

The White Bronzes of Early Islamic Iran¹

ASSADULLAH SOUREN MELIKIAN-CHIRVANI

THE EMERGENCE OF THE ART and culture of early Islamic Iran remains shrouded in mystery. Few works of art from the first three centuries of Islam have survived to tell us about the process that led from late Sasanian art to the fully developed Islamic art of the Samanid period. And those that exist do not provide the continuous sequences required to study a process of evolution. The discovery of a hitherto unknown school of metalwork that flourished from the early eighth century through the tenth, with a distinctive style as well as a specific technology, is therefore something of an event.

The pieces that form the basis for the identification of this early school of Iranian² metalwork are scattered

1. This article is the English version of part of my book on Iranian metalwork of which part I, *L'argenterie du Tabarestan et de l'Asie Centrale*, is to be published in 1977. Except as noted otherwise, the photographs were made by me. Wares with formally stylized patterns will be discussed in a second article. So-called international transliteration has been used for Arabic and Persian words where the original spelling is considered essential. Names of such well-known authors as Biruni, Kashani, and Tusi, and place names such as Khorasan, Neyshabur, and Khotan have been transcribed phonetically into English. Persian nouns frequently used—*safidruy*, *naskhi*, and others—are also spelled according to current English usage. Both the transcription and transliteration of Persian words record western Iranian pronunciation according to Tehran usage: Gorgan, not Gurgan, Keshm, not Kishm, *hokamā*, not *hukamā*. Iranian names are given according to the Persian rather than Arabic form: Biruni, not al-Biruni. Arabic names retain the article according to classic Arabic usage: al-Hajjāj.

I am indebted to many colleagues and friends for their generous help: to Ahmad Ali Mo'tamedi, director of the Kabul Museum, and Ra'uf Wardak, curator of the Islamic Department, who not only gave me permission to publish the objects under their care but assisted me in every possible way during photographic sessions and

all over the world. Many have reached the Western art market in recent years. They have turned up at Paris and London auctions, and have drifted into private collections, leaving little or no record. Some have found their way into museums where they are variously labeled "Luristan, 7th–5th century B.C." or "Sasanian," but never "Islamic." Those belonging to museums in Iran and Afghanistan have remained unrecorded in the museum reserves.

Several related groups of these objects may be differentiated, but almost all are characterized by the use of a special alloy that will be here called white bronze. Comparatively rare in the history of metalwork, it has an easily identifiable appearance. The metal takes a

otherwise; to the Herat Museum warden, for his unfailing courtesy to the stranger; to Firuz Bagherzade, superintendent of Persian Museums and advisor to the Minister of Culture and Art, and Parvin Barzin, curator of the Islamic Department, who supplied the information regarding the Neyshabur objects; to Philip Rawson of the Durham museum, who had the unpublished stem-bowl in his museum photographed at my request, and to my Swedish colleagues, among others Aron Anderson and Birgit Arrhenius of the Statens Historiska Museum, who arranged for an analysis of their cup. To Prudence Oliver Harper of the Metropolitan Museum I owe not only the privilege of publishing the analyses of the white bronzes in the Ancient Near East Department but the facilities for photographing and studying these objects. I am indebted also to H. M. W. Hodges of the Institute of Archaeology, London University, whose technical report appears in the Appendix, and to Cyril Stanley Smith of the Massachusetts Institute of Technology, who commented on the technology of white bronze and encouraged me to publish this article.

2. "Iranian" refers here to the areas that were historically part of the various Iranian states and are culturally Iranian. It is not used with its modern restricted meaning, connected with present-day Iran, since it also refers to the modern republic of Afghanistan.

peculiar patina varying from a deep mirror black to an ashy gray, with pale yellowish areas. Often some of the areas become almost white, which partly explains the appellation “white bronze.” In several cases its silvery appearance has caused collectors, art historians, and museums to mistake it for silver. The uncorroded surface has a very smooth, almost oily, feel. The corrosion tends to develop in concentric wartlike formations. The alloy is brittle, and its breaks are sharp and clean. All this suggests an alloy with a high tin content.³

In the cases where detailed laboratory inspection was possible (see Appendix) the alloy proved to be a copper and tin mixture, the amount of tin usually somewhat in excess of 20 per cent though less than in the white alloy commonly called speculum metal. An alloy of this composition requires specific methods of manufacture, for its properties, like those of steel, are strongly influenced by temperature and temperature changes. When cast into a mold and slowly cooled the alloy is brittle and cannot be deformed even slightly without fracture, but it is soft and malleable at a dull red heat (between 550 and 750° C) and easily forged to shape by the use of blacksmiths’ tools. Moreover, if the alloy is quickly cooled from an appropriate temperature, it becomes relatively hard but retains enough malleability to permit some finishing. One of the bowls presented in the Appendix (Figure 38) was probably produced by first casting a thick round cake, heating and forging this to a flat disc, then raising the metal into its present shape by hammering, while still hot. Then it would have been quickly quenched, slightly hammered to rectify small distortions, and finished with a scraping tool while rotating on a simple lathe. If the alloy is not to become embrittled, skillful control of heating and cooling is essential at all stages. Incidentally, the quenched alloy has fine acoustic properties and is widely used throughout East and Southeast Asia for gongs as well as for tools and dies.⁴

Iranian metalworkers, aware of the fragility of their

material, chose ordinary bronze for the more exposed parts of their pieces, such as the ring handles of cups (Figure 1), the handle of a ewer (Figure 7), the trumpet-shaped stem of a bowl (Figure 13), or the lion-shaped handle of a circular mirror from the Heeramaneck collection exhibited at Ann Arbor in 1967.⁵

Is white bronze the metal described in Persian literature as *safidruy*, literally “white bronze”? A detailed reference is to be found in the treatise of Abo’l Qasem Kashani on “The splendor of minerals and preciousness of perfumes,” completed in the early fourteenth century.⁶ In a section called “On the knowledge of *safidruy*” Kashani writes “It is called *sofr* [bronze]. It is an alloy of refined *mas* [Persian for copper] and white *qala’i* [a Persian-Arabic word meaning tin]. It is a clean white substance resembling silver. Surprisingly, copper and tin, both of them soft materials, become hard as they mix. *Reṣāṣ* [Arabic for tin, also used in Persian] and *noḥās* [Arabic for copper, frequently used by Kashani as a synonym of *mas*] produce an alloy that will not decompose itself. Its production was initiated by al-Ḥajjāj, who gave orders that all gold and silver wares be broken, banned any further manufacture, and forbade drinking out of gold and silver vessels in the provinces of Araq and Fars. The doctors [*ḥokamā*] of the time mixed tin and copper for the grandees and rich people and made the required vessels.”

If Kashani was accurate in his use of words, *safidruy* = *sofr* is simply ordinary bronze. However, his description of *ṣafidruy*, said to be white like silver, and “dry” (*ḥōšk*), that is, hard and brittle, raises the possibility that *safidruy* may in fact have referred to a special variety such as speculum. This identification might be further supported by Kashani’s contention that the alloy was devised in al-Ḥajjāj’s time, that is, in the late seventh century. Kashani and his predecessors must surely have been aware that “ordinary” bronze was not invented after the Sasanian period.

In the *Tansūh-Nāme*, written half a century before,

3. White bronze, as will be seen later, spread to China and thence to Korea, where vessels bearing the mark of Khorasan influence appear from the tenth to the twelfth century. In recent times it was used for specific purposes in China and Thailand. At the other end of the world it traveled as far afield as Islamic Spain, where white bronze vessels were made as late as the thirteenth or fourteenth century, as shown by an unpublished bucket in the Museo Arqueológico, Madrid. The occurrence of the alloy re-

mains rare, and the problems of its origin and transmission will only be touched upon in this article.

4. This paragraph is based on a private communication from C. S. Smith.

5. O. Grabar, *Sasanian Silver. Late Antique and Early Medieval Arts of Luxury* (Ann Arbor, 1967) cat. no. 58, pl. 58, p. 139.

6. Abo’l Qasem Abdollah Kashani, ed. I. Afshar, *Arāyes ol-Javāher va Naḥāyes ol-Atāyeb* (Tehran, 1345 h.s./1967) pp. 244–245.

Nasir ad-Din Tusi gives a slightly different account: “... if one smelts copper and pours a certain amount of tin over it, it takes on the color of silver. And that is *safidrū*[y].” Further on, in the section entitled “On *isfīdrūy* [note the semi-Arabicized form of the Persian *safīdrūy*] and its characteristics,” Tusi repeats a somewhat similar story concerning the invention of *safīdrūy*, omitting, however, the specific reference to al-Ḥajjāj’s time. Both Tusi and Kashani would appear to draw on an identical earlier source. In the opinion of Mojtaba Minovi (private communication to me) this could be a late twelfth-century work by one Nezāmi, on which Tusi leans heavily.

Reading Kashani and Tusi, one suspects that *safīdrūy* was no longer common in their time. The inconsistent spelling of Tusi (*safīdrūy*, then *isfīdrūy*) may be due to the diversity of his sources. The word is not found in the *Loḡat-e Fors*, an eleventh-century dictionary of “Persian” words (as opposed to Arabic loan words in Persian), or in the seventeenth-century dictionaries with the exception of the *Borhān-e Qāte*,⁸ where *safīdrūy* is obviously misunderstood. This may be further evidence that the word goes back to an earlier period.

While no earlier Persian account seems to have survived, there are similar references in Iranian literature written in Arabic in much earlier times. The most significant one is found in Biruni’s *Kitāb al-jamāhir fī ma’rifat al-jawāhir*, written in the early eleventh century, which may have been the source for Kashani and Tusi. *Isfīdrūy*, Biruni tells us, is a Persian noun meaning *nuḥās al-abyaḍ*, literally “white copper.”⁹ It is called *ṣufr*.

Biruni tells a similar story about the invention of *safīdrūy*/*isfīdrūy* in al-Ḥajjāj’s time. When the latter ordered that gold and silver vessels be broken in ‘Irāq and Fārs, one Fayrūz, a *mawla* (he is qualified by a name whose spelling remains uncertain), did not like drinking from glass (*zujāj*). Silver and copper were therefore mixed for his sake and bowls (*jāmāt*: Biruni uses the Persian word *jām* with an Arabic plural ending), were made from the alloy: “After that silver was

replaced by tin [*riṣāṣ*]. It is used for vessels [*al-awānī*], drinking utensils [*māṣārib*], water jugs [*kīzān al-mā*]: note unusual usage of Persian *kūza* in the Arabic plural], *ijānāt* [for Persian *lajan/lagan*=“basin”] . . .”

Biruni’s remark on the low-silver alloy in early Islamic times, which is corroborated by factual evidence—coinage, for example—and his indication that silver was later replaced by tin does suggest the intention to imitate silver and therefore the use of a whitish alloy. It is tentatively suggested here that this echoes the early Islamic use of a high-tin alloy—speculum—and that *isfīdrūy* was indeed the word used for it rather than just for any kind of bronze (*ṣufr*). It is conceivable that, as the alloy was going out of fashion by Biruni’s time, the word was used more loosely. Only half a century earlier the word would appear to have still retained its original specific meaning. It occurs at least once in al-Muqaddasi’s *Aḥsan at-taqāsīm fī ma’rifat al-aqālīm*, in a passage in which the tenth-century geographer mentions among the products exported from the city of Rabindjan in Transoxiana “*ṭāsāt isbīdrūy*,” “bowls of *isbīdrūy*.”¹⁰ One may reasonably assume that al-Muqaddasi, with his careful style, would not have chosen this word had the Arabic *ṣufr* been a synonym, as Biruni and Kashani would have us believe. Apparently, too, the product was typical of the area and used especially for bowls, a statement corroborated by archaeological evidence regarding al-Muqaddasi’s time. Kashani’s and Biruni’s equation *ṣufr*=*safīdrūy* may therefore be questioned, as previously suggested, and *safīdrūy* regarded as an alloy of the early Islamic period.

It may have been characterized not only by its special composition—the high tin ratio—but also by special metallurgical treatment: while high-tin alloys were to be used as late as the Safavid period, some peculiar light metallic wares with a remarkably high polish were certainly not used after the year 1000. Biruni’s and Kashani’s remarks on the “invention” of white bronze need not be taken literally. They may be understood as indicating that *safīdrūy* was extensively used by the end of the seventh century. Since early

7. Nasir ad-Din Tusi, ed. Modarres Razavi, *Tansūkh-Nāme* (Tehran, 1348 h.s./1970) p. 215. Afshar compares the contents of the two works in his edition of the *Arāyes*, p. 362.

8. Borhān-e Tabrizi, *Borhān-e Qāte* (Tehran, 1330 h.s./1952) II, p. 1094 A. Listed under *safīd rūy*: “pronounced like *safīd mūy*; this is the name of *qala’i* (tin); it is the material used to make copper

vessels white.” Neither Soruri, who was from Kashan like Abo’l Qasem Kashani, nor Nakhdjavani (*Seḥāḥ ol-Fors*) record the word.

