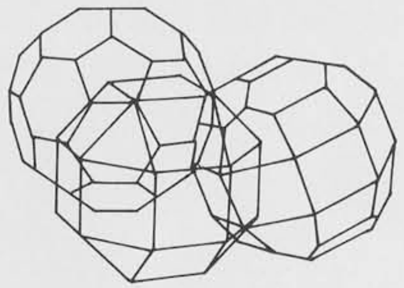


THE LAPIDARY ARTS IN ISLAM

An Underappreciated Tradition

MANUEL KEENE

ISLAMIC GEMSTONES AND GEMOLOGY

One can hardly think of jewelry without thinking of gemstones so strongly associated are they, both from the intrinsic and the historical point of view. Indeed, the use of ornamental stones for jewelry is far older than the use of metal. And one must assume that the lapidary industry as such is considerably older than the earliest use of worked *ornamental* stones.

By the beginning of the Islamic era, most of the great precious and semiprecious stones were in use in the regions which became part of the Islamic empire. This includes the diamond, which is mentioned by pre-Islamic poets in Arabia itself (Haschmi, 1935: 27, citing al-Bīrūnī). Diamonds in jewelry are also mentioned by a poet of the Umayyad period (7th-8th c. A.D. —Haschmi, 1935: 28). Indeed, there can be no doubt, despite his confusion on certain points, that it is to the diamond that Pliny refers (Book XXXVII, paragraph 55) when he says that it is the most precious of substances and that it was 'for long' known only to kings. The real question, however, is whether these were cut in the central Roman Empire or in the Fertile Crescent or, as seems a good possibility, imported ready-cut from India. For it seems that there is no evidence for the cutting of diamonds in the West until much later, whereas they were being cut in India before the 6th century A.D.: the *Ratnaparīksa*, or *Appreciation of Gems*, is a compilation of Indian tradition about precious stones, their varieties, qualities, sources, etc., apparently written as a technical treatise before the 6th century A.D. (Finot 1896: xxvii). In that compendium, one finds it expressly stated that the best form in which to have the diamond (already considered the supreme gem in India) is in its perfect natural octahedral crystal form, and *not as a cut stone*, with the clear implication that cutting them was a well-known practice. This is not to be wondered at overly, since India was *the* great source of diamonds throughout history until their discovery, first in Brazil (18th century), then in South Africa (19th century); and India has always been and remains home to one of the world's great lapidary industries. Still it is somewhat surprising to most to find Tavernier in the seventeenth century (Ball translation, vol. II: 56) specifically commenting upon the Indians' superiority over Europeans in understanding certain aspects of the nature of diamonds, manifested in the skilful cleavage of stones to retrieve the greatest yield from rough stones, whereas Europeans simply ground away great quantities of material to get the desired form.

Thus early Islam was the beneficiary on the one hand of a great ages-long practical tradition, probably at its most highly developed at that point in India, of working with these hard and beautiful minerals; and on the other, as in many other areas of endeavor, was the heir of the scientific achievements of the Classical Graeco-Roman civilization. What the Islamic civilization did with this heritage, particularly in the area of the science of mineralogy and gemology, is too little appreciated despite the fact that considerable European (especially German) scholarship on the subject is available which makes these achievements quite clear (see bibliography). For our purposes here, two examples will have to suffice as indicators of the understanding of and ability to work with hard stones in early Islam. Not uncharacteristically, both examples involve the previously mentioned Abuᶜl-Rayḥān al-Bīrūnī (born A.D. 973), the greatest scientist and scholar of the Islamic middle ages. On the one hand, al-Bīrūnī, in his *Book of Collections of Knowledge of Precious Stones*, written between 1041 and 1049 (as cited by Wiedemann 1911: 352), states that the 'people of Khurasan and Iraq' use the diamond only for drilling [and cutting] and poisoning. Thus we have evidence of the ability of

early Islamic lapidaries to cut any stone, including sapphire and ruby, the most commonly used gem varieties of corundum, the hardest stone after diamond. In fact, the same passage indicates diamond's usage as a gemstone (contradicting his own statement about its being used only for cutting, etc.), as he goes on to indicate that the same given weight of diamond costs ten times as much in one piece as in smaller pieces. This obviously would make no sense if the only use for diamond were lapidary, where only powder is used anyway. Furthermore, to erase any possible doubt, we find in another place in al-Bīrūnī's stone book (as cited by Haschmi, 1935: 13) that he writes of two 10th-century Iranian rulers who had rings set with large diamonds. Whether or not these diamonds were cut in the then Islamic realms, it is clear from the above that no *other stones* would have posed any technical problems. In fact, al-Bīrūnī says that the diamond is the 'precious stone which influences [cuts] the corundum.' This is doubly interesting as it is also an obvious recognition that the latter is the hardest stone next to the diamond (Wiedemann, *loc. cit.*).

In fact, as we shall presently see, there was in early Islam a surprisingly sophisticated understanding of the various families of gemstones and of methods of distinguishing them. The low state of popular appreciation of this fact, however, is perhaps most tellingly indicated by a passage from a recent, and in general highly laudable, work on the greatest extant collection of Islamic gemstones, the former crown jewels of Iran, kept in the Bank Melli in Tehran. In this work the authors (Meen and Tushingham 1968: 32) state, when discussing red spinels (or 'balas rubies,' the term ultimately deriving from the province of Badakhshan, now in northern Afghanistan, the great medieval source of this magnificent stone so much used in the Islamic world):

> From an early date there appears to have been recognition of a difference between true rubies and other red stones called balas rubies or spinels. As the distinction seems to have been based on slight differences of colour and perhaps of hardness, there was some confusion. Only in 1783 were ruby and spinel distinguished on chemical grounds. It is still easy to confuse cut rubies and red spinels; for certain identification, optical or specific gravity tests are necessary.

