when he fought the Romans in 121 B.C., and in which he appeared in Rome at the triumph of his conqueror, the consul Q. Fabius Maximus.<sup>4</sup> This was doubtless not of solid silver, but of plated wood and silvered bronze. The rich silver-lead mines of Pontgibaud, however, are situated in the country of the Arverni and must have yielded them considerable amounts of the precious metal.

In Scandinavia, where in the Kongsberg mine the largest deposits of native silver in Europe have been found, it might naturally be expected that silver objects would have been discovered in the remains of an early period, yet none occurs until the later Iron Age, about the first century of our era, and these have had their origin in metal from Gaul or southern Europe.

One of the most remarkable silver objects found in Scandinavia is a large cauldron,<sup>5</sup> of which a brief description may be inserted here. Though it is of Roman times, yet it is most probably of Gallic origin and is the most extraordinary silver vessel of barbaric ornamentation that has been found in Europe. It was discovered in a peat bog near Gundestrup in the neighbourhood of Aars on the north-west of Hobro in Jutland. The cauldron is ornamented both inside and outside with numerous figures in repoussée work, many of which are copies of classical subjects rudely executed. Another element in the designs is certainly Gallo-Roman; for instance, the frequent recurrence of the snake with a ram's head, and the male figure sitting with crossed legs, an antler on his

<sup>1</sup> Livy, xxxvi, 40.

<sup>2</sup> Strabo, iv, c. ii, 2

<sup>3</sup> Pliny, xxxiv, 48.

<sup>4</sup> Florus, iii, 2.

<sup>5</sup> Sophus Müller, *Nordische Altertumskunde*, vol. ii, pl. 1, 160.



head, and holding in one hand a large ring and in the other a snake, all of which are attributes of the Gaulish god Cernunnos. The cauldron is not in one piece, but is constructed of plates fastened together by silver bands soldered to them. It weighs 8,885 grm. (19.58 lb. avoirdupois), and from its nature, costliness, and decoration Dr. Sophus Müller concludes that it was made for use in religious ceremonies and was deposited in the peat bog as a votive offering to the gods.

As regards its age the cauldron is attributed to the Roman period of Denmark.

*Spain.* The northern border of the valley of the Baetis, but especially the mountain district between its eastern side and the sea, and notably the Sierra Almagrera, was the most highly mineralized region of the world, and was unequalled in its production of lead and silver by any other region in ancient times.

Owing to the occurrence of native silver, and probably of the easily reduced silver ore kerargyrite (silver chloride) in the outcrop of some of the veins, and its extraordinary richness in argentiferous galena, the metal was known to the natives and in use by them at a very remote period, long before the Phoenicians or even the Aegeans had reached the country. The explorations of MM. Siret have demonstrated that silver was even in use when implements of metal had only partially replaced those of stone.

The outcrops of the veins at the foot of the Sierra Almagrera near Herreiras in the Carthagera district, in which there is strong evidence to show that native silver occurred, were doubtless the source from whence they obtained the metal in that primitive stage of culture. I may say that native silver is reported by MM. Siret to have been found at the foot of the Sierra,<sup>1</sup> and at El Argar a sample of galena was rich in silver, containing nearly 1 per cent. (about 320 ounces per ton).<sup>2</sup>

In the tombs at El Argar of the beginning of the Bronze Age MM. Siret unearthed a large number of objects of copper, of bronze poor in tin, and of silver comprising flat celts, daggers of bronze, one with silver rivets, and one of silver, also halberds, two diadems of silver of simple form, and other silver personal ornaments. Of these various objects, some appear already in the Eneolithic Age, and, in many, Aegean influence is undoubtedly evident.

The silver objects found, chiefly bracelets, rings, and pendants, were 310 in number and weighed 1,500 grm. (about 53 oz. av.).<sup>3</sup>

One of the bracelets which was analysed gave the following results:

Silver, 92.64;  
Copper, 5.82;  
Chlorine, 1.00.

<sup>1</sup> Henri et Louis Siret. *Les premiers Âges du Métal dans le Sud-Est de l'Espagne*, 231.

<sup>2</sup> *Ibid.*, 232.

<sup>3</sup> *Ibid.*, 232.

Now native silver has been found to contain up to 10 per cent. of copper, and as no lead is present we may certainly infer that it was made of the native metal.

M. L. Siret is inclined to establish by archaeological evidence the presence of the Phoenicians in Spain even in the Neolithic period, but in the opinion of Déchelette this cannot be accepted, as, before the foundation of the town of Gades, there can be no question of Phoenician sea-power in the western Mediterranean, the Aegeans having had command of the sea in the previous centuries.

History does not record any intercourse between the Aegeans and Spain, but it is beyond doubt that they were seafaring peoples and voyaged in the Mediterranean before the Phoenicians; and that they may have reached the silver-bearing districts on the south-east as early as the Eneolithic period, we have the evidence afforded by the excavations of MM. Siret at Millares, and in the Bronze Age at El Argar.

In the chambered tumuli at the former place these explorers discovered some earthen cups ornamented in incised work with a pair of symbolic eyes undoubtedly indicating Aegean influence.<sup>1</sup>

From the foundation of Gades (1100 B.C.) until they were displaced by the Carthaginians and the Greeks, the Phoenicians had continuous intercourse with the argentiferous districts of Spain. 'They probably penetrated but a short distance inland, and, so far as we know at present, their presence on the fringe of a small stretch, the south-eastern part of the Peninsula, left no trace in the inhabitants, or in the country itself.'<sup>2</sup> They were essentially traders and merchants, and although it is recorded that they owned the mines in the islands of Thasos,<sup>3</sup> there is no evidence that the Iberian mines were ever worked by them.

The well-known tale of Aristotle<sup>4</sup> that the first Phoenician ships received so much silver for worthless wares that they left behind their anchors and chains, having replaced them with those of silver, is open to serious doubt for metallurgical and technical reasons. Any object made of silver must be cast, and there is no evidence that it was possible at this remote time to make a casting of the metal of the weight of the anchors required for the far voyaging ships of the period.

A more reasonable and trustworthy version of the tale is given by Diodorus.<sup>5</sup> After stating that the merchants bought silver by exchange of very small quantities of other articles, he says 'that the eagerness for the extraordinary

<sup>1</sup> Déchelette, *Manuel d'Archéologie*, i, 601.

<sup>3</sup> Herodotus, vi, 47.

<sup>5</sup> Diodorus, v, 35.

<sup>2</sup> Horace Sandars, *Archaeologia*, lxiv, 206.

<sup>4</sup> Aristotle, *Περὶ Θαυμασίων Ἀκουσμάτων*, cxxxv.

profits which they obtained by this barter was so great that when the cargo of their vessels had been completed and still some silver remained they cut off the lead which was attached to the anchors and substituted ingots of silver to serve the same purpose'.

After the fall of Tyre, in the 6th century B.C., the Phoenician trading stations passed into the hands of the people of Carthage, and in the same century the Greeks established settlements in the north-east and east of Spain. There is no certain evidence, however, that the silver mines were worked by either of these peoples, although 'the Carthaginians penetrated to the mining district on the northern confines of the valley of the Bactis, where they in all probability worked the mines'.<sup>1</sup> But with the advent of the Romans in the third century and their subsequent conquests the mines passed into their possession and were exploited by them on a very extensive scale until the fall of the Empire.

During the whole of the period from the beginning of Phoenician intercourse up to the early centuries of our era Spain had been one of the chief sources of silver to the Ancient World.

The nations or peoples whose uses of silver will now be considered had reached at a very remote period a higher stage of civilization than the races already dealt with. In the case of some we have in fact to go back to a time long anterior to that of Bronze Age man in Europe.

In a rude and primitive age the metallurgist and the worker in metals are solely occupied in the making of weapons and implements for war, the chase, and the simplest operations of agriculture, for none of which silver was as suitable as bronze, even had it been abundant. In the Early Iron Age the scope of their work still does not extend beyond the production of personal ornaments. But as civilization advanced, while the fabrication of arms and appliances of war is not neglected, their skill takes a wider range and they become the artificers of silver vases, cups, and other luxurious appurtenances of domestic and ceremonial life of which so many noteworthy specimens have been unearthed.

*Chaldea.* The earliest mention of the metal silver that I have been able to find is contained in an inscription on a granite obelisk discovered by M. de Morgan at Susa.<sup>2</sup> The monument is a boundary-stone on which are engraved the title-deeds of an extensive property purchased by Manishtusu, king of the city of Kish. On the grounds of the writing and contents of the inscription, it has been assigned to an age as remote as 4500 B.C.

<sup>1</sup> Sandars, *Archaeologia*, lix, 313.

<sup>2</sup> Letter of Mr. St. Chad Boscawen, *The Times*, 29th January 1901.

Records of the area and purchase price of the land and of the value of the slaves, asses, and various material bought with it are given in detail. As regards metal articles there is the following statement :

6 bronze khagi,  
4 „ wedges,  
3 „ cleavers.

Price per instrument 5 shekels silver.

Their value 1 mana 5 shekels.

In all the values given there is a regular silver tariff of the talent, mana, and shekel arranged according to a sexagesimal scale. The obelisk thus affords, in this use of silver as a monetary standard, conclusive evidence of the vast antiquity of the civilization of the early Babylonian states.

Of the same period is a silver vase dedicated as a votive offering to Ningirsu by Entemena the Sumerian king of Lagash, which was found by De Sarzec in his excavations at Tello and is now in the Louvre. The vase stands on a small bronze pedestal. A piously worded inscription runs round the neck, and the body is divided horizontally into two divisions enclosed by twisted cord work. In the lower division is a row of four eagles, representations of Imgig, the lion-headed eagle of Ningirsu, in the act of seizing animals with their claws, 'a representation which served as the heraldic cognizance of Lagash'.<sup>1</sup> In the upper division are dispersed seven heifers lying down.