9. Abu’r Reyhān al-Bīrunī, *Kitāb al-jamāhir fī ma’rifat al-jawāhir* (Haydarabad-in-Dakkan, 1355/1937) p. 264.

10. Al-Muqaddasi, ed. M. O. de Goeje, *Aḥsan at-taqāsīm fī ma’rifat al-aqālīm* (Leiden, 1906) p. 324, line 21.

sources as well as actual pieces prove that silver wares continued in use after the time of al-Ḥajjāj, the statements of Biruni and Kashani require some interpretation. They suggest that the alloy became fashionable among the affluent classes that had embraced the Islamic religion; in other words, among those who were less conservative culturally and who patronized modern art and culture.

These inferences all seem to agree with the two groups of objects now to be presented.

WARES WITHOUT DECORATION

The group includes a large number of cups, bowls, vases, ewers, pitchers, trays, and boxes.

Fairly common is a polylobed cup with a broad, almost flat—in fact slightly convex—base and a ring handle topped by a flaring thumb rest. The number of lobes varies from six to eight, seven being commonest. The Muze-ye Iran Bastan, Tehran, owns an eight-lobed cup (Figure 1) (height about 6 cm., diameter at opening, including width of rim, 12.5–12.7 cm.), labeled (in English) in the case as “Sasanian, small bronze bowl from Siyah Darre, Gilan.” A seven-lobed cup in the ISMEO Museum, Rome (inventory number 2703), carries a similar attribution. It was acquired from a Tehran dealer in whose shop I photographed two more cups reportedly from the same site, said to be in Deylaman. The interior of one of these cups (Figure 2) (height 5.6, diameter of opening 12.5 cm.) shows the typical sharp breaks of white bronze pieces exposed to shocks. Of rougher make than the ISMEO cup, the two in Tehran suggest that there were degrees of expertise within the same workshop, assuming that the information regarding the common provenance of all three cups is accurate. Other cups appeared at auction in London in 1967¹¹ and 1970.¹² With one exception, all these cups have handles of ordinary bronze, roughly

11. Sotheby & Co., *Egyptian, Western Asiatic, Greek, Etruscan and Roman Antiquities, Islamic Pottery and Metalwork* (London, 1 January, 1967) no. 46, p. 12: “a small Sassanian bronze lobed cup with ring handle.”

12. Christie's, *Fine Islamic Works of Art and a Mamluk glass sweetmeat Jar and Cover* (London, 23 June, 1970) no. 30, p. 11: “a fine Parthian bronze lobed wine cup, of deep form with sides shaped in seven petal lobes, a small flanged handle to one side.”

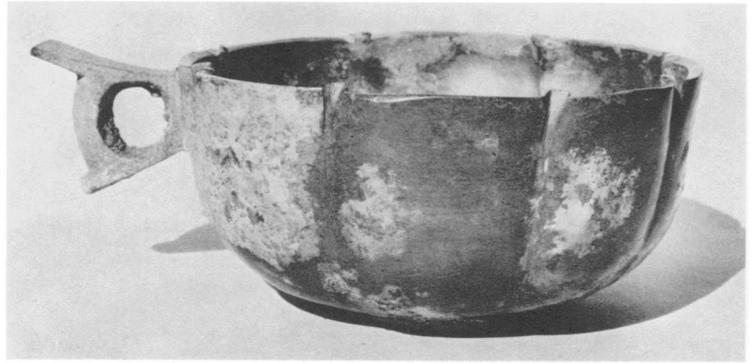


FIGURE 1
Polylobed cup, Muze-ye Iran Bastan, Tehran
(inventory number 3756)

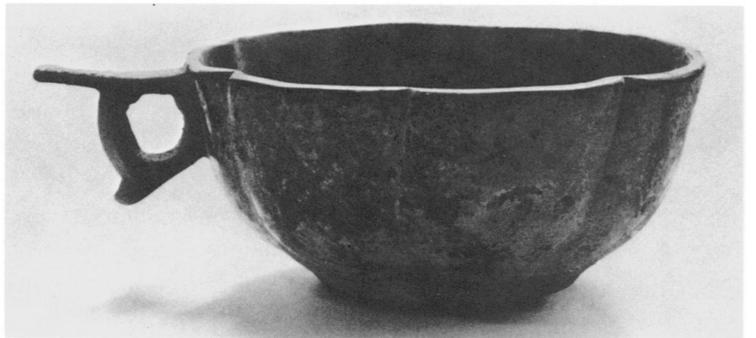


FIGURE 2
Polylobed cup, private collection, Tehran

trimmed and crimped into the central part of one of the lobes. On the first of the London cups traces of scraping could be seen around the handle under a thin layer of oxidation. The second London cup has a handle of white bronze cast hollow, a surprising feature revealed by a break in the metal. The handle appears to have been welded to the cup.

The only close parallels to this model are of the Islamic period. A well-known eight-lobed ceramic cup with the distinctive ring-handle topped by a shorter thumb rest appeared on the German art market, and is now in the Museum für Islamische Kunst, Berlin. It has a molded decoration under a green lead glaze and carries the signature of one Ḥusayn beneath the glaze on the underside.¹³ The epigraphy points to a date not later than the ninth century, more probably the eighth. Its closely comparable dimensions—height 6.8, maximum diameter of body 11.3 cm.—further strengthen the connection with the metal cups and point to the existence of established sizes whatever the material. This is borne out by a cut-glass cup from Iran recently acquired by the Metropolitan Museum (acc. no. 1970.20).¹⁴ Richard Ettinghausen has compared this shape with that of a stone basin in a mansion near Jericho in Palestine that can be dated within the years 724–34.

Another standard model of fairly distinctive shape is a vase with a squat rounded body resting on a broad base and a flaring fluted neck of approximately the same height as the body, topped by a short everted lip of triangular section. There are two basic moduli of this shape. One has a slender neck. A typical example was auctioned in London in 1969 (Figure 3) (height 13.4–13.5, maximum diameter of body 9–9.2, diameter of opening 5.6–5.65 cm.). It is heavily cast. There are remnants of a mirror black patina, with areas of ordinary green oxide. Twenty vertical facets decorate the neck. The body is very subtly faceted: nine pentagonal facets surround the neck, pointing downward, and nine much smaller facets go up from the bottom. In between are three imbricated rows of nine lozenges. Other models, much lighter in weight, with thinner walls, and the deep mirror black patina speckled with ashy dots and areas of a pale yellowish hue, are identical in shape and faceting. Their facets are sometimes more perceptible to the fingers than to the eyes.



FIGURE 3
Vase with faceted body, private collection

A second variety of this type of vase is characterized by a much broader neck. There are models with facets on the body and others without,¹⁵ but all have fluted necks. The metal used varies from the very light type of white bronze with mirror black patina and crackles

13. F. Sarre, "Frühislamische Keramik aus Mesopotamien," *Der Cicerone* 22 (1930) pp. 37–43. A. Lane, *Early Islamic Pottery* (London, 1958) pl. 4B and p. 12, where it is regarded as Egyptian. According to Sarre, the cup appeared on the Berlin market. It is more likely to be Iranian than anything else.

14. R. Ettinghausen, "Islamic Art," *The Metropolitan Museum of Art Bulletin* 29 (1970) ill. p. 85.

15. A piece with un-faceted body was sold at the Hôtel Drouot in 1969: M. Champetier de Ribes, *Tableaux modernes et objets de vitrine, Siège et Meubles, Tapis, Tapisserie* (Paris, 30 May 1969) no. 45: "Petit vase sphérique, à col godronné en bronze de patine foncée. Epoque Parthes, III^e s. av. J.C."



FIGURE 4
Vase with faceted body, private collection

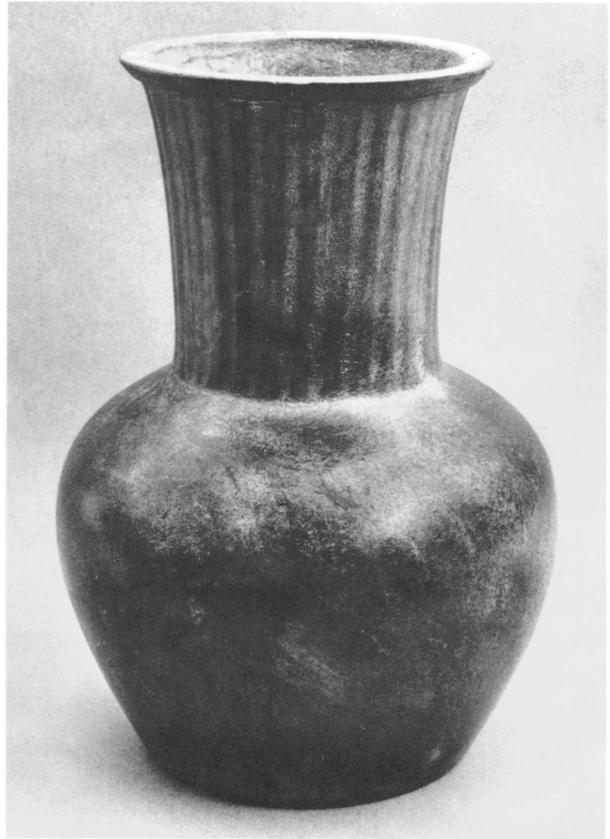


FIGURE 5
Vase with rounded body, private collection

on the surface to the heavier type of white bronze. A heavily cast version with wartlike formations of red oxide corrosion was auctioned in London in 1971 (Figure 4) (height 14.5, maximum diameter of body 10.55-10.7, diameter of opening 8.2-8.3 cm.).¹⁶ The patina, with a high polish, is ashy brown. The faceting of the body is of the usual type: eight pentagonal facets start from the base and neck and two rows of imbricated lozenges are inserted between them. Another heavily cast version with the body fully rounded and the neck fluted (Figure 5) (height 17-17.1, maximum diameter of body 12.5, diameter of opening 8.75-8.8 cm.) was auctioned at the same sale.¹⁷ Intermediary versions exist, for example, a lightweight vase without facets on the body is in the Tehran museum (inventory number 19318, height 15.4, maximum diameter of body 11.4, diameter of opening 7.4 cm.). This vase carries a label giving Rashi, Gilan, as its provenance.

Several parallels may be found for these white bronze vases. The slender-necked variety is matched, in reduced size, by a miniature pottery vase from Khotan.¹⁸ According to Soviet scholars, the Khotan finds are not later than the late seventh or early eighth century. It is interesting to note in passing that the miniature vase has a ring handle on the body. Since it is an improbable addition for a large metal vase, the assumption is that the potter copied it from cups with ring handles.

The slender-necked metal vases and cups were there-

16. Christie's, *Persian and Islamic Works of Art* (London, 1 March, 1971), part of lot 43: "A Parthian bronze vase, with faceted shoulder and tall fluted neck—6 in. (15 cm.) high."

17. *Ibid.*, part of lot 43: "another, similar—7 in. (17.7 cm.) high."

18. N. V. Diakonova, S. S. Sorokin, *Khotanskies Drevnosti* (Leningrad, 1960) p. 37, no. 1958. For general commentary, p. 24 under no. xxvii and text p. 106.

fore probably produced at about the same time. The broad-necked vases, on the other hand, may have been favored until much later. A silver broad-necked vase resting on a short slanting foot (a minor addition) carries the name of one amīr Abu'l 'Abbās Hārūn b. Valkin (or Valgīr ?) in so-called Kufic letters. The script of the nielloed inscription cannot be earlier than the middle of the ninth century and is more probably as late as the mid-tenth century.¹⁹

A third standard type, of which a great many examples have been circulating on the market, although none appears yet to have been bought by a museum, is a flat tray with a slightly convex bottom, and short, slanting, slightly convex walls (Figure 6) (height 3.7, diameter 23.3-23.5 cm.). The metal of this tray has a tin content of approximately 25-30 per cent (see Appendix). The underside has the usual mirrorlike patina. The inside, thoroughly cleaned, has an almost white appearance with faint yellowish undertones. Concentric traces of spinning are apparent. Several ceramic dishes from Susa usually dated to the eighth or ninth century have a similar profile.²⁰ This is shared by dishes from Neyshabur,²¹ one of which, in the Foroughi collection,²² is datable to the late ninth or early tenth century on the basis of its epigraphy.



FIGURE 6
Tray, H. Beres collection, Paris

Alongside the three types, represented by a large number of pieces, individual objects equally typical of the early Islamic period complete the repertoire of white bronze shapes.

Related to the small vases through its faceted body is a small ewer on loan to the Metropolitan Museum (Figure 7) (height with knob 15.8, maximum diameter

19. A. U. Pope, ed., *A Survey of Persian Art* (Tokyo, 1964-65) pl. 1345c.

20. One illustrated in M. Pézard, *La Céramique archaïque de l'Islam et ses origines* (Paris, 1920) pl. xi, bottom; text pp. 42-43. Pézard regarded these potteries as Sasanian, a long-discarded theory. Another dish is illustrated by Lane (*Early Islamic Pottery*, pl. 5B), who calls it Mesopotamian. It is in fact Iranian. It was bought in Iran by Charles Vignier before 1914. A very close model is a dish decorated in green and yellow enamels on a white slip, R. Koechlin, *Les Céramiques musulmanes de Suse au Musée du Louvre* (Paris, 1928) no. 100, pl. xiii, text p. 63. Note the convex rim and typical edge.