The excavations of Andrae and Noeldeke on the site of the ancient Shuruppak at Fāra carry still farther back the history of the Sumerians as a metal-using people acquainted with silver.

Silver finger rings, together with arm rings, and copper spear-heads, axes, and blades of daggers with rivets, were found in the earliest graves. The sources of the silver and copper were in all probability the ores of these metals in Carmania (Laristan), or the copper may have been obtained from the Sinaitic deposits and the silver from the Tiyari mountains, Amidu (Diarbekr), or probably the Taurus.

Additional evidence of great importance of the remarkable antiquity of the civilization of this region has been recently afforded by the carved ivory handle of a flint knife stated to have been found at Gebel el-Arak opposite Nag Hamadi, Egypt. It has been described by M. Bénédict, of the Louvre Museum, in the *Monuments et Mémoires* of the Académie des Inscriptions (tom. xxii, fasc. 1). An abstract by Professor Flinders Petrie appears in *Ancient Egypt*, 1917, part i, p. 26 et seq. The designs represent fighting men, ships, and hunting scenes. According to Petrie, 'The art is not Egyptian.

<sup>1</sup> Hall, *The Ancient History of the Near East*, 182.

The general style of the fighting groups reminds one of more than one monument of early Mesopotamia. Above all, the figure of the hero with lions is a purely Mesopotamian or Elamite type.' It is evident, therefore, that the advance of civilization may have been earlier on the Tigris than on the Nile (Petrie).

Of a somewhat later but still an early date is the inscription on a statue of Gudea which was unearched at Tello by De Sarzec. It contains a very valuable passage relating to silver and other metals. Here the king, speaking of his statue, says: 'Of this statue, neither in silver, nor in copper, nor in tin, nor in bronze, let any one undertake the execution' (Boscawen). The approximate date attributed to the reign of this monarch is 2,500 B.C. It would hence appear that at this time silver was sufficiently plentiful to be used for casting statues, although these may probably have been only of small size.

About the same period there is a considerable number of documentary clay tablets in the British Museum<sup>1</sup> ranging from the time of Dungi, king of Ur (*c.* 2400 B.C.), to Ammi-zaduga, king of Babylon (1977-1957 B.C.), referring to sales of houses, land, and slaves, in which silver in manehs and shekels appears as the medium of exchange. Yet notwithstanding these records, and many others extending to the captivity of Babylon by Cyrus (539 B.C.), no ingots or pieces of silver which could have been used as currency have been found either in Babylon or Assyria. Neither have any silver or gold vessels, except the silver Entemena vase, been obtained in any of the numerous excavations. This is strange, as we may well believe that the Babylonian and Assyrian kings by their conquests had accumulated vast stores of these treasures as spoils of war. A confirmation of this, if such is needed, is afforded by a black alabaster monolith which was set up by Shalmaneser II (860-825 B.C.), at Nimrud, and is now in the British Museum.<sup>2</sup> It is inscribed on the four sides with an account of his victories and of the silver and gold and vessels of gold received as tribute from the kings whom he had conquered. Silver is placed first in the lists of metals in the booty, and is followed by gold, lead, and copper. No tomb, however, has yet been discovered that by its size, richness, or isolation can be regarded as the burial-place of royalty, yet the sovereigns of Mesopotamia must have had something analogous to the vast and magnificent sepulchres of the Egyptian kings.

As the country is simply an alluvial plain, and sun-dried bricks alone were available for constructive purposes, it is extremely probable that the royal tombs may have been built of this material, and hence did not afford that protection for their contents which we find in Egypt and Mycenae. They were, therefore, easily

<sup>1</sup> *Guide to the Babylonian and Assyrian Room, British Museum*, pp. 131 and 142 et seq.

<sup>2</sup> *Op. cit.*, p. 24.



destroyed. That their destruction and spoliation were most remorselessly and completely carried out we have the evidence of an inscription of Ashurbanipal (668–626 B.C.), in which, speaking of his campaign against Susiana, he says, ‘the tombs of both their ancient and modern kings I threw them down and demolished them and carried away their corpses into Assyria.’

As regards the relative value of silver and gold, I have already mentioned that in the tribute lists *c.* 900–800 B.C. silver precedes gold; but in the time of Sennacherib, 705 to 681 B.C., the order is reversed and gold precedes silver.

An inscription found at Khorsabad, to which the date 708 B.C. has been attributed, gives the ratio of 1 gold to  $13\frac{1}{3}$  silver.

*Egypt.* In Egypt there is a marked absence of silver in the earliest times. It does not appear to have come into use until the beginning of the second pre-historic civilization, when it was used for a cap of a jar, a spoon, and other small objects (Petrie).

It is still rare in the Twelfth Dynasty (2466–2266 B.C.). Only a few silver objects have been found, the chief of which are a necklace of beads and the royal hornet with inlaid wings and pieces of pectorals from Harageh.

As there are no silver mines in the country the metal had to be obtained from abroad, but this does not satisfactorily account for its scarcity during this dynasty if we may accept Elliot Smith’s<sup>1</sup> statement that ‘early in the third millennium B.C., fleets of Egyptian ships were trading in foreign parts’ and ‘there is evidence to show that an intimate intercourse had sprung up between Egypt and Palestine before the end of the Third Dynasty (3733 B.C.)’. Nor must it be overlooked, as we have already seen, that there was intercourse with a silver-using people in the Mesopotamian region in even earlier times.

At Hissarlik, as we shall see later, silver vases were in use as early as 2500–2000 B.C., and at Mycenae *c.* 1600–1500 there were skilful workers in the metal. Hence it is extremely strange that so few silver objects have been found in Egypt.

In the Eighteenth Dynasty (1650–1400 B.C.) silver appears still to have been rarer than gold, if the order in which these metals are mentioned in the lists of the offerings to temples may be accepted as evidence. A characteristic example of these lists is the inscription on the stele of Neb-onu, chief prophet of Osiris in the reign of Thothmes III. It runs thus: ‘I have consecrated numerous gifts in the temple of my father Osiris; in silver, in gold, in lapis-lazuli, in copper, and in all kinds of precious stones.’<sup>2</sup> A silver ring of Amen-hetep IV (1430 B.C.), in the British Museum, a group of hollow silver bangles found by Petrie at Querneh in a grave under the store-rooms of Seti I (1366 B.C.), and a few

<sup>1</sup> G. Elliot Smith, *The Ancient Egyptians*, 98.

<sup>2</sup> Mariette, *Notice . . . du Musée*, no. 93.

other small articles comprise the whole of the objects of silver of the Eighteenth and Nineteenth Dynasties; yet there is no lack of gold.

On the other hand, inscriptions of the reign of Thothmes III state that amongst the offerings to Amen, the chief deity of Thebes, were 562 talents of silver. Also a great quantity of silver vases are recorded in the papyrus of Rameses III. Further, according to Petrie, 'the totals given to the various gods by Rameses III during his reign must show fairly the relative amounts of the precious metals in use. It is not quite clear how far totals recapitulate, but the totals offered to the various gods amount to 9 cwt. of gold and 30 cwt. of silver, the grand totals named later are 20 cwt. of gold and 33 cwt. of silver.'<sup>1</sup> Hence we may conclude that silver was not scarce, but abundant, during the reign of that monarch (1200 B.C.).

Before the end of the Eighteenth Dynasty, with the rise of the sea-power of the Minoan and the Aegean peoples, followed by Phoenician intercourse with Spain, Egypt must have been in a position to acquire large amounts of silver.

In the course of centuries, however, by external trade and as spoils of war, silver had accumulated to an extraordinary extent, if the accounts of the destruction of Thebes by Cambyzes (526 B.C.) are only approximately true, when it is said that an almost fabulous amount of the metal, exceeding 60 tons in weight, was taken out of the rubbish. I may add that some silver was also obtained by treating electrum, a native gold-silver alloy, by a cementation process.

As is well known, all native gold contains silver. If sufficient was present to produce a paleness of colour, the metal was termed *asem* by the Egyptians, and *electrum* by the Greeks. Specimens of gold leaf from mummies of the Sixth Dynasty, analysed by Berthelot, were found to contain from 3.2 to 4.5 per cent. of silver. The golden foil taken by Schliemann from one of the royal tombs at Mycenae, which was analysed in Dr. Percy's laboratory at the Royal School of Mines, contained 23.37 per cent., while in a rod of electrum from Ilios, analysed by Roberts-Austen, the large amount of 33.4 per cent. was present.

That the Egyptians separated silver from gold at the Nubian mines by a process of cementation we have the evidence of Agatharchides (second century B.C.), as given by Diodorus.<sup>2</sup> The process was undoubtedly carried on by them in the sixth century B.C. and probably in somewhat earlier times.

The description of the process by Agatharchides is undoubtedly obscure and wanting in accuracy, although its general meaning is quite clear, and in this connexion it must be borne in mind that it is an account of an extremely technical process by a writer who had no technical knowledge, and is not more inaccurate than some accounts in our own times by non-technical men of subjects of a similar character.

<sup>1</sup> Petrie, *Ancient Egypt*, 1915, p. 16.

<sup>2</sup> Diodorus, iii, 14.

His description is as follows: 'The gold in the form of granules, together with various proportions of (lead?), salt, and barley bran, was placed in a porous earthen vessel and the cover luted on with clay. The vessel was then placed in a furnace and heated continuously for five days and five nights. After this treatment the gold was left perfectly pure.' Unfortunately no account is given of the method followed for the recovery of the silver.



Fig. 3. Charging the furnace. Japan.