21. W. Hauser, J. M. Upton, and C. K. Wilkinson, "The Iranian Expedition, 1937," *The Metropolitan Museum of Art Bulletin* 33 (1938) fig. 18, p. 20. The fragment is dated to the late ninth or early tenth century on the basis of archaeological evidence.

22. [R. Ghirshman, G. Wiet], *7000 ans d'art en Iran* (catalogue) (Paris, 1961) no. 904, pl. ci.

FIGURE 7
Ewer, The Metropolitan Museum of Art, Anonymous Loan, L61.74.4

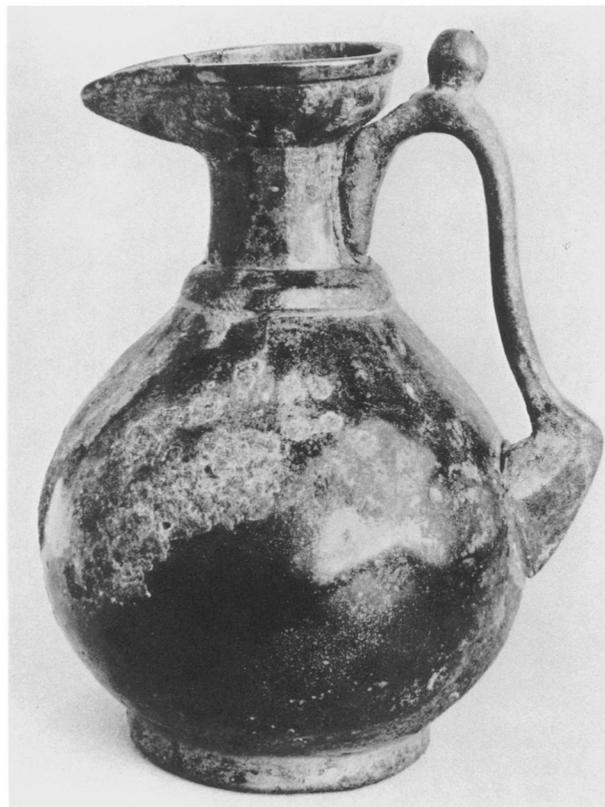




FIGURE 8
Ewer, Kabul Museum

of body 10.5 cm.). (For analysis, see Appendix.) With typical mirror black patina on one side and heavy green oxidation on the other, it has a broad, short foot and a short, vertically faceted neck marked off from the body by a molding—the latter a standard feature in eighth- and ninth-century bronzes from eastern Iran. An important unpublished ewer in the Kabul Museum (Figure 8) (height 17.2, diameter of opening 5.8 cm.) has just a molding at the base of the neck. Of undetermined provenance, it was found in present-day Afghanistan and is therefore of eastern, not western, Iranian origin. The typically Islamic shape has as its closest parallel the much larger ewer found at Abusir al-Malak, now in the Museum für Islamische Kunst. Other well-known pieces not generally identified as eastern Iranian can be cited.²³

It should be noted that the molding of the ewer of Figure 7 is not rounded but slightly faceted, a feature so far unparalleled. However, this does not affect its basic analogy with the ordinary nonfaceted moldings.

The closest parallels to the spout of this ewer are to be found on the silver ewers from Djete-Su (in Russian Semiretchie)²⁴ and an eighth-century pottery ewer

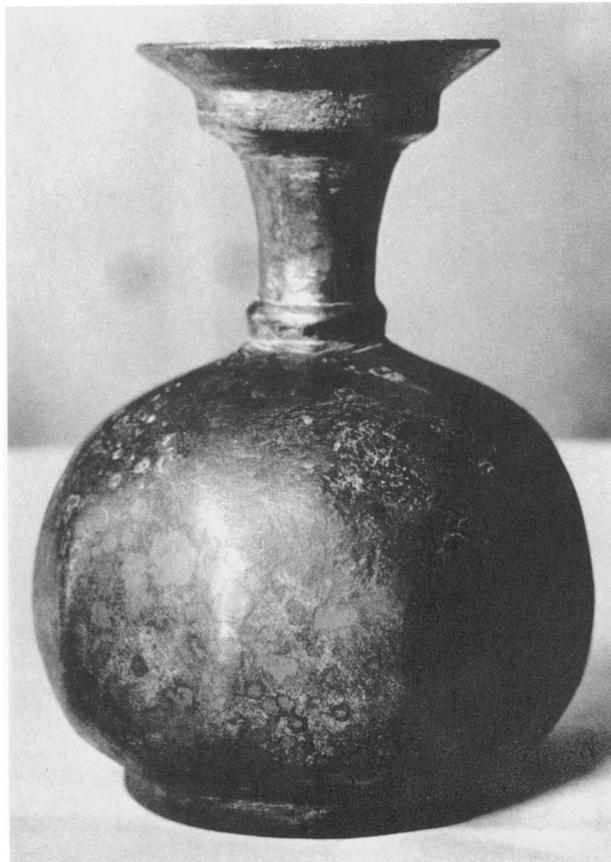


FIGURE 9
Vase from Gorgan, Tehran market

23. On the Abusir al-Malak ewer, see O. Rubensohn and F. Sarre. "Ein Fund Frühislamischer Bronze Gefässe in Ägypten, vermutlich aus dem Besitz des letzten Omajjaden, Marwan II," *Jahrbuch Preussischen Kunstsammlungen* 50 (1929) pp. 85–95, pl. 3. This corrects an earlier publication by O. Rubensohn, *Zeitschrift für ägyptische Sprache und Altertumskunde* 41 (1904) p. 18. Also illustrated in [J. Zick-Nissen] *Islamische Kunst* (Berlin, 1967) pl. 10, text p. 22. The supposed connection with the Caliph Marwan II is pure speculation. The object was found in the debris left by looters near the edge of a tomb plundered earlier. On the excavators' own admission, the latter was located 600 meters away from a place linked with Caliph Marwan II by local village tradition: dating the ewer on such a basis (which appears to have gained general acceptance since then) would be unsafe. The connection of the Abusir al-Malak ewer with Sogdian shapes and their Chinese counterparts, (B. Gyllensvärd, *T'ang Gold and Silver* [Stockholm, 1957] pls. 6e, 9c), seems to provide a safer basis. The lower part of the body is the exact reproduction of such shapes.

24. A. Belenitsky, *Asie Centrale* (Geneva, 1968) pl. 71. Among the typically Islamic features of this ewer is the faceted knob on top of the crozier-shaped handle. See also a ewer (No. 4513, unpublished) in the Freer Gallery of Art.

from T'ang China.²⁵ The handle, made of ordinary bronze like the ring-handles of the lobed cups, is fashioned like the eighth-century handles from Tabarestan and Sogdia:²⁶ it rises from the neck in a crozierlike movement, then undulates downward until it reaches the middle of the body. There, a thick element develops at a sharp angle to hold the handle away from the body, in keeping with the Islamic tradition in Khorasan.²⁷ Moreover, the handle is subtly faceted, a feature typical of the early Islamic style. Interestingly, the underside of the short foot is slightly concave, like the underside of the faceted vases. The faceting of the ewer is very close to that of the small vases with trumpet-shaped necks. This in itself is enough to establish a common provenance for both types: the usual pentagonal facets—eleven in this case—appear at the bottom and top of the body, and two rows of imbricated lozenges are inserted between their triangular ends in the central area.

Related to the small vases is an unusual squat vase (Figure 9) (height 12.1 cm.) with a similar broad foot, the squat body being likewise marked off from the neck by a rib. The top of the vase is funnel-shaped. The squat body and general structure are remotely reminiscent of a well-known silver type from T'ang China datable to the first half of the eighth century.²⁸ The hexagons



FIGURE 10
Pitcher, private collection

25. M. Prodan, *La poterie T'ang* (Paris, 1960) pl. 25, caption p. 36. The sharp excrescence on this piece may derive from a leather model.

26. Melikian-Chirvani, *L'argenterie du Tabarestan*. For a Sogdian example, Pope, *Survey*, pl. 223A, recently discussed by B. I. Marshak, *Sogdiskoe Serebro* (Moscow, 1971).

27. For eastern Iranian examples of the 8th-11th centuries, I. A. Orbeli, K. V. Trever, *Sasanidskii Metall/Orfeverie Sasanide* (Moscow-Leningrad, 1935) pl. 73, and the ewer acquired by Sarre in Tiflis, F. Sanc, *Erzeugnisse Islamischer Kunst I: Metall* (Berlin, 1906) p. 5, pl. II.

28. Gyllensvärd, *T'ang Gold and Silver*, pl. 20c. Line drawing of profile, fig. 27a. This T'ang shape is not only of eastern Iranian-Sogdian derivation, like almost all T'ang silver shapes, but also built in the same way, i.e., by combining two shapes borrowed from what I call the repertoire of interchangeable basic volumes, in this case a vase plus a truncated conical bowl—here lobed—possibly used initially as a funnel. For the Sogdian derivation of T'ang shapes so far mistakenly referred to as being of Sasanian derivation, see my "Iranian silver and its influence in T'ang China," *Pottery & Metalwork in T'ang China: their chronology and external relations* (Colloquies on Art & Archaeology in Asia No. 1) (London, 1971) pp. 9-13. Sogdian silver is briefly reviewed in my *L'argenterie du Tabarestan*. In 1971 Marshak (*Sogdiiskoe Serebro*) independently expressed similar views with regard to the Sogdian nature of the vessels.

on the body are similar to the faceting of the small vases. According to its owner, the vase was acquired in present-day Gorgan, formerly Asterabad. (Between October 1968, when I first saw and photographed the piece, and November 1971 it was unfortunately "embellished" with a tiger-ended spout taken from a Luristan vessel.)

Various small faceted vases belonging to this group are related, although not identical, to the big glazed pottery vases from Iran presumed to be of the eighth to ninth century. These have not yet been studied as a typological group or published in scholarly studies.²⁹

An important, and so far unique, pitcher provides a striking example of a simple shape modulated by complex faceting (Figure 10) (height 12, diameter of body

29. For a good illustration of the standard type, Parke-Bernet, *Antiquities. The Property of the Kevorkian Foundation* (New York, 18 December 1970) no. 91, p. 54.

6, diameter of opening 4.8 cm.). It was cast in five separate pieces: the slightly convex bottom and grooved ridge, the cylindrical body cast as a flat thick sheet and later bent and welded, the shoulders and grooved ridge at the bottom of the neck, the neck, and finally the handle. The profile is reminiscent of that of an earthenware pitcher from Samarra³⁰ and the ewer in the Kabul Museum (Figure 8). The slanting handle rises from the upper part of the body, to which its arrowhead-shaped end is welded, and runs parallel to the tall neck before coming down in a crozierlike curve to be welded to the upper part of the neck. The neck and the profile of the handle are common in early Islamic pottery, but in its details the white bronze handle is more sophisticated than usual. Instead of being perfectly cylindrical, it is slightly flattened, with a finely molded groove within two deeply incised lines at the bottom. The unusual faceting makes the sturdy shape of the ewer look light. On the lower part of the body, grooves emphasized by a deep incision on either side alternate with flat facets, creating a light-and-shadow effect, enhanced by the rows of four punched marks on each facet. The neck is

FIGURE 11
Dish, Paris market



fluted and topped by a grooved ridge with a flat, slightly rounded edge. The neck is further emphasized by two deep incisions immediately below it, repeating the two incisions at the bottom and top of the cylindrical body. This grooved ridge appears on some of the lobed cups—for example, the cup cited in note 13—and on several of the more carefully executed shallow bowls. On the underside, three circles carefully engraved with dividers testify to the great care with which this small vessel was produced.

Among the plates and dishes, a dish on the Paris market in 1967 (Figure 11) (diameter 21.3, height 3.2 cm.) deserves notice. It is a version of the flat dish with narrow rim known from Sogdian metalwork³¹ as well as its T'ang derivations³² of the eighth century, and at least one late survival in Islamic pottery of the ninth century.³³ But it has the hallmarks of the artistic tradition followed in the workshops where white bronzes were made: a very slightly convex bottom like that of the pitcher of Figure 10 and of the lobed cups, a slanting rounded edge finishing off the ridge, and circles carefully and lightly incised with dividers on the inner surface.

Reviewing the evidence so far available for determining the period of production of the group, it is obvious that we are dealing in the main with objects relating to the earliest period of Islamic art in Iran. There are parallels for several of them—the lobed cups, the slender-necked vases, the flat dish of a shape already known from Sogdian and Chinese silver—and this points to the eighth century as the most likely period. This does lend some weight to Kashani's statement that the use of white bronze started in the late seventh to early eighth century. One would expect in this case at least a few direct imitations of the supposedly forbidden silver wares. They appear to exist.