This ancient process for separating silver from gold by means of common salt I found in use in Japan in 1872. The operations as conducted there, which I will briefly describe, throw considerable light on the mode of procedure followed at the Egyptian mines (figs. 3 and 4).

The gold was first reduced to a coarse powder by heating it to near its melting-point, and rubbing on an iron plate with a stone or iron rubber. The coarsely powdered gold was mixed with common salt and a certain proportion of clay, and piled up in the form of a cone on an earthen dish. The whole was

then placed in a furnace containing charcoal as fuel and was kept at a red heat, insufficient to melt the gold, for at least twelve hours, by which means the silver was converted into chloride, which was absorbed by the clay. The dish with its contents was then removed and the gold separated by washing with water. The silver was extracted from the residue by smelting with litharge in a simple furnace.



Fig. 4. Removal of the charge after treatment.

*Ilios.* In the Troad the excavations of Schliemann have brought to light the earliest examples of the use of silver in the eastern Mediterranean region. They consist of a silver pin, an earring, and a piece of wire, which were found at Hissarlik in the stratum representing the lowest city, to which the date 3000 to 2500 B.C. has been assigned by Tsountas and Manatt.

In a higher stratum containing the remains of the second city (2500 to 2000 B.C.), the prehistoric fortress of Dörpfeld, there was quite a wealth of silver vessels and objects comprising eleven vases, goblets, jugs, etc., six silver bars, some personal ornaments, as well as crucibles in which gold and silver had been



melted. Several of the vases and goblets are of graceful forms and delicate workmanship, indicating remarkable technical skill in the working of the metal.

The silver bars (fig. 5)<sup>1</sup> differ in size, but their weight only varies from 6 oz. to 6.1 oz. They are of even greater interest than the other silver objects, as they most probably represent a system of currency in use in Hissarlik of a similar character to that of the small stamped pellets of the Minoans (1600-1350 B.C.) (see p. 141). One of the bars was analysed by Roberts-Austen, and its composition is given in the following table, in which is inserted for comparison the analysis of a Roman *patera* in the British Museum:

	<i>Silver.</i>	<i>Copper.</i>	<i>Gold.</i>	<i>Iron.</i>	<i>Lead.</i>	<i>Analyst.</i>
Silver Bar	95.61	3.41	0.17	0.38	0.22	Roberts-Austen
Roman Patera	95.15	3.44	0.47	0.07	0.33	Gowland

Now Roman silver was undoubtedly obtained from argentiferous lead by cupellation, and, as the bar from Hissarlik is practically identical in composition with it, it is reasonable to assume that the silver of which it consists was the result of the same process.

The sources whence the people of the prehistoric towns Hissarlik and Lamunia could obtain the metal were not far distant, in fact they lay at their very doors. In the mountain districts to the north-east of Mt. Ida in Mysia, and at various points on the range of which Mt. Olympus forms the prominent peak on the frontiers of Mysia and Bithynia, there are considerable deposits of argentiferous galena and many remains of ancient surface mining. As silver-lead mining was undoubtedly carried on in Pontus at a very remote period, we may not unreasonably presume that some of these remains may be of Hissarlik times and furnished the silver.

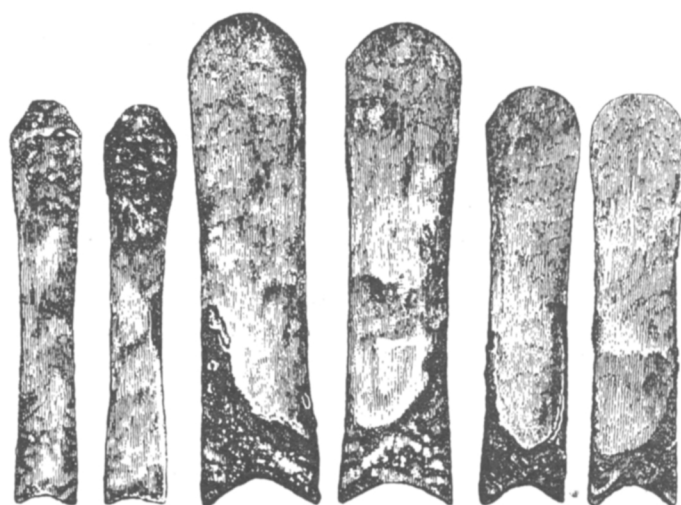


Fig. 5. Silver bars from Hissarlik (Second City).  
(From Schliemann, *Ilios*, by permission of Mr. John Murray.)

It may be mentioned in this connexion that the sites of several of the ancient workings for ore in this district have been exploited in recent years, notably at Hodsha Germish (Balía), to the north-east of Mt. Ida, and at Karie-Seunluk, and near Broussa, on the Olympus range, and have yielded both lead and silver. The mine at Balía, which at the present time is the most important in Asia

<sup>1</sup> Schliemann, *Ilios*, 470.



Minor for lead and silver, produced in 1903 7,600 tons of lead containing 63 oz. of silver per ton.

*Crete.* As regards the Minoans the comparative rarity of silver objects at Knossos is difficult to understand in view of the facts that they were specially distinguished as a seafaring people and must therefore have had communication with the silver-bearing regions near the coasts of the Aegean and of Asia Minor, and that their vessels and utensils of bronze and their work in gold testify to their skill as artificers in metal. The only explanation that seems possible is that the city was not only destroyed by fire, but was plundered before its destruction. On the other hand, objects of the metal have been found in tombs.

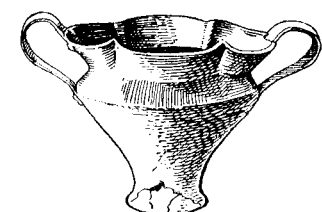


Fig. 6. (1) Silver cup; (2 and 3) Polychrome ware cups. Gournia, Crete.

(From Hall, *Aegean Archaeology*, by permission of Mr. Hall and the Medici Company.)

In the royal tomb of Isopata, excavated by Sir Arthur Evans,<sup>1</sup> which unfortunately had been previously plundered, there were found near the edge of the pit the remains of two silver cups, one nearly perfect. It is about 9.5 cm. ( $3\frac{3}{4}$  in.) in diameter and is fitted with a handle attached by rivets. 'That they had been originally contained in the sepulchral cist is probable enough,' hence their date must lie in the Middle Minoan III period (1900–1700 B.C.). Silver vessels of typical Minoan form appear in the representations in the Theban tombs among the gifts borne by Cretan ambassadors to the court of Hatshepset and Thothmes III (1550 B.C.).<sup>2</sup> A silver ring was found by the same explorer in the tomb of the polychrome vases of the Late Minoan III period (1450–1200 B.C.), and the handle of a silver cup in the tomb of the Double Axes, Late Minoan II (1500–1450 B.C.).<sup>3</sup>

At Gournia a tall silver cup of kantharos shape was found in a house tomb of the Middle Minoan period, together with two clay cups (fig. 6)<sup>4</sup> of the same form. The silver cup is 8 cm. ( $3\frac{1}{8}$  in.) high, with fluted rim and projecting handles fastened by silver and bronze rivets. The clay cups are interesting examples of the imitation of a metal form by the potter; even the rivets are represented by pellets of clay. Since this discovery a number of fine silver bowls, also of Middle Minoan date, have been unearthed at Knossos.<sup>5</sup>

<sup>1</sup> *Archaeologia*, lix, 533, 545.

<sup>2</sup> *Archaeologia*, lxxv, 24 and 45.

<sup>3</sup> C. H. and B. Hawes, *Crete the Forerunner of Greece*, 116.

<sup>4</sup> Hall, *Aegean Archaeology*, 58.

<sup>5</sup> Hall, *Aegean Archaeology*, p. 54, fig. 5.

Among the epoch-making results of the excavations of Sir Arthur Evans at Knossos, not the least important is the discovery of the earliest beginnings of coinage in the world.<sup>1</sup> The coins, if this term is permissible, consist of small bits and drops of gold and silver that must have been in use as daily currency. One of these small dumps of silver weighing 56.4 gr. coming from a Late Minoan deposit is marked with what is either a broad H or a T, the first of which is found as a mason's mark, and the second as a sign in the linear script. It had evidently been made by dropping molten silver on a surface marked with the symbol. The earliest coins of Greece and Asia Minor, many centuries later, were only similar molten dumps.

In Japan until quite recent times there were similar drops of silver, termed 'Mamme-ita-gin' in regular use for commercial and other payments. They were, however, of an irregular size and weight, were stamped on the upper surface usually with a representation of Daikoku, one of the Seven Lucky Gods, and a small portable balance of the form of a Roman balance or 'steelyard' was carried by all who had to make payments with them.

As regards the other prehistoric sites in the Aegean there is also an almost complete absence of silver, yet there were silver-bearing ores in the island of Siphnos. Moreover, the island peoples are credited with the maritime supremacy of the Mediterranean up to Phoenician times, so that the deposits of Thasos and the west coasts of Asia Minor were easily within their reach, while there is strong evidence that they had intercourse with far distant Iberia.

*Greece.* After the fall of Knossos (1400 B.C.) the predominance of Aegean civilization passed from Crete to Mycenae and the mainland, but long before that time Mycenae had been a city of wealth and importance. In the famous shaft-graves of the necropolis excavated by Schliemann, which have been referred to Late Minoan I (1700-1500 B.C.), there was no lack of silver but an extraordinary abundance of gold.

The graves were situated within a circular enclosure about 87 ft. in diameter, surrounded by a double row of limestone slabs.

In grave I a silver vase (fig. 7)<sup>2</sup> of imposing size, 2 ft. 6 in. in height and 1 ft. 8 in. in diameter, was found together with four silver goblets. The upper part of the large vase is ornamented with spirals in repoussée work and the lower with horizontal parallel flutings. The mouth and an encircling band are plated with copper and the copper with gold. Curiously the bottom is entirely of copper, the rim of which may have been plated with gold.