Probable examples of such imitation work are some models of a totally different inspiration from the white

30. F. Sarre, *Die Keramik von Samarra* (Berlin, 1925) pl. 1, 1, p. 6, text p. 5.

31. Found at Churinskaya, formerly Viatka province. See I. I. Smirnov, *Vostochnoe Serebro* (St. Petersburg, 1909) no. 111, pl. LXVI, caption p. 15.

32. Gyllensvärd, *T'ang Gold and Silver*, pl. 9a.

33. Iraq Government Department of Antiquities, *Excavations at Samarra 1936-1939, II: Objects*. (Baghdad, 1940) pl. LXII. Note similarity of slightly curved rim. No dimensions given in either English or Arabic text.

bronze shapes studied so far. One is the boat-shaped drinking vessel, well known from silver objects decorated in Sasanian style. There are a great many white bronze versions of this shape, including one in the Metropolitan Museum; for analysis of this example see Appendix. They could be later than the fall of the Sasanian empire. Certainly some of the silver shapes were created as late as the eighth century. Such is a boat-shaped bowl in the Kettaneh collection, which should be dated to the eighth century, as it is a typical product of a Tabarestan school working in a tradition derived from the imperial style of the Sasanian period.³⁴ Tabarestan exported silver to the province of Khorasan, a fact of considerable significance that has escaped attention so far.³⁵ It is not unreasonable to assume that the boat-shaped white bronzes are among the first imitations of silver vessels.

Another possible case of white bronze interpretations of silver models are some stem-bowls closely comparable to a type found at Susa.³⁶ A white bronze version made in separate parts—bowl and stem—as are the silver pieces, was on the Persian art market in 1971 (Figure 12).

Assuming that the tentative identification of high-tin bronze—speculum—with *safidruy* is correct, the boat-shaped vessels and stem-bowls made of this alloy may



FIGURE 12
Stem-bowl, Persian market, 1971

illustrate the beginnings of the school noted by Kashani and Biruni.

It is also to this early period that one might date those white bronzes that have parallels in the early eighth-century Chinese shapes. Of these, two are of particular interest. One is a stem-bowl in the Gulbenkian Mu-

34. The Kettaneh bowl was published by Ghirshman (*7000 ans d'art en Iran*, no. 805, p. 140, pl. xcii) as "Sasanian, VI–VII century." The eighth-century date given here as well as the ascription to a school located in Tabarestan are primarily based on the typological characteristics linking the Kettaneh bowl with two of three bowls actually dug up in historical Tabarestan (modern Mazandaran) and furthermore inscribed to the names of a ruler (Isfahbad) of this province (on the inscriptions, see W. B. Henning, *Bulletin of the School of Oriental and African Studies* XXII, 1 [1959], pp. 132–134), and the well-known bottle formerly in Naser ad-Din Shah's collection. The latter, now in the Muze-ye Iran Bastan, Tehran, is also said to have been excavated in historical Tabarestan (first published by Y. Godard, "Notes. Bouteille d'argent sassanide," *Athar-e Iran* III, 2 [1938] pp. 291–300). The formal decoration and low-relief carved figures on the Kettaneh bowl, which was reportedly dug up in Deylaman, a modern village located in historical Tabarestan, and those to be seen on the inscribed bowls offer close analogies. The dancer on the Kettaneh bowl is framed by formally stylized vinestalks—two stalks joined together—carrying leaves whose veins, reduced to purely geometrical curves, are identical to those seen on the bowls inscribed to the name of the late eighth-century Isfahbad. The tips of the leaves on the Kettaneh bowl are drawn as pointed arches, as are the leaves at Khirbat al-Mafdjar, the early Islamic site in Palestine. The bunches of grapes, each made of seven grapes, are identical to those on the inscribed

bowls. The stylization of the face and costume of the dancer finds exact parallels on the figures to be seen on two of the inscribed bowls. There is therefore every reason to consider the Kettaneh bowl as a product from the workshop located in Tabarestan and active at about the same time, the latter half of the eighth century. On the school of Tabarestan, to which many more bowls may be ascribed, see my *L'argenterie du Tabarestan*.

35. Ibn Isfandiyar tells the story of a prince of Khorasan who came to visit the Isfahbad, Khorshid the son of Dadborzmehr, and asked for trays to display his presents: 500 silver trays were brought, from the Isfahbad's pantry. The Isfahbad then graciously accepted the presents and sent back to Khorassan 2000 silver trays laden with presents. See Ibn Isfandiyar, E. G. Browne, ed., *Ibn Isfandiyar's History of Tabaristan* (Leiden-London, 1905) p. 46. In another passage, according to Clement Huart, Ibn Isfandiyar tells about a treaty between Farrokhan and Yazid B. Muhallab, governor of Khorasan, whereby the Isfahbad pledged himself to send an annual tribute including 400 men each carrying a shield, a silver bowl, and a silk saddle-cloth. Huart singled out this passage, *Encyclopédie de l'Islam* IV (Paris-Leiden, 1934) article "Tabaristan," p. 608 B, but missed its significance.

36. An excellent example is in the Metropolitan Museum (acc. no. 62.46). Another is in the Louvre, see P. Amiet, "Antiquités Parthes et Sassanides," *Revue du Louvre* (Paris, 1967) p. 278, pl. 9.



FIGURE 13
Stem-bowl, Museum of Oriental Antiquities,
Gulbenkian Foundation, Durham (photo: cour-
tesy Museum of Oriental Antiquities)

FIGURE 14
Flat dish, Tehran market, ex coll. Clayton, Lon-
don



seum of Oriental Antiquities, Durham (Figure 13). Bequeathed to the museum as part of Sir Charles Hardinge's collection, formed before World War II, it is not otherwise documented. Though it was regarded as Chinese, an attribution plausible enough as long as the existence of Iranian white bronze was unknown, it has all the characteristics of the group studied so far. The bowl is made of hammered white bronze and has the same round edge as the boat-shaped vessels. Corrosion typical of this metal has eaten a hole through the side. In profile the bowl is close to T'ang metallic shapes³⁷ and the dome of one of two incense burners found at Bishapur in Fars.³⁸ The trumpet-shaped stem is of ordinary bronze.

The other "T'ang" shape is a flat dish from the Tehran art market with slanting convex rim topped by a rounded rib (Figure 14) (diameter 28-28.1, height 2.4 cm.). The back shows the characteristic deep mirror black patina with emerald green oxide areas under the rim. The inside has presumably been cleaned, revealing the almost white metal. The network of crackles is typical of the early stage of white bronze corrosion. The shape is well known from T'ang three-colored pottery dishes and also a glass footed dish in the Shosoin at Nara.³⁹

Both the series of shapes echoing the Sasanian tradition and these other early types with middle T'ang parallels apparently support Biruni's and Kashani's

37. Gyllensvärd, *T'ang Gold and Silver*, pl. 10d. The profile of the Durham bowl is exactly that of another early eighth-century stem-bowl, pl. 8d. One has simply to omit the stem and the upper part marked off by the rim, both of which may be regarded as secondary additions to the basic volume.

38. R. Ghirshman, "Les fouilles de Chapour (Iran)," *Revue des Arts Asiatiques* 12, 1 (1938) pl. ix, fig. 5. The two incense burners were found inside a glazed pottery jar in a cache. From the brief report, one gathers that the cache included luster wares from Rey as well as a glass flask of the Samanid period—objects of various periods presumably regarded by the owner as precious. Ghirshman refers to the house as an "Arab dwelling." No description is given of the incense burner related to the Durham bowl, nor are the dimensions stated. I suspect that it was of white bronze and belongs in my second group, "Wares with Geometric Patterns."

39. Pottery dishes: see W. Willetts, *Foundations of Chinese Art* (London, 1965) pl. 38. Glass footed dish: Sir Percival David, ed., *Chinese Connoisseurship: The Ko Ku Yao Lun* (London, 1971) pl. 15 d, caption p. xxxv. The shape, like many others in this group, can be traced back to early Iranian art. A similar profile may be seen on the alabaster footed tray from Persepolis: E. F. Schmidt, *Persopolis II, Contents of the treasury and other discoveries* (Chicago, 1957) pl. 27, no. 4.

contention regarding the sudden vogue of white bronze in the days of al-Ḥajjāj. Are we to take the old writers literally and assume that white bronze was really “invented” at that time? This seems incompatible with an archaeological find brought to my attention by Prudence Oliver Harper: a shallow bowl excavated by Namio Egami in Gilan and tentatively dated by him to the latter half of the Parthian period.⁴⁰ Analysis has shown the alloy to contain 21.4 per cent tin, 1.2 per cent lead, 0.7 per cent iron, the rest being copper. The simple shape of the bowl would lend itself excellently to hot forging. It is, indeed, similar to small bowls of the same alloy that can be bought in the Kerman market today. Metallographic examination of some of them clearly shows that they were hot-forged and quenched.⁴¹ Should the Egami bowl be found to possess a similar microstructure, and be confirmed by further archaeological finds, it would be of the utmost importance. For the first time it would be possible to relate a definite metallurgical technique of the early Islamic period to the distant Iranian past.

We cannot, on the other hand, rule out the possibility that the making of undecorated white bronzes may have lasted into the early tenth century. The similarity in shape between the vase of Figure 5 and a vase with a nielloed inscription of the mid-ninth to mid-tenth century was noted earlier (page 129). Polylobed shapes persisted long after the eighth century. A splendid polylobed bronze cup in the Herat Museum (Figure 15)

FIGURE 15
Lobed cup with inscription, Herat Museum



(diameter 11.2-11.4 cm.) is inscribed in a variety of the so-called Kufic script:

بركة و / يمن و / سرور / [و]سعادة /
و نعمة و / دو[لة]

“Divine grace/bliss/joy/felicity/God’s favor/g[ood fortune].”

The lettering, with its combination of triangular apices, as on the *yā’* of *yumn* (visible in the illustration), and its foliated endings of the curved tails of the *wāw* (also visible), dates it to the tenth century, if not even to the early eleventh. It is therefore not inconceivable that several of the undecorated white bronzes of similar shape may have been manufactured as late as the tenth century. For the time being, considering the broad span covered by the white bronzes, the group must be dated late seventh to early or middle tenth century.

Determining their place of manufacture raises similar problems. The Caspian area is a possibility. Only one object of those discussed so far was personally bought by any of the dealers making statements regarding provenance, and that one came from the modern city of Gorgan—that is, from the cultural borderland between the Caspian area and Khorasan, the great eastern province, leaning more toward the East than the Caspian area. This does not settle the question. On the other hand, several undecorated white bronzes may be seen in Afghanistan, including lobed bowls, though I could not photograph or study any of these closely. Another indirect argument supporting an eastern location is the number of parallels provided by Chinese silver shapes. As all of the T’ang shapes derived from so-called Sasanian shapes are in fact related to a group of Sogdian origin, datable to the seventh and eighth centuries,⁴² it is not unreasonable to assume that early Islamic shapes that have equivalents in the T’ang repertoire of shapes were also manufactured in the eastern

40. Namio Egami, Shinji Fukai, and Seichi Masuda, *The Tokyo University Iraq-Iran Archaeological Expedition Report 7: Dailaman II. The excavations at Noruzmahale and Khoramrud* (Tokyo, 1966) line drawing of profile, pl. XLIII, 5; analysis, p. 9; date, p. 18. A photograph and chemical analysis, unfortunately without microphotographs, appear in Tsurumatsu Dono, *Kodai Kinzoku Bunka-Shi* [“Chemical Investigation of the Ancient Metallic Culture”] (Tokyo, 1967) fig. 66, pp. 112, 217.

41. C. S. Smith, private communication.

42. Melikian-Chirvani, “Iranian silver,” pp. 9-15.

FIGURE 16
Fragmentary bowl
from Neyshabur,
Muze-ye Iran Bastan,
Tehran

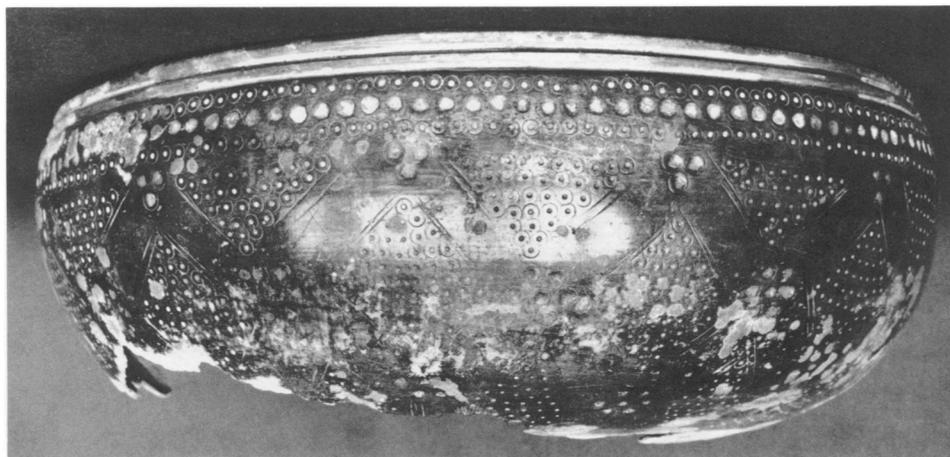


FIGURE 17
Bowl from Neyshabur,
Muze-ye Iran Bastan,
Tehran (inventory
number 9797)



Iranian world. None of this, however, allows any definite statement, and the question of geographic provenance cannot be solved at present.

WARES WITH GEOMETRIC PATTERNS

It is possible to reach more positive conclusions with the second group of white bronzes, characterized by geometric patterns in which the dotted circle was used either in continuous chains or as a matting device. The group is primarily represented thus far by bowls, trays, and spoons. There are examples in the reserves of Iranian and Afghan museums, and on the bazaars of Khorasan. Many more are to be found on the Western art market.

Although none of the objects studied in the East was

available for laboratory analysis, several of them are obviously made from the same alloy as the preceding group. The wartlike corrosion in neatly defined concentric circles, the black patina, the shallow parallel grooves left by rough scraping on the underside of trays and bowls, the marks left by turning on the lathe—all establish the identity of the alloy and the technical methods its use implies. Other objects in this group probably should not be classified with white bronzes. They may have been made from a different alloy or have undergone a different treatment, or both, for their patina takes on a rich deep olive color. However, their decoration is executed with the same tools—dividers and punches—as the white bronzes with geometric patterns.

Moving from west to east, the first large group comes from commercial excavations at Neyshabur. Several

bowls in the Muze-ye Iran Bastan were seized, Parvin Barzin of the Islamic Department informed me, as illicit finds from commercial diggings many years ago. A good example is an unnumbered fragmentary bowl (Figure 16) (diameter 23.9 cm.) with mirror black patina and the typical corrosion that has destroyed more than half the metal. The grooving at the top is a frequent feature in the series. Underneath, two deep incisions serve to emphasize it. The rounded profile is equally common. Two rows of punched dotted circles bordering a central row of cavities, also punched, mark off the main decoration from the rim. The lozenge pattern with its broad bands carelessly indicated by double parallels and the punched dot filling used to mat the surface are typical of the repertoire. So is the stamping of three cavities at the top of each lozenge and seven cavities at the intersection of two lozenges. The rough incisions and somewhat shoddy punching characterize what may be tentatively called the rustic style.

A more sophisticated type of bowl in the Muze-ye Iran Bastan (Figure 17) (diameter 18.7, height 8.7 cm.) is in a heavier yellow alloy mostly covered by a dull red patina with faint traces of small wartlike corrosion. The bowl was cast, the decoration executed with dividers, punches, a gouge, and chisel. On the outer walls, the bottom is marked off by a continuous band of circular cavities framed by incised parallels. A gadroonlike motif appears on the lower part topped by another band of cavities. Dotted circles punched at the bottom of each incised arc make a highly stylized capital, and other dotted circles appearing above the arcs are reminiscences of the lotus-bud or flower normally represented between consecutive architectural arches on Sasanian, Sogdian, and early Islamic arcades. The central area is occupied by twenty large roundels—dotted circles surrounded by a cut-out ring, the whole framed by three incised circles. The intervals are filled by a circular cavity with three dotted circles on the outside, a common motif in the series. Finally, two chains of dotted circles within thinly incised fillets frame a band of smaller roundels consisting of the same dotted circle surrounded by a cut-out ring.

Although the inner decoration (Figure 18) need not be described in detail, one should note the two compartments enclosing the stylized *hastae* of the letter *alif* between rows of dotted circles. There are twelve *alifs* in one and fourteen in the other. These are stand-

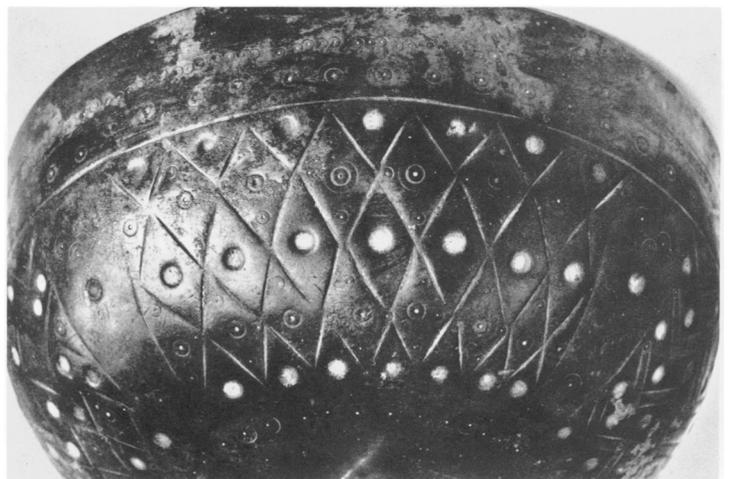
ard numbers that govern the elements of any kind used in Iranian metalwork according to what I call the aesthetics of number.

One large, nearly hemispherical bowl acquired by a Tehran dealer in Neyshabur (Figure 19) (diameter 23.5-24 cm.) is cast in an olive yellow alloy with a fine brown and red patina and a few patches of green oxide. The walls are marked off from the bottom by forty-two



FIGURE 18
Interior of bowl, Figure 17

FIGURE 19
Bowl from Neyshabur, private collection



dotted circles punched within a second circle of greater diameter. A similar motif appears at the top between deeply incised lines with one last chain of small dotted circles before the bare area that may be regarded as the rim. The walls are divided into four compartments by incised gadroons. Each one has a different decoration alternately based on the lozenge and the herringbone gadroon with an abundant use of cavities and dotted circles arranged according to well-defined numbers.

Further east, at Herat, several white bronzes with geometric patterns belong to the city museum. One, typically corroded, has a decoration in the beveled style well known from carved wood and marble revetments found at Samarra. In profile (Figure 20) (diameter 17.25 cm.) the shallow bowl has a flat bottom and slanting, slightly convex sides. In feel and lightness the metal is exactly like that of the small faceted vases. Whatever inside decoration may have existed can no longer be seen under the corrosion. The underside (Figure 21) is very subtly faceted. Eleven lotus-bud-shaped facets point toward the center. In the middle of each facet, a smaller lotus-bud motif is cut out in low relief and in the center of this appears a third motif, a depressed circular area with a ring cut out in relief. Starting from the flat central area eleven lotus-bud facets, now almost obliterated by corrosion, radiate outward. The flat central area is marked off from the lotus-bud decoration by two concentric grooves. Over the upper lotus-bud motifs arched bands, slightly concave, form a festoon with large shallow circular cavities appearing in the intervals. Above, a band of molded cavities inserted between deeply incised fillets separates the festoon and cavities from the final motif at the top: a succession of trapezoidal compartments created by deep incisions with a punched hemispherical cavity in the middle.

Another large bowl (Figure 22) (diameter 28.8, height 10.8-11, width of rim 0.45-0.55 cm.) illustrates the rougher version of the beveled style. The mirror black patina appears on the outer walls. Sharp breaks typical of the brittle alloy crack the surface, and small concentric corrosion bubbles are to be seen on the underside. The decoration is based on geometric figures chiseled after the casting, emphasized by the usual hemispherical cavities and chains of dotted circles. Thirty-four hexagonal facets were carved on the outer

FIGURE 20
Bowl, Herat Museum



FIGURE 21
Underside of bowl, Figure 20

walls, and the main feature is a complicated pattern of the Star of Solomon (*Setare-ye Soleyman*, as the Hebrew Star of David is called in Persian). This was an important esoteric symbol in early Islamic art down to the fourteenth century. The badly worn pattern indicates prolonged use before the bowl was buried, as was the case with the bowl of Figure 19. Inside, on the bottom, is a rosette similar to that seen in a bowl reputedly from the Ghor district (Figure 26).

A third bowl in the Herat Museum (Figure 23) (diameter 23.3-23.35, height 11.7-12.15 cm.), first cast

then apparently hammered and spun, is decorated with twenty-five roughly incised lozenges on the walls and the Star of Solomon on the underside (almost erased by wear). It is of the same style as several bowls from Neyshabur in the reserves of the Tehran museum. The perfunctorily punched dotted circles with a second circle around each one inserted between two deeply incised fillets, also the sham groove simulated at the top by another incised fillet, are borrowed from the same repertoire. In profile, too, this bowl is identical to several of the Neyshabur bowls.

Finally, a white bronze ladle with the same pattern (Figure 24) (length 33.4 cm.) can be closely compared to a ladle and spoon in the Tehran museum (Figure 25) (length 28.6). No record could be found of the actual provenance of the white bronzes in the Herat Museum; for the time being they must be considered to come from the Herat district in the broadest sense.

Hence the interest of a finely cast hemispherical bowl

FIGURE 23
Bowl, Herat Museum



FIGURE 24
Ladle, Herat Museum

FIGURE 25
Combined ladle and spoon from Neyshabur,
Muze-ye Iran Bastan, Tehran (inventory number
9834)

FIGURE 22
Bowl (underside), Herat Museum

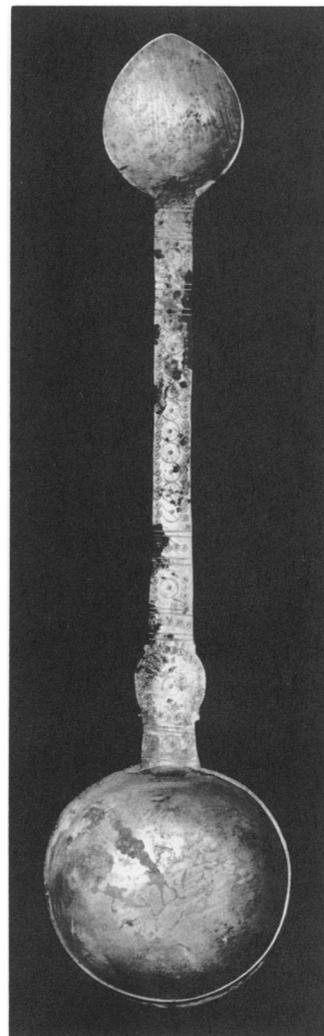
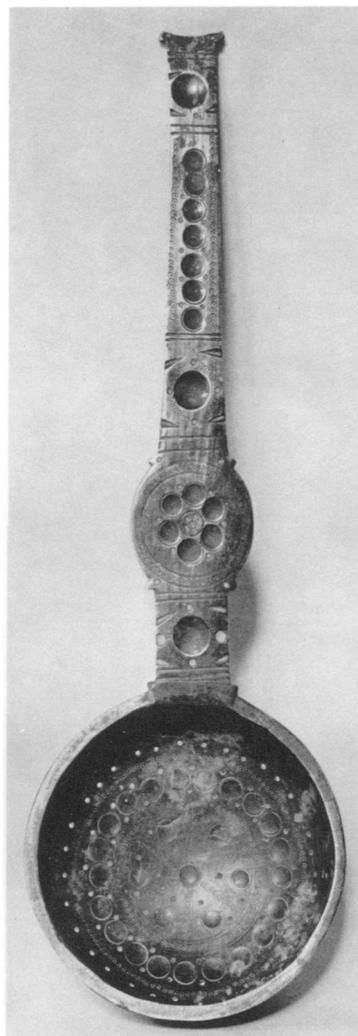


FIGURE 26
Bowl reputedly from the Ghor district,
private collection, Herat



FIGURE 27
Interior of bowl, Figure 26



FIGURE 28
Tray, Muza-i Rawza, Ghazni

in a Herat private collection (Figure 26) (diameter 24, height 10.3 cm.), reportedly found in the Ghor district. Tiny red corrosion specks dot the inner surface, which otherwise has only slight traces of green oxidation. The decorative scheme, with the chain of molded dotted circles at the top of the pattern and its division into four compartments separated from one another by flat grooves, recalls the Neyshabur bowl of Figure 19. Here, too, each compartment has a different motif executed in typical beveled style. The bottom is marked off from the walls by a groove emphasized by two incised fillets framing a pattern based on the Star of Solomon. The latter is identical to the pattern noted on the second Herat Museum bowl, but is executed with far greater precision. Inside the bowl, the only decoration is a fine rosette (Figure 27), a device that ultimately goes back to the Achaemenid motif represented inside shallow bowls as well as on the underside.

Further east, the district of Balkh, the easternmost “quarter” of Khorasan, has yielded a series of flat white bronze trays. Brought to the Ghazni bazaar, these were eventually acquired by the Muza-i Rawza, in Ghazni. Some are decorated in the geometric style (Figure 28) (diameter 50.4, height 5.7-6.4 cm.), others (Figure 29)

(diameter 48-48.2, height 5.3-5.8 cm.) in the figurative style of the twelfth century, a dating borne out by the style of the naskhi inscriptions.