In grave III in the royal necropolis at Mycenae, in which three women and two children were interred, there was a profusion of gold ornaments, but of silver

<sup>1</sup> Sir Arthur Evans, *Corolla Numismatica*, Oxford, 1906.

<sup>2</sup> Schliemann, *Mycenae and Tiryns*, p. 316, fig. 478.

articles there were only four silver vases and goblets and two silver rods plated with gold.

In grave IV, which is apparently the earliest of the graves, lay the bodies



Fig. 7. Silver vase. Mycenae.

of five persons 'literally smothered in gold ornaments'. Of silver objects there were the famous ox-head and nineteen silver vessels.

The most important of the silver vessels is the vase<sup>1</sup> with the vivid siege scene, of which only a fragment remains. It was a wide-mouthed vessel having the rim plated with gold, below which is a small gold shield which may have served for a handle.

<sup>1</sup> Schliemann, *Mycenae and Tiryns*, 213.

The silver ox-head is a hollow casting in one piece, while the horns are shaped out of gold plate and fastened on.<sup>1</sup> The head is further bedecked and the features brought out by the application of gold, plated not directly on the silver but on an intermediate plating of copper.

A cup from this grave<sup>2</sup> is of special interest, as it is enriched with inlaid decorations of golden lotus plants in flower-pots and a ring of discs of the same metal. All these are cut out of gold-leaf and inlaid upon the silver, a method of ornamenting which occurs on another Mycenaean silver cup and on dagger-blades.

A portion of one of the vases was analysed in Dr. Percy's laboratory and found to have the following approximate composition:

Silver	.	.	.	.	.	.	95.59
Gold	.	.	.	.	.	.	0.30
Copper	.	.	.	.	.	.	3.23
Lead	.	.	.	.	.	.	0.44
Iron	.	.	.	.	.	.	0.12

It is of practically the same composition as the silver bars from Hissarlik and the Roman patera given on p. 139, and as the silver of the latter was undoubtedly obtained by cupellation from argentiferous lead, the Mycenaean silver was the result of the same process.

It has been asserted by a continental author that the production of silver by the cupellation of lead was unknown in Mycenaean times. But this assertion is based on imperfect data, on absence of a quantitative chemical analysis, and on a superficial acquaintance with metallurgy. He states that the silver from Mycenae was very impure because, besides gold, it contained copper and antimony. Now gold and copper are universally present in cupelled silver, and antimony is by no means uncommon in very small quantities. That antimony was not present in larger proportions than are found in cupelled silver is proved by the forms and workmanship of the Mycenaean cups and vases. A very small quantity of antimony renders silver so exceedingly brittle that if it were present in more than traces it would have been quite impossible to construct these vessels.

Further, a stag with antlers (fig. 8)<sup>3</sup> from grave IV, which seems to have served as a vase, was analysed by Professor Landerer and found to consist of an alloy of two-thirds silver and one-third lead, a mixed metal which had undoubtedly been taken from a cupellation hearth before the operation of cupelling had been completed, and is simply argentiferous lead imperfectly cupelled.

The rich deposits of argentiferous galena, which occur on an extensive scale

<sup>1</sup> Schliemann, *Mycenae and Tiryns*, 216.

<sup>2</sup> Tsountas and Manatt, *The Mycenaean Age*, p. 103.

<sup>3</sup> Schliemann, *op. cit.*, 257.



in the region of Laurion in Attica, afforded the Mycenacan people a supply of silver. These deposits in the earliest times, as is shown by the numerous superficial workings, were exposed at the surface of the ground, and I think there can be little doubt that the mines of Laurion, so famous in a later age, had been previously worked by them.

The discovery of three domed tombs, containing undoubted Mycenacan remains,<sup>1</sup> at Thoricos, in the mining region of Laurion, in the vicinity of many primitive superficial mining excavations, affords very strong evidence indeed in favour of this view.

At Tiryns, in marked contrast to the abundance of silver at Mycenae, Schliemann reports that of silver there was only found a simple signet-ring with



Fig. 8. Stag from grave IV. Mycenae.

a star engraved on it; yet, considering the numerous objects of this metal found in the royal tombs at Mycenae, we cannot doubt that the inhabitants of the palace at Tiryns had silver in common use.<sup>2</sup>

When we reach the times of the *Iliad* and *Odyssey* (c. the 9th and 8th centuries B.C.) silver is by no means abundant in Greece.

The mines of Laurion, so famous in later times for their richness, which, as we have seen, were worked by the Mycenaeans at an early period, had probably ceased to be productive and Greece had to rely for the silver she required on importations from abroad through Phoenician traders.

Homer ascribes the home of silver to the town Alybe. The position of this place has not been definitely determined. Even classical authors are by no means agreed as to its locality. According to some it was in the land of the Chalybes in Pontus, whilst others place it in Bithynia or Mysia. It has been suggested by Movers<sup>3</sup> that its site should be sought for in Spain, whence the Phoenicians obtained their silver, but there is the strongest presumption in favour of the view that it lay in the Pontus region of Asia Minor.

It may be noted here that neither mining nor metallurgy is mentioned in either the *Iliad* or *Odyssey*, and when silver is spoken of it is always as finished metal or as works of art. It appears in many passages as in use for cups, goblets, and the like, and for the ornamentation of weapons, armour, and furniture, and the decoration of the walls and the pillars of the doors of palaces; but the most beautiful and highly-prized silver objects are always

<sup>1</sup> Staïs, *Πρακτικά de la Société Archéologique d'Athènes*, 1893, quoted in *Les Mines du Laurion*, par E. Ardaillon, 127.

<sup>2</sup> Schliemann, *Mycenae and Tiryns*, 171.

<sup>3</sup> Movers, *Die Phönizier*, 37.



of Sidonian or foreign origin. Thus the mixing-bowl of silver, 'the most beautiful on earth', which Ulysses offered as a prize in the foot-race at the funeral games in honour of Patroklos is said to have been 'wrought by the artificers of Sidon and brought by men of the Phoenicians over the misty sea',<sup>1</sup> while the silver work-basket of Helen and the two silver baths of Menelaus were gifts respectively from Alcandra the wife of Polybus of Thebes in Egypt, and from Polybus himself.<sup>2</sup>

I may also cite the 'beautifully wrought' silver goblet with golden rim given by Menelaus to Telemachus, which he had received as a present from Phaidimus, the king of the Sidonians.<sup>3</sup>

A Greek craftsman, Icmalius, however, is mentioned by Homer as being the fabricator of the silver and ivory throne of Penelope,<sup>4</sup> and Achilles as having himself fashioned his sleeping couch and ornamented it with inlaid work of gold, silver, and ivory.<sup>5</sup>

Hesiod, in speaking of the Stygian palace, states that it stands on silver pillars,<sup>6</sup> and in his elaborate description of the ornamentation of the shield of Hercules<sup>7</sup> the bodies of the warriors, the dolphins, and the tendrils of the vines are of silver, but there are very few references to silver in his works. Personal ornaments are not mentioned in either the *Iliad* or the *Odyssey*, and all the references to silver tend to show that in Homeric times silver objects were not in common use. They were only to be found in palaces, in the houses of important men, and in the treasuries of temples.

Somewhat later, about the middle of the fifth century, the metal seems to have become fairly abundant, and silver vessels and other objects appear not only in the homes of the opulent, but also in those of people of less affluence.

As a result of the vast booty obtained by the conquests of Alexander a period of luxury sets in, and we have a profusion of silver plate displayed at the feasts and fêtes of persons of rank and of the wealthy citizens, while the common people who could not afford real silver had imitations made of silvered pottery.

Notwithstanding the abundance of vessels of luxury and other objects of silver which Greece possessed during the days of her greatest prosperity, few examples have come to light. This is, however, hardly surprising if the accounts of historians of the ruthless plunder and destruction effected by the Romans on their victories over the Greeks are only partially true.

The following two examples are worthy of note. They were dug up with other silver and gold objects by Mr. John Lee in 1812, in excavating some tombs on Mt. Aito in Ithaca (Ionian Sea).<sup>8</sup> The silver dish is 9½ in. in

<sup>1</sup> *Iliad*, xxiii, 740.

<sup>2</sup> *Odyssey*, iv, 125.

<sup>3</sup> *Ibid.*, iv, 615.

<sup>4</sup> *Ibid.*, xix, 55.

<sup>5</sup> *Ibid.*, xxiii, 200.

<sup>6</sup> Hesiod, *Theog.* 778.

<sup>7</sup> Hesiod, *Scutum Herculis*, 183 et seq.

<sup>8</sup> *Archæologia*, xxxiii, 45 et seq. and pl. iii.

diameter. Its outer surface is embossed in a radiated pattern consisting of two circles of conical ornaments. It had originally been supported on a stem, as the ornamentation is in relief on the exterior, and in the centre of the base there is a small concave plane for its attachment.

The other is a bell-shaped cup  $3\frac{3}{4}$  in. high and  $3\frac{7}{8}$  in. in diameter at the mouth. The upper part of the cup is delicately engraved with vine leaves and branches of grapes, the lower part is embossed with boldly designed leaves. This portion has been gilt by burnishing on thin leaves of gold.

The mines of Laurion, which subsequent to the Homeric period contributed largely to the revenue and advancement of the Athenian State, are worthy of consideration, and especially so as they are typical examples of the mining industry of silver and lead in the ancient world.

The old workings and remains have been very thoroughly explored by Cordella and Ardaillon, more so in fact than any other ancient mines. It will hence be not without interest if I give here a brief description of the manner in which they were worked, as determined by these explorers,<sup>1</sup> and a short account of their history.