An important find was made on the eastern marches of Afghan Khorasan, at Toškān, a few miles from Keshm in Badakhshan. Fourteen white bronzes now

FIGURE 29 Tray, Muza-i Rawza, Ghazni



in the reserves of the Kabul Museum were reportedly dug up together, according to Ra'uf Wardak, curator of the Islamic Department. A large tray (Figure 30) (diameter 30.2, height 5.1-5.3 cm.) and a bowl (Figure 31) (diameter 17.6-17.7 cm.), both hammered and spun, are typical examples. In the case of this find, too, four items of apparently identical workmanship are decorated in twelfth-century style, with naskhi inscriptions. A tray with this script (Figure 32) (diameter 46.3, height 6.7 cm.), having a pale yellowish patina with tiny wartlike red oxide formations and remains of an ashy patina, is closely related to the Ghazni tray (Figure 29). The same peculiar wavy incisions meant to set off the lettering are seen on both; the tall letters have one or two incisions at the top of their hastae; the five-lobed palmettes between these tall hastae are identical, and so on. It would thus seem that on the fringes of Khorasan at least, white bronzes decorated both in the geometric style and with patterns incorporating epigraphy were still being made well into the twelfth century.

One more bowl should be mentioned for its provenance, since it was acquired by a Mashhad dealer in present-day Zabol—that is, in Sistan, not Zabolistan centered around Ghazni.⁴³ Heavily cast and having an ashy olive patina, the bowl (Figure 33) (diameter 25.5-

43. See anonymous geographer, V. Minorsky, tr., *Hudud al-Alam*, 2nd ed. (London, 1970) p. 112.

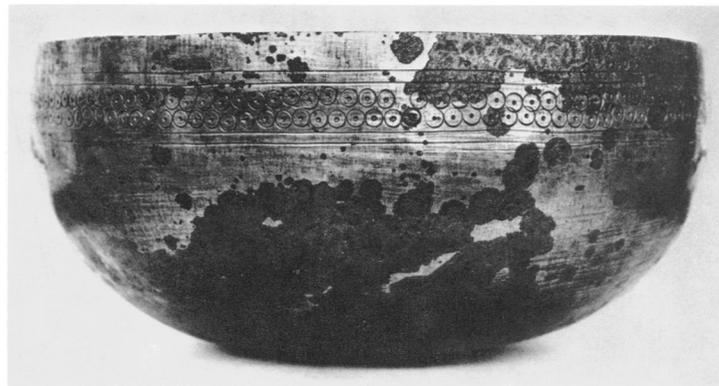


FIGURE 31
Bowl from Toškān

25.75, height 11.45 cm.) has a deep groove at the top and a succession of sixty-one circular depressed areas with a flat pierced disc in the center that recall the bowl of Figure 26. Eleven hexagons have been hollowed out on the walls. Within each hexagon, circles incised with dividers frame seven punched dotted circles. The decoration on the underside is marked off from the walls by a chain of dotted circles inserted between two circles incised with dividers. This decoration (almost worn away) seems to have been based on a hexagonal frame with shallow circular cavities marking out geometrical figures. Inside the bowl there appears a fine rosette like that of Figure 27.

FIGURE 30
Tray from Toškān, Kabul Museum

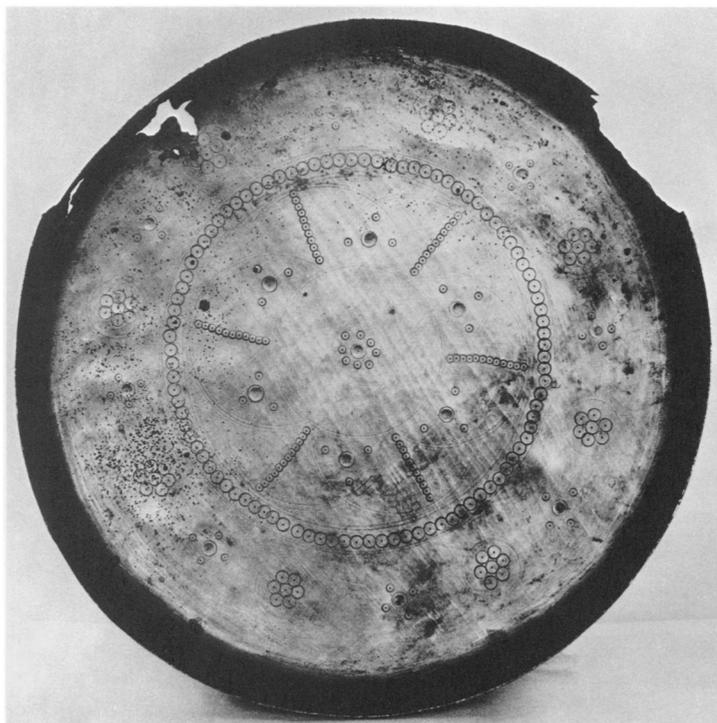


FIGURE 32
Tray from Toškān, Kabul Museum





FIGURE 33
Bowl from Zabol, Sistan, private collection

This survey could be considerably extended, since many more white bronzes are to be seen in the museums of Tehran, Kabul, Herat, and Ghazni, and in private collections. The number alone shows that the white bronzes decorated in the geometric style were fashionable over the entire area of eastern Iran. This includes not only Khorasan with Neyshabur to the west, the Herat district in the eastern central area, and the Balkh district in the east—but also its cultural dependencies, so to speak, with Badakhshan to the far east and Sistan to the south. There is no doubt, in view of the large amount of material, that it was produced in these areas, but only properly conducted excavations will tell us eventually which were the major centers. Neyshabur and Herat are likely to have been the leaders.

On the other hand, there is some reason to assume that bronzes decorated in the geometric style were not confined to eastern Iran. True, for the time being metal pieces are almost entirely lacking in the west. The two incense burners found at Bishapur (note 37) are hardly significant. They were discovered in a cache with objects of various periods presumably regarded as precious, and they may therefore have been imports. This may also be the case with a bowl recently found at Siraf on an excavation level not earlier than 1263.⁴⁴ Siraf was the most active of the Iranian seaports, and it had constant exchanges with China in the Umayyad and early Abbasid periods.⁴⁵ The bowl may be nothing but a leftover of the white bronze export trade, which was very active, especially toward China. But two western sites have yielded pottery sherds decorated with similar patterns. At Susa a fragmentary vase, the

lower part of which was illustrated by Koechlin,⁴⁶ shows the combined use of punched dotted circles as chains or as matting ground, and the beveled style. At al-Ḥira, an Arab city belonging culturally to the Iranian sphere, several sherds have exact parallels in the decorated metalwares.⁴⁷ Numismatic evidence suggests an eighty-century date for them: two coins struck in 769/70 and 774/75 were found in the debris with the sherds. The terra-cotta imitations may indicate the existence of metallic pieces in the area. This raises the problem of chronology.

Establishing a chronological chart for the white bronzes with geometric patterns based on the use of punched dotted circles and incisions is still hazardous.

The earliest evidence for the use of chains of punched dotted circles inserted between incised fillets on vessels comes from Turkestan, namely the Khotan area. A number of terra-cotta vases bearing these motifs on their handles and on the shoulder of the body were found at the end of the last century. They do not appear to be later than the late seventh century, possibly the beginning of the eighth century by comparison with related material.⁴⁸ The dating of these objects is too

44. D. Whitehouse, "Excavations at Siraf. Second Interim Report," *Iran* VII (1969) pl. v (a). A tear in the wall and a hole suggest that this is a white bronze.

45. D. Whitehouse, "Excavations at Siraf. Third Interim Report," *Iran* VIII (1970) pl. XII c and p. 5; "Fifth Interim Report," *Iran* X (1972) pl. x and p. 74.

46. Koechlin, *Les Céramiques musulmanes*, pl. 25. Note the parallel rows of chains of dotted circles, halfway up, and dotted circles punched within compartments between the almond-shaped motifs in the beveled style.

47. D. Talbot Rice, "The Oxford Excavations at Hira," *Ars Islamica* I (1934) pp. 51–73. See fig. 18 facing p. 65 top left for pleated lozenges framing rosettes consisting of dotted circles. These are in low relief. Bottom right, a piece may be seen with punched chains of dotted circles.

48. Diakonova, Sorokin, *Khotanskije Drevnosti*, pl. 4, no. 14, a continuous chain with use of smaller dotted circles in intervals, and pl. 4, no. 33. Both pieces belong in the same category as nos. 15 and 18 with precisely molded Sogdian figures. Note the three-eared cap in the frescoes from Pandjikand: A. Belenitsky, B. B. Piotrovsky, ed., *Skulptura i Zhivopis Drevnego Piandzhikenta* (Moscow, 1959) pl. XIII, left-hand figure to be compared with *Khotanskije Drevnosti* pl. 4, no. 18, and on an unquestionably Sogdian silver bowl found at Malaya Anikova; for colored ill. of the latter, Belenitsky, *Asie Centrale*, pl. 74. Note the triangular shape coming down on the breast, typical of both Sogdian and Bactrian Buddhist costume. This group of terra cottas clearly reflects the iconographic tradition of northeastern Iranian lands in the seventh century. See further interesting examples, *Asie Centrale* pl. 13, nos. 295, 302; pl. 17, no. 474.



FIGURE 34
Glazed cup, T'ang period, British Museum
(photo: courtesy Trustees of the British Museum)

uncertain to provide per se a firm chronological basis. But the terra cottas are of some consequence in connection with the first group of wares directly related to the white bronzes with geometric patterns. These consist, oddly enough, of Chinese glazed cups (Figure 34), with which the Khotan terra-cotta patterns establish a logical geographical link. To the best of my belief, the group has not yet been typologically defined. The cups are shaped like the T'ang silver model derived from Sogdian silver and in use during the first half of the eighth century.⁴⁹ The only difference is the simpler, faceted ring handle, which follows an age-old Iranian tradition. Instead of the usual T'ang silver floriated design, the glazed cups are decorated with superposed rows of dotted circles inserted between fillets. They are incised under the glaze. As this motif was not indigenous to China, and, as we know by now, was widely used in Iran, it follows that the Chinese group of T'ang pottery reflects lost Iranian prototypes of the same period, that is, the first half of the eighth century.

It is of some interest to note in this connection that white bronzes with geometric patterns have actually been found along the Silk Road. Sir Aurel Stein, who discovered them at Kara-Khodja in the Turfan area,

49. On the Chinese silver cups with ring handles and thumb rests, and other basic shapes of Sogdian derivation, see my "Iranian silver," note 28.

did not identify them as such, which he could not possibly do, but his careful descriptions of one of the bowls accompanied by a small-size illustration can leave no doubt as to the nature of the object—a bowl from Khorasan.⁵⁰ While this bowl cannot be dated, it establishes the existence of a white bronze trade via Turkestan.

B. Laufer remarked long ago that the Chinese term *pai-t'un*, literally "white bronze," renders the Persian/Arabic *isfidruj*.⁵¹ If my identification of white bronze with *safidruj* is correct, the Chinese borrowed the word as well as the metal. They definitely used the metal by the early T'ang period. The Freer Gallery owns an unpublished pair of scissors and matching blade (Figure 35) decorated in the pure T'ang style of the first

50. Aurel Stein, *Innermost Asia II* (Oxford, 1928) pp. 592–593, on the chronological data of the cache, which included coins as late as 1102–07. The cache appears to have been that of a copper-smith. The bowl (Kao. III 0106), with traces of ancient repair and wear (see caption in vol. II, p. 605) must have been a discarded antiquity, *Innermost Asia III*, pl. LXX. Other of Stein's objects appear to be of white bronze too—he thought them of very thin iron-sheet, but his careful description suggests the alloy: Kao. III 099, 0100, 0101, 0102. A six-lobed bowl—0102—and a plain dish with flat bottom and low curved walls—099—might well be of Iranian make.

51. B. Laufer, *Sino-Iranica* (Chicago, 1919), p. 555. He mistakenly understood the word as meaning "whitish in face." Indeed "white-surfaced" would read in Persian "*safidruj*," but Kashani's description makes it clear that here *ruj* is the homonym meaning "bronze." As Edward H. Schafer remarks (*The Golden Peaches of Samarkand* [Berkeley-Los Angeles, 1963] note 90, p. 339 B), the same word may apply to different realities through the centuries. So the fact that modern *pai-t'un* applies, according to Laufer, to a copper-zinc-nickel alloy with a small amount of iron does not lessen the significance of the linguistic correspondence. Laufer adds that Japanese "*sabari* or *sahari* . . . denotes the white copper of the Chinese." He assumes it is derived from the Persian word *sepīdrūi* (= *safidruj*) and points out (p. 555, note 6) that the Japanese spelling points to the foreign origin of the product. The Japanese apparently retained the Persian word, which may have reached Japan via Korea.

FIGURE 35
Blade, T'ang period, Freer Gallery of Art, Washington, D.C.

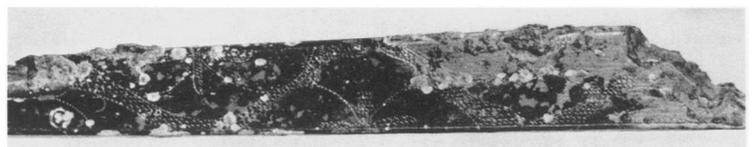




FIGURE 36
Pouring vessel, stone ware, from Neyshabur,
Muze-ye Iran Bastan, Tehran

half of the eighth century as seen on silver wares. The metal has the patina and corrosion of white bronze.

None of this proves that the metallic models imitated by the glazed pottery cups were made of white bronze, but it makes it very plausible. It establishes the earliest date of the geometric patterns based on punched dotted circles and therefore, presumably, of white bronzes with such patterns as the first half of the eighth century.

The next chronological evidence comes not from Sogdia via its Chinese derivations, but from the other end of the Iranian world. As already mentioned, al-Hīra, on the Persian gulf, a few kilometers from the modern Iraqi-Iranian border, has yielded terra-cotta sherds with geometric patterns based on punched dotted circles. Fragments of stone wares with similar patterns were also found at the site. The excavator, David Talbot Rice, does not precisely locate the terra cottas relevant to the chronological problem of white bronze. He merely states that the general group of terra cottas they belong to was mainly found with filling debris datable by coins to the third quarter of the eighth century.⁵²

At a slightly later date the vast amount of stone

52. D. Talbot Rice, "The Oxford excavations at Hira," pp. 51–73. Regarding terra cottas, see among others fig. 18 facing p. 65, top left; chronological data on filling debris, p. 66. Concerning stone wares see G. T. Scanlon, "Ancillary dating materials from Fustat," *Ars Orientalis* 7 (1968) pl. 4, fig. 5, text fig. 7 a, p. 15, text p. 8A. Scanlon's excavation is important because some of the material is datable. Although not identical—they lack the dotted circles—the stone wares appear to support the tentative dating ascribed to the al-Hīra find.

wares excavated at Neyshabur offers close parallels to the geometric patterns executed with punches, dividers, and a gouge, as found on white bronzes (Figure 36). In 1944 Charles K. Wilkinson gave these stone wares a late eighth- or early ninth-century date.⁵³ Stylistic evidence, however, suggests that stone wares with geometric patterns executed with dividers, rulers, and punches were still being made after the ninth century. Moreover, the Museum für Islamische Kunst, Berlin, owns a gray stone funerary tablet dated Di'l Qa'ada 421/October–November 1030,⁵⁴ the handle of which, the only decorated part, has a geometric pattern of dotted circles, some of them framed by a second circle.

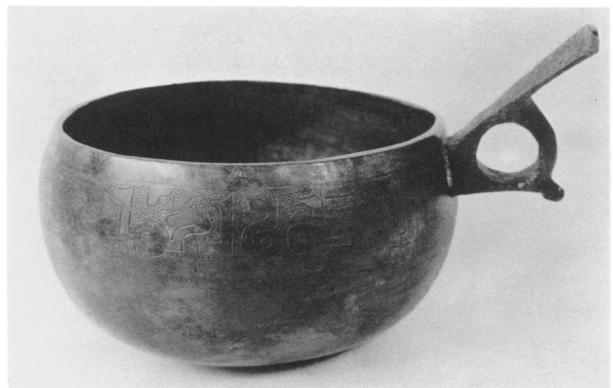
The last piece of evidence regarding the date of white bronze with patterns based on punched dotted circles hails from western Siberia: a cup (Figure 37) found by the Swedish collector Fredrik Martin in the course of a perfunctory excavation at Barsoff-Gorodok, ten kilometers from Surgut on the river Ob.⁵⁵ It was exhibited in London as a "silver cup with bronze handle, eleventh

53. A passing reference in C. K. Wilkinson, "Heating and cooking in Nishapur," *The Metropolitan Museum of Art Bulletin* 10 (1944) p. 290: "The stone and pottery vessels illustrated are from ninth century houses." I understand that Wilkinson is now inclined to bring his dating down to the tenth century.

54. *Museum für Islamische Kunst, Berlin. Katalog, 1971*, no. 233, p. 68.

55. T. J. Arne, "Barsoff-Gorodok," *Kungl. Vitterhets Historie Och Antikvitets Akademiens Handlingar Del 39:5* (Stockholm, 1935) fig. 49a, p. 104, inscription fig. 49b, p. 104, commentary or related text, pp. 26, 58, 76, 77. First publication by Smirnov, *Vostochnoe Serebro*, no. 145, pl. LXXX.

FIGURE 37
Cup from Barsoff-Gorodok, Statens Historiska
Museum, Stockholm



century,"⁵⁶ an identification similar to Arne's, but it is in fact white bronze. Analysis (see Appendix) shows that the alloy is distinctly different from that of the Metropolitan Museum's pieces. The handle, cast in ordinary bronze, is exactly the same as that of the polylobed cups discussed earlier. Even the dimensions (diameter 10.3, height 5.7 cm.) are those of the small cups. The body carries an epigraphic frieze on a ground matted with a continuous series of dotted circles. A continuous band of the same dotted circles runs down from the rim along the handle, breaks off horizontally at a right angle to underline the epigraphic frieze, and goes up again at the end. The crudely made inscription was published in a line drawing by Smirnoff, who did not attempt to give a transcription in cursive script or comment on its period. It includes five words:

بركة و نعمة و سلامة و سعادة و [ت]امة

"Divine grace, God's gifts, salvation, bliss, fulfillment, A!" Features of this inscription point to the first half of the eleventh century. The pointed *mīm* combined with the very special type of *tā' marbūṭa*—one tall hasta against which the *tā' marbūṭa* is leaning—are not found before the middle Samanid period. The pointed *'ayn* with the lower part drawn as an arch can hardly be earlier than the early eleventh century. Apart from the interesting evidence regarding the export of Khorasan white bronzes to western Siberia, the cup proves that white bronzes with punched decoration were still being made well into the late Buyid period. It further suggests that the combination of two alloys, white bronze or speculum plus ordinary bronze, was still known—unless one assumes that the inscription was added after the cup itself was completed, a possibility that can neither be accepted nor discarded until additional white bronzes are found.

Important questions such as when the beveled style first appeared in metalwork from eastern Iran must remain unanswered. There is at present no way of telling which appeared first, the Samarran wood and marble decoration or the bowls of Figures 20, 22, and 26.

It is striking that both in the case of the undecorated shapes and the vessels with geometric patterns, chronological evidence, however loose, independently points to an early start somewhere around the late seventh or early eighth century, a continuation through the ninth

into the tenth, and a dying out some time in the eleventh century. There are indications that the geometric style may still have been active in the twelfth century in outlying territories—for example, Badakhshan, as discussed above.

The long period of production as well as the wide area which it covered probably account for the many stylistic as well as physical differences, including variations in the thickness of the metal and possibly the composition of the alloy. It is to be hoped that future investigations in which laboratory analyses might play an important part will help sort out what is at present a fascinating but somewhat confused body of material. This material, despite all the unanswered questions, is a major addition to our knowledge of early Iranian art. It reveals an extraordinary interest in pure geometry. Such objects in the first group as the faceted vases (Figures 3, 4), the faceted ewer (Figure 7), and the vase found at Gorgan (Figure 9) may be considered exercises in solid geometry. The designs of the second group represent similar exercises limited to two-dimensional space. Not only does the bronze-maker draw geometric figures, he uses the very instruments required in geometry—rulers and dividers. The urge to wield these instruments was such that he could not resist incising circles on the underside of certain pieces even though they would normally not be seen (Figure 10). Actually, these same instruments were used even when the artisan represented animal figures.⁵⁷

In basic components, the patterns on the white bronzes were not new in Iran. The dotted circle appeared as early as about 3000 B.C. in Fars,⁵⁸ and was handed down to the northwestern potters⁵⁹ and bronze-makers. Geometric patterns were already executed with dividers, and a pointille was used to mat the ground on the underside of gold beakers from Gilan.⁶⁰ Such patterns appeared in Urartu on stone and

56. *Exhibition of Persian Art* (catalogue) (London, 1931) p. 13, pl. bottom right.

57. A good example of this style was published at a time when it was a totally isolated object: R. Ettinghausen, "The 'Wade Cup' in the Cleveland Museum of Art, its origin and decorations," *Ars Orientalis* 2 (1957) pp. 341, 342, pl. 6. Ettinghausen dates the bowl to the Samanid period.

58. R. Ghirshman, "Notes iraniennes XII," *Artibus Asiae* 26 (1963) p. 157, fig. 9.

59. [M.-L. Vollenweider, F. Brüscheweiler, R. Stucky] *Trésors de l'Iran Ancien* (Geneva, 1966) pl. 41 no. 563, p. 109.

bronze.⁶¹ The simpler geometric patterns such as lozenges with a dotted circle in the middle were painted on prehistoric pottery. Some were known as early as the third millennium B.C., as may be seen on a bowl from Termez in Khorasan,⁶² precisely where the geometric patterns were to appear on white bronzes. Throughout Iranian history the dotted circle stamped with a punch (which also spread far and wide outside Iran) recurs. From the Achaemenid silversmiths who used it to render stylized festoons on their silver⁶³ to Sogdian silversmiths who punched dotted circles on the low-relief arches they hammered on jugs,⁶⁴ the dotted circle never went out of the decorative repertoire. Its extensive use in the early eighth century was the resurgence of a familiar motif.

The shapes of the white bronzes likewise echo forms already familiar in ancient Iran.⁶⁵ Rather than inventing new patterns and shapes, the bronze-makers se-

lected models and ideas that already existed, exploiting to the utmost the possibilities they afforded. What is new is the systematic use of geometry to an extent unparalleled in Iran and elsewhere.

It seems, at this stage of our knowledge, that the northeastern area—Sogdia and presumably Bactria—must have played a major role. There, the tendency to break up round volumes into facets, and to multiply compartments and frame each of them heavily, was particularly strong.⁶⁶ Generally speaking, the trend toward abstraction appears to have been more marked in the northeastern area than in the contemporary Tabarestan workshops. Apparently the Islamicized area further emphasized pre-existing trends. This may explain why Khorasan was to be the place where the geometric style attained such pre-eminence. The east, rather than the west, was the primary source of modern art when Islamic Iran came into being.

60. H. Samadi, *Les découvertes fortuites* (Teheran, 1959) fig. 14, p. 16.

61. B. Piotrovsky, *Ourartou* (Geneva, 1969) pls. 115–116. Could these objects be Iranian? Similar objects are on the Iranian market.

62. Belenitsky, *Asie Centrale*, pl. 9, caption p. 241.

63. Smirnoff, *Vostochnoe Srebro*, pl. iv, no. 15.

64. Orbeli and Trever, *Sasanidskii Metall*, pl. 47, bottom left, where pyramids of three dotted circles are visible on the right-hand arch.

65. The origins and developments of these forms through the ages are a separate subject. A few early prototypes of typical white bronze shapes may be mentioned here. The flat dish with short

convex slanting walls goes as far back in time as the pottery excavated at Tall-e Shogha (Vanden Berghe, *Archéologie de l'Iran Ancien* [Leiden, 1959] pl. 54 c, center—omitting the stem, which can be treated as a separate element). The Durham stem-bowl is descended from the alabaster mortars, shaped like stem-bowls, found at Persepolis (Schmidt, *Persepolis II*). The stem-bowl copying the Susa silver form goes back to very early models, of which a stem-bowl found at Qal'e-ye Dasht is an example. And so on. Our sketchy knowledge of common pottery from the Achaemenid period down to late Sasanian times prevents the drawing of a precise chart. Future excavations will perhaps make this possible.