The ancient mining district of Laurion lay between the promontory of Sunion and Amphitrope and covered an area of about eight miles from north to south and three miles from east to west, the richest portions being around Maronea near the modern Camcreza. The mines only appear in the history of Athens about the beginning of the fifth century B.C., but, as I have already pointed out, there is evidence that they were in operation as early as Mycenaean times. The production of the mines in the first centuries of their existence yielded but little silver compared with those of Asia or Spain. During a long period Laurion was unable to compete with the richness of the mines of Lydia, which Herodotus considered as El Dorado of his time, nor with those of Thasos or of Siphnos that were in full development in the seventh and sixth centuries. This may account for the silence of the ancients regarding them.

As regards the people of the island of Siphnos in the time of Polycrates (sixth century B.C.), according to Herodotus they possessed more wealth than all the other islanders, since they had gold and silver mines on their island, and they divided among themselves the money which came in from the mines every year.<sup>2</sup> The ore which yielded silver was argentiferous galena, and remains of the hearths employed for the extraction of silver from the lead have been found on the ancient mining sites.

At this time or shortly afterwards Spain must also have been a direct source of silver, as Massilia was founded in 600 B.C. and the ships of the Greeks

<sup>1</sup> Ardaillon, *Les Mines du Laurion* (Marseille, 1869).

<sup>2</sup> Herodotus, iii, 57, 58.

which visited Gaul can hardly have failed to voyage to the south-east coasts of the silver-producing regions of that country.

In the fifth century Laurion enters on a period of activity greater than in earlier times. At the commencement of the century, according to Aristotle,<sup>1</sup> the mines of Maronca were discovered in one of the oldest districts of Laurion, an event confirmed by the testimony of other authors. This doubtless relates to the occurrence of an unusually large deposit of galena rich in silver in one of the old mines. It is said to have yielded about 100 talents, and it was proposed that this should be divided among the citizens of Athens, but on the advice of Themistocles it was devoted to the construction of a fleet of war ships.<sup>2</sup>

The mines were then the property of the State, but were leased to individuals and were worked by slave labour.

About the middle of the fourth century B.C. Xenophon<sup>3</sup> complained that the output of the mines had greatly diminished as compared with the previous years, and attributed the falling off, first, to the want of vigour in the exploitations due to the deficient capital possessed by the lessees, who were hence reluctant to engage in any exploratory work which might be unprofitable, and, secondly, to a want of slave labour. To remedy the first of these disadvantages Xenophon proposed that the lessees should no longer act as individuals, as was their custom, but should work in combination by forming companies and so avoid individual losses. As regards the second he proposed that the State should purchase at once 12,000 slaves, this number to be afterwards increased, and lease them to the miners. By this procedure he estimated that the increase of output due to their work would yield in one year an amount of silver of the value of sixty talents clear of all expenses. There is no record of either of Xenophon's proposals being adopted, but the mines shortly afterwards certainly had a time of great prosperity, that appears to have continued during the years of peace preceding the Peloponnesian war. From that time the production of the mines gradually diminished until in the time of Strabo mining operations ceased altogether.<sup>4</sup> The veins no longer yielded sufficient ore to pay for its extraction, and the little silver that was produced was obtained by smelting the waste heaps left by the old miners and resmelting the slags which, owing to the want of skill of the older men, still contained paying amounts of the metal.

In the second century of our era Pausanias speaks of the Attic mines as things of the past.<sup>5</sup> They were, however, reopened in 1864 and are at the

<sup>1</sup> Aristotle, *Constitution of Athens*. Trans. by T. J. Dymes, 52.

<sup>2</sup> Herodotus, vii, 144; Plutarch, *Life of Themistocles*, iv.

<sup>3</sup> Xenophon, *Ποροὶ ἢ περὶ Προσόδων*, iv.

<sup>4</sup> Strabo, ix, cap. i, 23.

<sup>5</sup> Pausanias, *Ἀττικά*, i, 1.

present time again producing silver. Although when mentioned by ancient writers they are termed silver mines, the ores they yielded were not true silver ores but argentiferous lead ores—galena and cerussite—and the silver produced

was not obtained directly from them, but from the argentiferous lead which was the first product of the smelting.

The ore varied in its content of silver, but was fairly rich, containing according to Cordella from about 32 oz. to 114 oz. of silver per ton, whilst according to Cambresy its content was from 49 oz. to 130 oz.<sup>1</sup> The earliest workings at Thoricos were merely surface excavations. In later times, the mining was carried on by means of shafts, one of which is 119 metres (about 390 ft.) in depth, and small galleries, never exceeding a metre in height. The tools which have been found in the galleries are all of iron. They are simply the hammer, the gad (miner's chisel), and a single-headed pick. No stone or bronze implements were found. The underground mining is hence not earlier than the Iron Age.

M. Cordella, Director-General of the mines at Laurion, when clearing the ground for the modern works, was fortunate in discovering remains of the furnaces in which the ore was smelted.<sup>2</sup> These remains are of special importance as they are of undoubted antiquity. In other regions where the metallurgical work has been more or less continuous up to medieval times and later, there are often great difficulties in deciding as to the period to which any given remains should be assigned; but at Laurion these do not occur, as the mines

were abandoned in the first century of our era and there is no evidence to show that any work was afterwards done there until the year 1864.

No complete furnace was discovered, yet the fragments were sufficient to

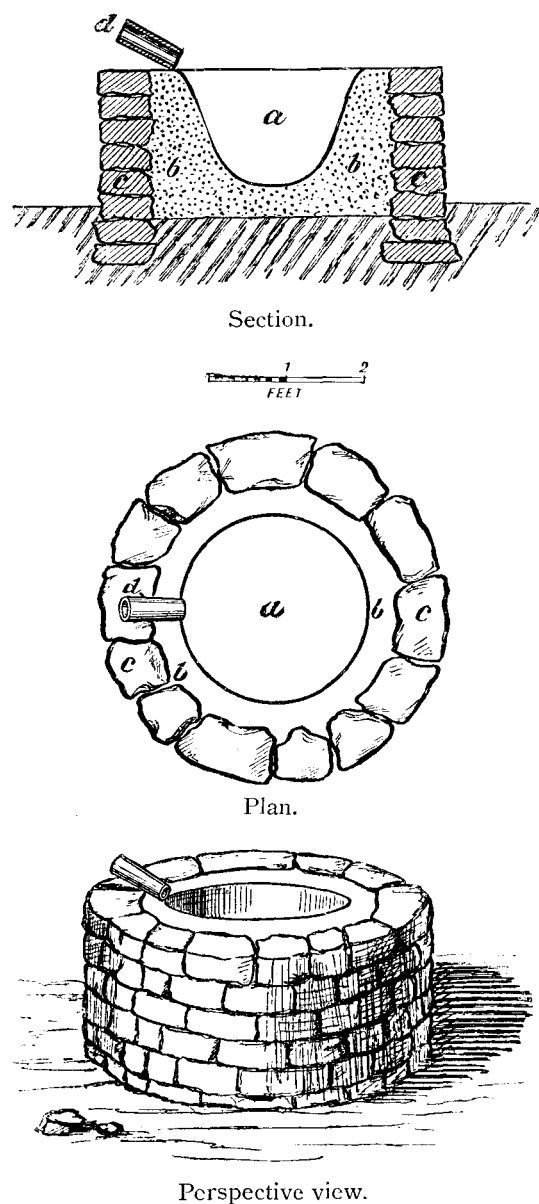


Fig. 9. Lead-smelting furnace. Laurion. Reconstructed. (a) Working hearth. (b) Refractory lining. (c) Rude wall of roughly-dressed stones. (d) Blast pipe.

<sup>1</sup> Ardaillon, *op. cit.*, 17.

<sup>2</sup> *Ibid.*, 76.

show that the furnaces were low hearths, rising but little above the surface of the ground, circular in form, about one metre (3.28 ft.) in diameter, and constructed of roughly-cut blocks of trachyte or schist, or sometimes of bricks. The cavity or working hearth must have been formed within this wall by the usual lining of refractory clay and charcoal. The furnace was worked with the aid of an artificial blast of air, and a clay tuyère or blast-pipe was discovered on the site. No aperture for the blast-pipe or for tapping out the lead from the hearth is mentioned by Cordella. In a former paper I have given drawings, which I reproduce here (fig. 9),<sup>1</sup> of what in my opinion was the construction of the old Greek furnace and which I think represent fairly accurately its essential features when ready for the operation of smelting.

It is difficult to say from Cordella's description whether it was or was not more deeply embedded in the ground than is shown in the figure.

The furnace is hence in all essential characters practically identical with the furnace (fig. 10) used in Japan,<sup>2</sup> differing from it only in its slightly larger size, its encircling wall of stones, and in requiring more powerful bellows. And I am strongly convinced that it was worked in the same way, i. e. with the blast-pipe resting on the upper edge of its cavity, and certainly not entering at its base, as has been supposed by some writers.

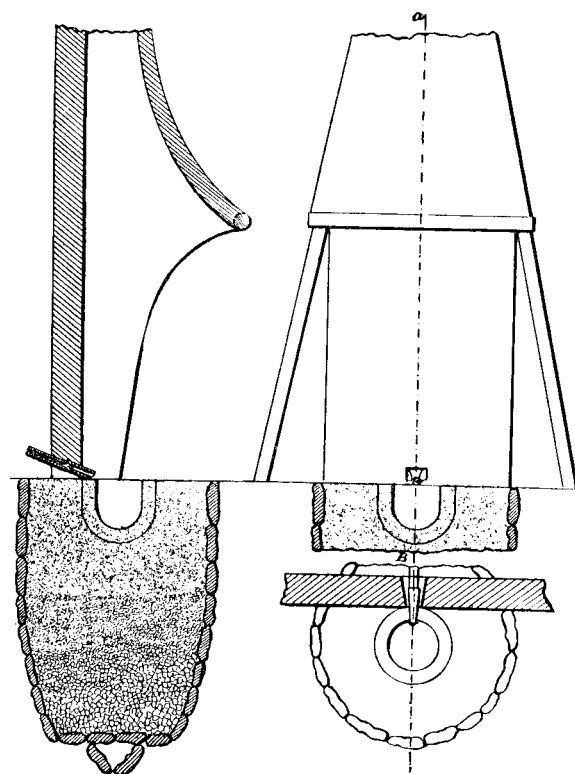


Fig. 10. Japanese smelting furnace.

The operations for the treatment of the ore must have been as follows:

The surface ore would consist largely if not entirely of cerussite and would require no preparation before smelting. When the ore was wholly galena a preliminary partial roasting would be required. As no remains of roasting kilns have been found, this operation was probably carried on in heaps as practised in Japan. Much of the ore apparently was poor and required concentration to free it from impurities and gangue. This was effected by a series of washings with water, the cisterns for which are very numerous on all the sites of the old mines. The cerussite or the roasted galena was charged into

<sup>1</sup> *Archaeologia*, lvii, 392.

<sup>2</sup> *Archaeologia*, lvii, 387.



the furnace in alternate layers with charcoal and smelted by the aid of a blast of air through one or more tuyères resting on the upper part of the furnace as

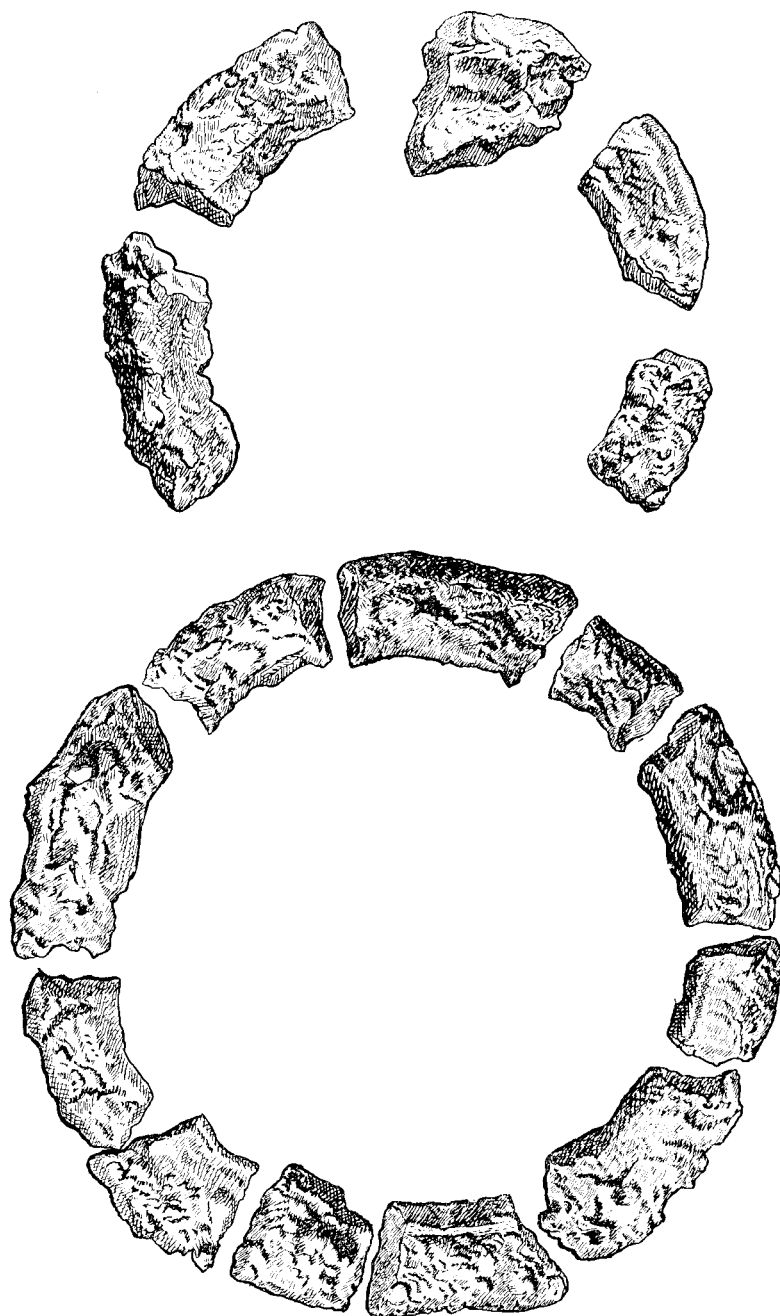


Fig. 11. Remains of Roman cupellation hearth Hengistbury Head.

shown in the figure. As soon as sufficient lead had accumulated in the furnace, the slag was raked off and the lead either ladled out or tapped through an aperture in the side of the furnace. The latter I think may perhaps have been

the usual practice, although Cordella noticed no tap-holes in the remains of the furnaces which he found.

The silver was extracted from the lead by the process of cupellation in simple furnaces similar to the Roman hearths (fig. 11) of which remains have been found at Silchester, Wroxeter, and Hengistbury Head. The furnace consisted of a shallow hearth of marl together with bone-ash enclosed by stone or clay slabs. A charcoal fire was made on the hearth and the lead to be desilverized placed on it and melted. The fire was then raked towards the sides, a blast of air was introduced, the lead was oxidized, the lead oxide formed being partly absorbed by the hearth and partly raked off. When the whole of the lead had been thus removed, a cake of silver, which also contained any gold which had been present in the ores, was left in the cavity of the hearth. That bone-ash was used in the construction of cupellation hearths at Laurion is proved by the occurrence of 2.4 per cent. of phosphoric acid in an ancient slag found by Cordella at Thoricos.

The metallurgists of Laurion were evidently skilful in conducting the operations, as the coins of Athens before Alexander generally assay 985 parts of silver per 1,000.

At Ergasteria (Laurion) a cupel made of earth and of a similar shape to those used in silver assaying at the present day was found among the ancient slags. Its dimensions are: diameter 40 mm., height 20 mm., depth of cavity 10 mm. According to Cordella,<sup>1</sup> it had been used for the purpose of estimating the amount of silver in lead. It is just possible that it may have been so used, yet, if so, it is difficult to account for the total absence of any literary evidence to show that the Romans had a knowledge of the assay of silver by cupellation.

*Phoenicia.* An ancient people of special importance in the early history of silver now claims our attention. Our knowledge of the Phoenicians is very far from being so complete as we should wish, hence not all they have been credited with can be accepted as fact, and there are good grounds for holding that much which has been attributed to them really belongs to the early Aegeans. In Phoenicia it is hardly necessary to point out that only very feeble traces of its once great renown for the working of metals, especially silver, have been found in the country itself. Its antiquities have been destroyed and its cities despoiled of everything of value. Hence, for examples of its work in silver we are dependent on the discoveries which have been made in excavations in Cyprus, and in Etruria and Latium in Italy, and on the works of Homer and other Greek writers.

If the predominance of Sidon was reached in the tenth century B.C. and the

<sup>1</sup> A. Cordella, *Le Laurion*, 103.

supremacy of Mycenae came to an end in the twelfth century, the Phoenicians would seem to have been a great maritime people in late Mycenaean times and to have continued so for several centuries, until Carthage and the Greeks wrested the sea-power from them. They were then the merchants and traders of the world, and as such had become rich in silver, which they obtained from Spain, Gaul, Sardinia, Thrace, the islands of Siphnos and Thasos, the silver-bearing districts of Asia Minor, and probably Laurion. But it was from Spain that they derived their chief supply of the metal.

Gades was founded by the Phoenicians in 1100 B.C. and became an important silver port. Even before that date they had intercourse with the people of the rich mineral district of the Baetis. For more than ten centuries, from the time of Thothmes III (1550 B.C.) to Alexander the Great, they remained the great maritime traders of the ancient world and exported the products of their workshops to all the countries of the Mediterranean region.

The Jewish kingdom, owing to its proximity to Phoenicia, appears to have been a specially important recipient of the metal, as we read that in the reign of Solomon (1015-977 B.C.) 'silver was as stones in Jerusalem'.<sup>1</sup>

Among the various examples of work in silver which have been found in graves in the Mediterranean region and have been attributed to the Phoenicians the following are specially noteworthy.

Perhaps the most characteristic are the shallow drinking-cups or bowls corresponding to the *φιάλη* of the Greeks and the *patera* of the Romans. In all these the decorative designs are executed partly in Egyptian and partly in Assyrian style, preference being given to the former. The subjects are distributed in concentric bands or zones around a central medallion. Sometimes there is only one band, but usually two and rarely three. Perrot and Chipiez<sup>2</sup> divide these vessels by their designs into two groups, but not with rigorous exactness, as they pass insensibly one into the other. In the first, the artist represents a scene of ideal or real life; in the second, he portrays a series of irrelevant incidents or *motifs* taken here and there from Assyria and especially from Egypt.

One of the bowls<sup>3</sup> which is typical of the first class was found at Praeneste in Latium. It was taken from a cavity, probably funereal, and was associated with a quantity of objects of bronze, gold, amber, electrum, others of silver, and iron, also arms and various utensils. It is 19 cm. (about 7½ in.) in diameter, and coated with gold. The exterior is without ornament, while the interior is decorated in repoussée and chased work.

<sup>1</sup> 1 Kings x. 27.

<sup>2</sup> Perrot et Chipiez, *Histoire de l'Art dans l'Antiquité*, iii, 757.