66. Melikian-Chirvani, *L'Argenterie du Tabarestan*.

Appendix

Analysis of the Cup from Barsoff-Gorodok (FIGURE 37)

Made at the author's request, the analysis was carried out by Birgit Arrhenius of the Statens Historiska Museum, Stockholm, using a Perkin-Elmer Atomic Absorption Spectrophotometer. A 2 mg. sample taken from the edge of the rim showed:

COPPER	TIN	SILVER	ZINC
64.5%	31.2%	3.3%	0.5%

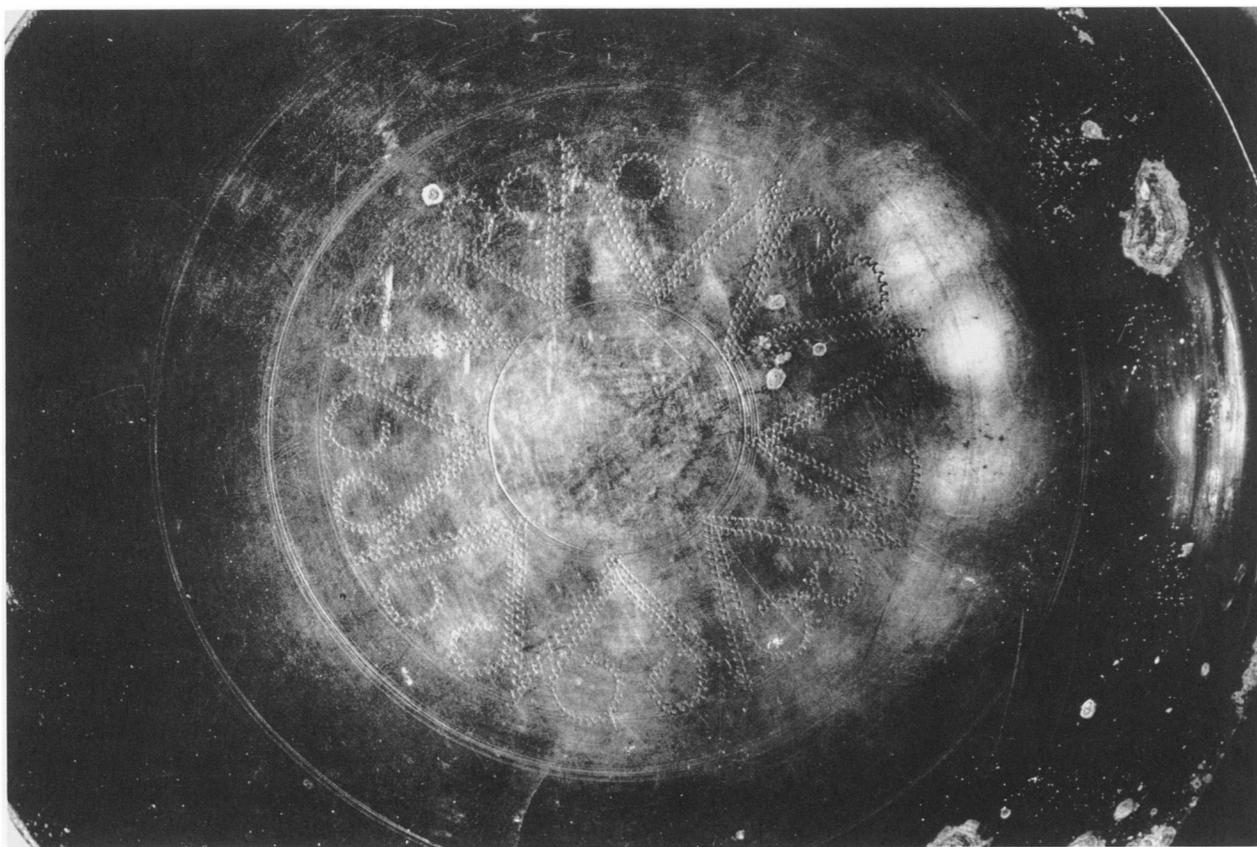
Mrs. Arrhenius expresses surprise (communication of 25 February 1974) that the tin content is higher than that of similar bowls reported on in this Appendix. In her view, the difference may "be due to the corrosion which affects the tin-copper."

Technical report on fragmentary bowl, ex coll. Jean Pozzi (FIGURE 38)

Composition: Micro-chemical tests with rubeanic acid and cacotheline solutions showed the composition to be a copper alloy with a high proportion of tin, certainly in excess of 25%. The material is, thus, a speculum. This finding agrees well with other observable features, namely the rectilinear natures of the fractures, and the strictly localised areas of wart-like corrosion.

Method of manufacture: The complexity of the rim deco-

FIGURE 38 Shallow bowl (diameter 19 cm.) ex coll. Pozzi. Bowl presents the mirror black patina also seen on bowls in the Metropolitan Museum (Figures 39-41)



ration, and the fact that it shows no evident signs of having been shaped by the use of hammers or punches, must imply that this bowl was first cast. At this point it would have been rather shallower than the final form, but the rim and its decoration would have presented the shape in which they are today. The bowl was then placed on an anvil and the metal in the central area, diameter roughly 5 cm., was stretched by hammering. The evidence for this is quite clear, for on both inner and outer surfaces the parallel lines of many series of hammer-blows are plainly visible. The purpose of this operation was to thin down the metal in the central area which would be out of reach in the subsequent process. The bowl was finally mounted in a lathe, presumably with a mastic material since there is no sign of a centre-point perforation, and the metal was further stretched with burnishing tools, so making the vessel thinner and deeper. The evidence for this process exists in the form of a great number of horizontal striations on the surface of the metal. It is difficult to be emphatic on this point since it is possible that the bowl may also have been shaved down (turned) rather than thinned down by spinning, or even by a combination of the two processes, since the final appearance would have been identical in either case.

One may reasonably speculate as to why this rather unusual procedure was followed. In the first place it would have been very difficult to have produced a vessel as thin as this simply by casting. On the other hand, speculum is a far more brittle metal than, say, a 10% tin bronze, and hence requires frequent annealing. To have spun a bowl of this shape from a flat disc of metal would thus have involved repeated removal from the lathe. In this case the craftsman appears to have avoided this tedium and achieved his aim by an ingenious combination of techniques.

Decoration: The decoration on the interior surface was executed with a punch, the working end of which was roughly V-shaped, one side of the V being curvilinear rather than straight. In operation the punch was struck in series along the line of decoration while being rotated clockwise and counterclockwise between alternate blows.

H. W. M. HODGES
Institute of Archaeology
University of London
 2 July 1971

Spectrographical analysis of tray, H. Beres collection, Paris (FIGURE 6)

This analysis was carried out at the author's request by the Laboratoire de Recherches des Musées de France (Institut Mainini) in February 1970, through the kindness of Henri Marchal and Marthe Bernus, keepers of the Département des Antiquités Orientales. Findings: "The alloy primarily consists of copper and tin, including other elements as impurities only.

			ANTI-		
COPPER	TIN	LEAD	MONY	IRON	ARSENIC
X	approx. 25-30%	0.6%	0.3%	0.7%	0.1%

Zinc, aluminum, nickel, manganese were less than 0.01 per cent. Silver and magnesium traces were too negligible to be assessed. The tin content is high, about 25 to 30 percent. This is an approximation since it is difficult to evaluate such quantities by emission spectrography. Examination of the patina and corrosion will not answer the question: "Was the tray tinned or not?"

Technical Notes on Seven High-tin Bronzes in The Metropolitan Museum of Art

AUTHOR'S NOTE: Objects 6 and 7 in this report have stylized floral or semifigurative patterns inside, so they do not belong in either group presented in the article; however, the results of their analysis confirm the virtually constant composition of the high-tin alloy in the bronzes, the tin content never going under 20 per cent. Objects 2-3 are bowls with simple, atypical shapes that cannot be dated on the basis of typological data. Objects 1-5 are all made of light sheet metal that takes on a deep mirror black patina and easily corrodes from within. I suspect that this patina, far commoner in the group of undecorated wares than the decorated, must reflect special methods of manufacture: either the surface treatment of the metal or a particular method of producing the alloy. My present assumption is that these special methods characterize the earlier period, since the patina is found on the wares with shapes known from the repertoire of Sasanian-style silver ware, e.g., Object 3.

Report by Lambertus van Zelst and Pieter Meyers of the Research Laboratory of The Metropolitan Museum of Art, 18 October 1973:

The elemental composition was determined by dispersive X-ray fluorescence spectrometry on solutions of 5 milligram samples dissolved in 1 milliliter 6N HCL and 3

per cent H₂O₂. The results are in the following table. Metal of this composition is known as bell metal. Although the group of objects is too small to be considered as true representations of the two types of high-tin bronzes (plain and decorated), it appears that there is no difference in composition between the plain (Objects 1–5) and the decorated (Objects 6–7). It seems that for all the objects a deliberate attempt was made by the metalworkers to achieve a constant tin content.

OBJECT	PER CENT	PER CENT	PER CENT
	Cu	Sn	Pb
1	76	21.9	0.4
2	80	22.9	0.4
3	80	21.6	0.5
4	81	23.6	0.3
5	77	22.1	0.6
6	82	22.6	0.5
7	81	21.6	≤0.7

ACCURACY:

Copper percentages	± 3% relative
Tin percentages	± 4% relative
Lead percentages	± 50% relative

The method of manufacture could be determined with the aid of X-ray radiographs. These radiographs, together with visual and microscopic examination, provide in general a reliable indication of whether an object of this type was cast, hammered out, or spun.

OBJECT 1. Boat-shaped bowl, 23.2 × 9.1, height 4-5 cm. (Figure 39). Clearly hammered; radiograph shows variations in density that could be hammer marks. Moreover, bowl is thinner in areas with maximum curvature. This is consistent with hammering, since in order to obtain its present shape, hammering would be required in these areas. Because of the oval shape, spinning on a lathe is ruled out.

OBJECT 2. Round bowl, diameter 13, height 5 cm. (Figure 40). Same evidence for hammering as Object 1; visible evidence of scraping on the outside.

OBJECT 3. Round dish, diameter 18.5, height 4 cm. (Figure 41). Same evidence for hammering as Object 1. Although no centering mark is visible, a lathe may have been used for polishing the outer surface.

OBJECT 4. Ewer (Anonymous Loan, L61.74.4), height 15 cm. (Figure 7). Radiograph shows no thickness variation as a function of diameter of body, a strong indication of casting. Moreover, the radiograph shows a horizontal ring of increased thickness in the middle of the body, where diameter is greatest. Since no evidence is visible of joining the two halves, the body was most likely cast in one piece in a two-piece mold. The inside of the neck shows traces of scraping and possibly hammering, probably to remove excess metal and correct deformations.

OBJECT 5. Jug, height 13 cm. (Figure 42). Radiographs show evidence of hammering: thickness of metal decreases with increasing diameter of body. Hammering marks are also visible.

OBJECT 6. Large bowl (Anonymous Gift, 1973.338.9), diameter 27.5, height 12 cm. Had this been cast, one would expect it to be thicker in areas of greatest curvature, and would expect also to find casting flaws or voids in the metal structure. However, radiographs show the metal to be thinner in the areas of greatest curvature, and no casting flaws or voids are to be seen. This evidence is consistent with the object's being extensively hammered. In addition, vaguely defined concentric rings in the X-ray radiographs may indicate raising courses or possibly scraping.

OBJECT 7. Bowl (Anonymous Gift, 1973.338.8), diameter 21.5, height 8.7 cm. Same evidence as for Object 6.

It is likely that some of these objects were initially cast in a shape approximately like the final product. However, the major part of the shaping (except for Object 4) was done by hammering. Because of the brittleness of this alloy at room temperature, hammering probably took place at elevated temperatures. The forging must have taken place at a dull red heat, followed by quenching. This process was confirmed by a metallographical study of cross sections obtained from Objects 1 and 3. The brittleness of the alloy at room temperature makes the use of spinning as a method of manufacture very unlikely.

(Note: Lambertus van Zelst and Pieter Meyers are grateful to Cyril S. Smith for his interest in this study and his valuable suggestions and advice.)

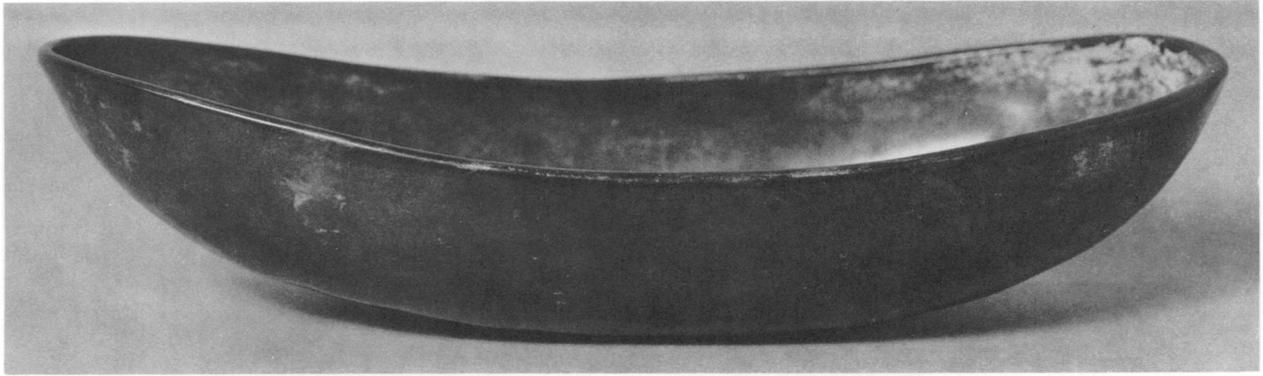


FIGURE 39
Boat-shaped bowl, The Metropolitan Museum of Art, Rogers Fund, 49.112.1



FIGURE 40
Round bowl, The Metropolitan Museum of Art, Rogers Fund, 49.112.2



FIGURE 41
Round dish, The Metropolitan Museum of Art, Rogers Fund, 58.101

FIGURE 42
Jug, The Metropolitan Museum of Art, Anonymous Gift, 1973.338.10