<sup>3</sup> Perrot et Chipiez, *op. cit.*, iii, 758.

In the outer zone are represented the various incidents in a hunting expedition, in the inner a file of horses with birds above, and in the medallion a scene in a combat.

A silver-gilt bowl<sup>1</sup> from Dali, Cyprus, is typical of the decoration of the second class, in which there is a mingling of imagination and reality. In the principal zone we have indeed a lion hunt, but the lion is not alone, but with him the imaginary beast, the griffin, also appears. It is, too, not a representation



Fig. 12. Silver bowl. Praeneste.

of a continuous scene, as in the Caere bowl, but a series of groups of distinct incidents not related to one another.

Another bowl (fig. 12)<sup>2</sup> which was found in the necropolis of Praeneste is specially worthy of note as it bears a Phoenician inscription and the style of its decoration is more purely Egyptian than that of others. It is 19½ cm. (about 7⅝ in.) in diameter.

A silver plate (fig. 13)<sup>3</sup> from the famous Regulini Galassi tomb at Caere in Etruria is of particular interest as its approximate date has been determined

<sup>1</sup> Perrot et Chipiez, *op. cit.*, iii, 771.

<sup>2</sup> Perrot et Chipiez, *op. cit.*, iii, 97.

<sup>3</sup> Perrot et Chipiez, *op. cit.*, iii, 768.



(seventh century B.C.). In the zone surrounding the medallion is represented a lion chase. The outer zone, which is only partly shown, is occupied by a procession of warriors and chariots, while in the medallion we see two lions attacking a bull.

In the decoration of all these articles we have just considered, and of many others which have been found, a striking feature is the limited range in the



Fig. 13. Silver plate. Regulini Galassi tomb.

*motifs* of the Phoenician craftsman; the same subjects are repeated again and again, so that one is almost inclined to believe that they comprised his stock-in-trade and that he was a manufacturer rather than an artist.

‘If there is one thing more characteristic than another in Phoenician art, it is its borrowed nature, and its incongruous collocation of foreign elements.’<sup>1</sup>

*Cyprus.* In Cyprus the silver objects of indigenous workmanship which have been unearthed are mostly finger rings and other personal ornaments.

<sup>1</sup> Evans, *Address, Anthropological Section of the British Association*, 1896.



A silver poniard, however, is worthy of special note, as it is of similar form to those of copper, which are undoubtedly of a very high antiquity, and to one also of silver that was found by Schliemann<sup>1</sup> in the layer of the second city of the Hissarlik settlements (2500–2000 B.C.), and is most probably of Cypriote origin. It is placed by Déchelette<sup>2</sup> in period I of the Bronze Age in Europe, to which he assigns the date 2500–1900 B.C.

Unfortunately some of the excavations in the island have not been conducted so systematically or carefully as the importance of such work demands. The other and more valuable articles have been attributed to Phoenician origin. Of these the most important are the bowls, one of which was unearthed by Cesnola at Amathonte. They resemble very closely those which were found in Etruria and Latium.

The bowl<sup>3</sup> which was dug up in a tomb in the necropolis of Amathonte is imperfect, about one-half having been destroyed by weathering. In the outer zone are represented various episodes in the siege of a town. The very varied costumes and arms of the besiegers would almost seem to indicate that the scene has no historical basis, but that the artist has portrayed in it the principal types of the peoples known to him.

*Etruria.* Another ancient people, the Etruscans, are more noted for their bronze and iron than for their possessions of silver. Yet the excavations which have been made on the ancient sites in Etruria and the explorations in the tombs tend to show that silver was in use to a considerable extent. Personal ornaments are rare, and the metal appears to have been chiefly used for bowls and vessels for domestic use, mounts for furniture, and the like. The earliest specimen of Etruscan silver work known to me is a fibula to which the date 1000–900 B.C. has been assigned by Montelius.<sup>4</sup> A curious example of the use of the metal is afforded by some finger rings found with bronze mirrors in an ancient tomb in Praeneste, in which silver forms the core upon which a sheath of gold has been fashioned.<sup>5</sup>

In the famous Regolini Galassi tomb (seventh century B.C.), whilst the objects of gold are numerous, those of silver are but few.

There is no evidence of silver mining in their territory, hence the metal must have been obtained by commercial intercourse. Of this we have the evidence of the silver bowls with Egyptian and Assyrian designs which have been found in the early tombs and have been attributed to Phoenicia (see p. 152).

There was also found at Praeneste, in a grave cut in the ground, the silver

<sup>1</sup> Schuchhardt, *Schliemann's Excavations*, 67.

<sup>2</sup> Déchelette, *Manuel d'Archéologie*, ii, pt. i, 47, 194.

<sup>3</sup> Perrot et Chipiez, *op. cit.*, iii, 775.

<sup>4</sup> Montelius, *Journal of the Anthropological Institute*, xxvi, pl. xxvi.

<sup>5</sup> *Archæologia*, xliv, 354.

mounts of a wooden *situla* or bucket, with similar conventional representations of bulls, griffins, and sphinxes.<sup>1</sup>

Many of these articles may have been directly imported by the Phoenicians, but there can be little doubt that the skilful metal-workers of Etruria would copy the foreign designs which were in favour and some may really be of native work.

It is not until later times that Greek *motifs* are common in metal work, and in this connexion Murray states: 'It is not now regarded as a fiction that in the seventh century B.C. certain artists who found life in Corinth unbearable from the tyranny of its ruler emigrated to Etruria and established themselves and their art there.'<sup>2</sup> Hence a little later the designs on Etruscan bronze work are chiefly Greek in subject and conception, yet examples in silver are rare.

*Lydia, Caria, Lycia, and Rhodes.* The south-west of Asia Minor in later but pre-Roman times was a region of some importance in silver mining.

Slags, excavations, and waste heaps mark the sites of ancient mines in at least five localities, some of which have been reopened and at work in our own times. At Yenekoi, in Lydia, not far from the ancient Tralles, the argentiferous lead produced at a modern mine, working on one of the ancient sites at Gumush Dagħ (Silver Mountain), is reported to be exceptionally rich in silver, containing up to 559 oz. per ton.<sup>3</sup>

In the island of Samos the old workings are being exploited by a Belgian company, but the results have not been published.<sup>3</sup>

At Myndos (modern Guimushli) in Caria, near Halicarnassus, the remains of shafts and large quantities of slags testify to the former importance of this mining site, while in the island of Rhodes and in the mineral district of the Tris Maaden in Pisidia are also similar evidences of ancient work.

Lydia, Caria, and Lycia were hence of no little importance in the Ancient World owing to their possession of these silver-lead mines. The Lydians appear to have been the richest in silver, and the city of Ephesus the most noted for workers in the metal. They were said by Herodotus to have been the first of men who had a gold and silver coinage.<sup>4</sup> This statement is confirmed by numismatists, who attribute the first Lydian coins of silver to the time of Croesus (the middle of the sixth century B.C.).

As regards Rhodes it is almost certain that the drinking-cups, *θηρίκλεια*, for which the island was noted, were often made of silver.

*The Hittites.* In the Hittites we have a people whose early history is buried in obscurity and of the limits of whose territory we have but little know-

<sup>1</sup> *Archaeologia*, xli, pl. xi.

<sup>3</sup> *Mineral Industry*, 1899, p. 442.

<sup>2</sup> Murray, *Handbook of Greek Archaeology*, 120.

<sup>4</sup> Herodotus, i, 94.

ledge. During late years, however, sufficient evidence has come to light to show that the rich metalliferous districts of the Taurus ranges were at one time in their possession. The ancient mines of Denek Maaden (Galatia), Ak Dagħ Maaden (Cappadocia), and Gumush Maaden near Iconium were also in their territory. Important evidence of the extreme antiquity of mining in Asia Minor, probably extending back to the Neolithic period of culture, is afforded by the recent explorations of an American mining engineer in some old workings in the neighbourhood of Iconium, one of the Hittite towns.<sup>1</sup> They are not in argentiferous lead ore but in a deposit of cinnabar (native vermilion). In sinking a small shaft from a chamber in the upper part of the old mine a large lower chamber was penetrated in which were the skeletons of more than fifty men, with a great number of stone hammers and some earthen lamps. The mine had been worked for cinnabar for its use as a colour, and the men had evidently been entombed owing to a collapse of the gallery leading from the chamber to the open air.

The Taurus range as a source of silver in Asia Minor was perhaps second in importance only to the Trapesus region. At several points extensive remains of the workings and waste heaps of the ancient miners occur, and some of the veins of argentiferous galena are being worked in our own times. Near the eastern extremity of the range are situated the silver-lead mines of Bulghar Maaden, on a rock near which a long Hittite inscription of nearly 400 ancient symbols was discovered in 1890.<sup>2</sup> The presence of a Hittite text so near these important mines goes far to create a presumption that they were worked by that little understood people. Other ancient workings are not far distant. The mines of Bulghar Maaden were reopened in the latter half of the last century and are reported to have produced 7,050 lb. of silver in 1910.<sup>3</sup>

Notwithstanding the above-mentioned deposits of argentiferous lead ores in the territory of the Hittites, we know as yet very little of the uses to which they applied silver, but that they were users of the metal in comparatively early times is shown by a plate of silver<sup>4</sup> on which is written in Hittite characters a copy of the treaty with Egypt which was presented to Rameses II (1330–1250 B.C.) by the ambassador of Khatlusil, king of the Hittites. Also by a small plaque of a later time bearing the figure of a warrior and inscribed in Hittite and cuneiform characters with the name of a Hittite prince. From the style of the cuneiform inscription Professor Sayce attributes it to the time of Sargon (722–705 B.C.).

*Persia and Media.* In Persia as in Chaldaea but few specimens of silver work have been unearthed in any of the excavations and explorations which

<sup>1</sup> *Mineral Industry*, 1908, p. 746.

<sup>2</sup> *The Times*, 25th July 1891.

<sup>3</sup> *Mining Journal*, 1910, p. 1202.

<sup>4</sup> Hall, *The Ancient History of the Near East*, 364.

have been made on the sites of the once famous cities of Susa and Persepolis. No royal or princely tomb has yet been discovered, and the remains of the palaces have not yielded even a trace of the vast treasures which history recounts were in their possession when Persia was in the height of its prosperity, had conquered the greater part of western Asia, and even held Egypt in subjection. The vast treasure in bullion alone that the kings of Persia had accumulated in Susa as a reserve against adverse fortune, and which, according to Diodorus,<sup>1</sup> Alexander found in the palace, amounted in value to 40,000 talents of silver in silver and gold ingots, besides 9,000 talents in coins.

Additional testimony to the original wealth of the country in silver is supplied by Polybius<sup>2</sup> in his description of the palace at Ecbatana, in which he states that the columns in the arcades and peristyles were overlaid with plates of silver and gold, while all the tiles were of silver. Most of these had been stripped off by Alexander. His description is of the state in which the palace was found at the time of the Macedonian conquest. There was, however, a considerable number of silver tiles and bricks piled up in the temple of Aena at the time of the arrival of Antiochus (third century B.C.).

If, as Polybius states, a large sum of money was coined with this silver, the so-called bricks must have been ingots, as the tiles would only be silvered, and not consist of the pure metal. Further confirmation, if such is needed, of the wealth and luxury of the Persians is afforded by the account given by Herodotus<sup>3</sup> of the spoil taken by the Hellenes at Plataea, 'the tents were furnished with gold and silver, and beds overlaid with these metals'. 'There were, too, cups and cauldrons of gold and silver in sacks on waggons, also sheets of gold and silver and other treasure on the field.'

A fragment of a silver vase found by M. de Morgan in his excavations on the necropolis of Susa is of interest on account of the unusual percentage of gold present. It was partly converted into silver chloride. An analysis by Berthelot gave the following results:<sup>4</sup>

Silver	65.27	64.14
Gold	1.12	
Copper	2.94	
Chlorine	16.98	16.72
Sand	1.44	

The vast treasures of silver amassed by the Persian and Median kings were doubtless largely the plunder obtained in successful wars. There were, however, important deposits of argentiferous lead ores in the country, notably in the Elburz Mountains near the Caspian Sea, the Karadagh range, and near

<sup>1</sup> Diodorus, xvii, 66.

<sup>2</sup> Herodotus, ix, 80, 81. See also Strabo, xv, cap. iii, 10.

<sup>3</sup> Polybius, x, 27.

<sup>4</sup> *Comptes rendus*, cxlii, 473.

Uramiah in the north-west, and to the south-east of Kerman. The mines of Armenia and Western Asia Minor were also within reach and for some time were in their possession. The ores worked in the Karadagh have been examined by C. A. Brouard, who reports a content of 30 per cent. of lead, the lead obtained assaying about 20 oz. of silver per ton.<sup>1</sup>

As regards the peoples of antiquity who at any time in their history were engaged in maritime intercourse, I may say it is extremely probable that they obtained part of their silver from Pontus and the adjacent districts to the south of the Euxine. This region, so far as our present knowledge goes, is the most highly mineralized region of Asia Minor, and the very numerous ancient workings testify to its great importance as a source of the metal in early times.

The following are the principal sites which have been explored, but there are many others of lesser extent :

*In Pontus.*

Gumush Khanch to the south of Trebizond (*Trapezus*). Gumush Maaden in the neighbourhood of Tireboli (*Tripolis*), the probable site of the ancient Argyria (Professor Warrington Smyth).

Baiburt near *Domana* on the northern frontier of Armenia.

Hadjee Kioy, ENE. of Amasia (*Amaseia*).

*In the Karahissar district.*

Karahissar (*Colonia*).

Gambibel near Enderes, in the vicinity of Karahissar.

Boucar Dagy.

The Derekioi valley.

Lidshesi near Sivas (*Megalopolis*).

Another site is near Erzerum (*Carana*), Armenia.

All the above-mentioned places were the sites of argentiferous lead mining at a very remote period long prior to that of Roman activity. The ore deposits, however, were not exhausted, as the excavations of the ancient miners extended only to shallow depths.

At Karahissar some of the local inhabitants do a little mining upon narrow rich veins of argentiferous galena, one of which is said to yield ore of the value of £300 per ton, as it contains gold as well as silver.<sup>2</sup>

Another deposit of ore which was discovered by ancient surface workings yields 70 per cent. of lead containing from 48 to 128 oz. of silver per ton.<sup>2</sup>

At Boucar Dagy, an old mine which was reopened by the Turkish Government is said to afford a profit of £4,000 annually. The ore is of unusual richness, the large amount of 600 oz. of silver per ton being sometimes obtained. At

<sup>1</sup> *Mining Journal*, November 1913.

<sup>2</sup> G. M. Edwards, *Trans. Inst. of Mining and Metallurgy*, 1914, 197.



Lidshesi, a mine operated by the Asia Minor Mining Company is reported to have an annual output of from 3,000 to 7,000 tons of argentiferous galena. Another mine has also been reopened by this company at Gambibel, but no return of its production has been published. That so few have been reworked is owing to the difficulties of communication, the absence of facilities for transport, and the lack of enterprise of the Turkish Government.

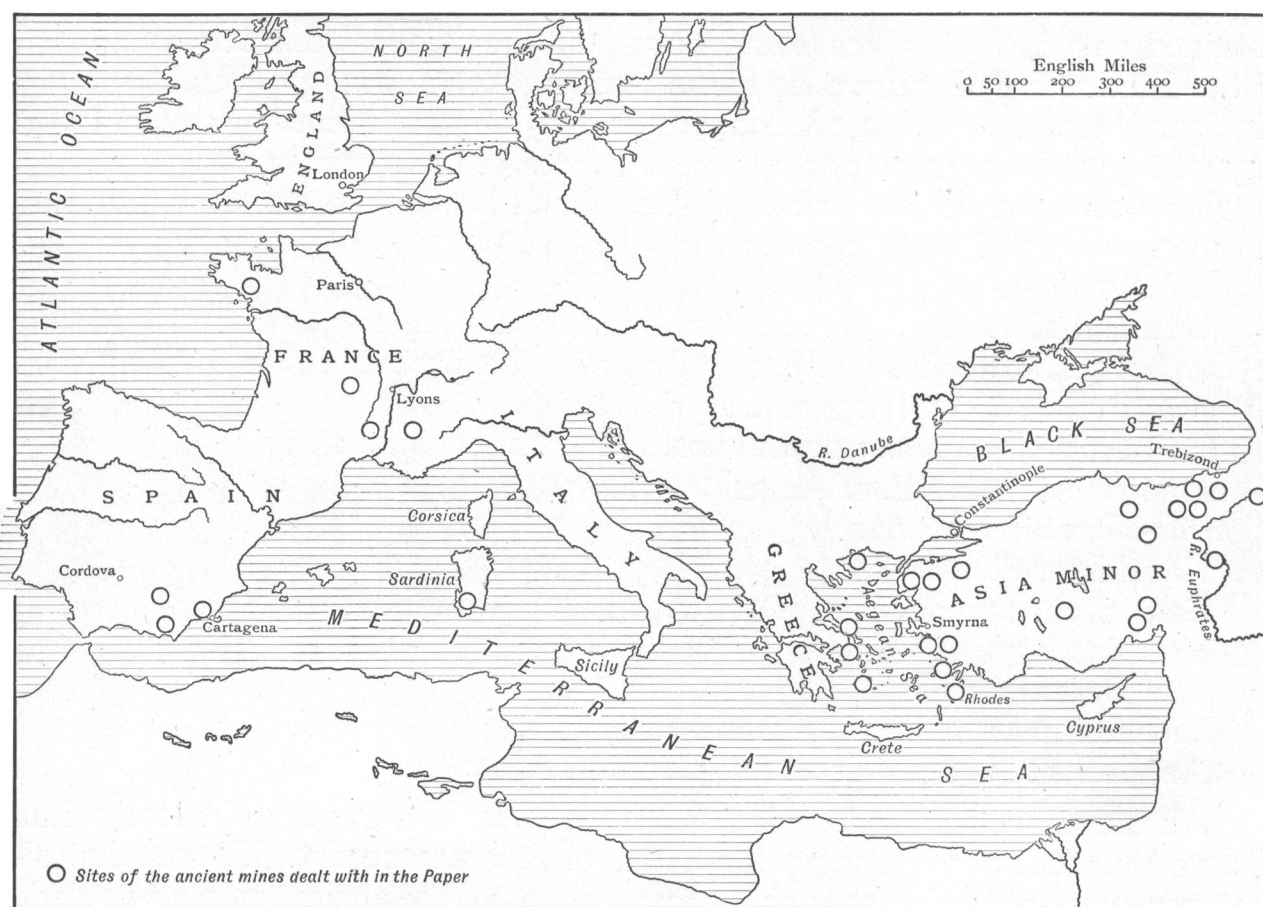


Fig. 14. Map showing sites of principal ancient mines.

The sites of the principal ancient mines dealt with in the paper are shown in the Map (fig. 14).

*China.* An early use of the metal has been claimed for China, where, in the third millennium B.C., three metals are said to have been used as barter, the yellow, the white, and the red, namely, gold, silver, and copper. It was without doubt known in that country in very remote times, but Chinese chronology, whilst possessing the quality of precision, lacks that of accuracy, so that it is quite impossible to assign an even approximate date to most of the records contained in the ancient books.