The simple fact of the matter is that apparatuses were developed by the Greeks (Wiedemann 1936: 532) for making specific gravity tests, embodying Archimedes' great solution to the celebrated 'problem of the crown' (Heath 1921: 92-97), a heritage not lost on Islamic scientists, who in this as in so many branches of knowledge, pushed forward significantly. In the specific case under consideration, they devoted particular energy and inventiveness to the identification of metals and jewels by means of specific weights, developing scales celebrated for their sophistication and accuracy (Wiedemann 1936: 531 and *passim*). The most important work of the extensive medieval Islamic literature of mineralogy, again that of al-Bīrūnī, includes an exhaustive treatment of the subject of stone differentiation through the use of specific gravity determination, including tables of various factors manifesting their specific weights (metals, foodstuffs, etc., are also listed). Among the factors given by al-Bīrūnī are the quantity (by weight) of water displaced by a given weight (in air) of the various stones and metals; the weight in water (suspended on a hydrostatic balance) of each, when the weight in air is thus and so; the weight in air of the various metals when their volume is equal to that of a given weight in gold; and the weight in air of the various stones when their volume is equal to a given weight of (blue) sapphire. Incidentally, it should be noted that throughout Islamic times, the terminology reflects the awareness that the stones we call 'ruby' and 'sapphire' are essentially the same mineral, both being called *yāqūt*, the former being qualified as red and the latter as blue; and that, for example, an altogether different term, *laᶜl*, was used to refer to the spinel 'ruby.'

The exhaustive thoroughness evidenced in al-Bīrūnī's treatment of the matter of specific weights is altogether typical of him, as he brought encyclopedic erudition and analytic originality to his treatments of most of the important branches of knowledge; and it will be immediately apparent that the first set of factors (that of the weight/volume comparisons between the stones and metals on the one hand and of water on the other) is sufficient for easy conversion to the modern mode of statement of specific weight, which is given in relation to water at a value of one. I have made these calculations from al-Bīrūnī's factors for certain stones, and a sample citation shows that his measurements were highly accurate and quite sufficient for differentiation between look-alikes. A few examples should suffice to demonstrate this fact unequivocally. Al-Bīrūnī, as cited by Abu ᶜl-Faẓl ᶜAllāmī (Blochmann 1873:43), states that 100 *mithqāls* of blue sapphire displaces 25 *mithqāls*, 1 *dang* and 2 *tassujes* of water (1 *mithqāl* = 6 *dangs* and 1 *dang* = 4 *tassujes*), which gives a specific weight in relation to water (the latter being taken at a value of 1.00) of 3.97. By way of comparison, a standard reference work in English gives for corundum a specific weight of 3.90 to 4.00 (Webster 1962: 713). For 100 *mithqāl* of spinel (*laᶜl*, translated by Blochmann simply as 'ruby,' whereas for the corundum ruby and the sapphire he retains the original nomenclature of red and blue *yāqūt*), al-Bīrūnī gives a weight of water displaced of 27 *mithqāls*, 5 *dang* and 2 *tassujes*, which converts to a specific weight for spinel of 3.59, whereas Webster (*loc. cit.*) gives 3.58 to 3.61; and for emerald, the factors are, al-Bīrūnī, 2.75, and Webster (p. 710), a series of factors for emerald from different sources ranging from 2.69 to 2.75 (no factor is given for Egyptian emerald, the likely source of that used by al-Bīrūnī). In light of the foregoing, considerable revision of popular notions regarding the history of gem identification seems in order.

As for the fact that 'there was some confusion' in the usage of stone names, we need only say that in medieval times as in modern, it matters very much who is speaking when we want to know how appropriate the terminology used to refer to precious stones. That is, it is quite obvious that the ordinary layman who has no particular experience with precious stones, whether living in 10th-century Nishapur, 16th-century Agra or 20th-century New York, cannot distinguish between red spinel, red or pink tourmaline, the lighter shades of red garnet and the stone properly called 'ruby' in modern English, the red variety of corundum. The same might be said about yellow beryl, yellow sapphire, yellow quartz and yellow topaz; and this principle holds for the stones of the other major colors.

All this said, the real point to be made here is that there were in Islamic society those capable of such precise distinctions, as we have seen. Furthermore, this knowledge was not confined to a few highly specialized or theoretical scientists. A telling confirmation of this latter fact is the above-cited quotation of al-Bīrūnī's table by Abuᶜl-Faẓl in his great work on Akbar's India, coming as it does in a special section called "On Specific Gravity" and conjoined with his whole treatment of the imperial coinage and treasuries. Thus it is quite clear that where important differences of price existed between look-alike stones, a determination would have been (or at least could have been) made. And such a situation probably also existed at earlier Islamic courts, as well as in commercial dealings in the most expensive stones where there was any doubt about the identity of the stone.

Thus when Akbar's grandson Jahāngīr speaks in his *Memoirs* (Rogers and Beveridge 1909: 317) of an extraordinary yellow sapphire, we should give him the preponderance of our credence, and strongly question his translators' 'correction' to the effect that what is really meant is topaz. A further suggestion of this probability is furnished by the presence in the Iranian National Treasure of several notable yellow sapphires and the apparent absence of topazes (see Meen and Tushingham 1968: 90-91). This is particularly pertinent, since we know that much of the Iranian Treasure was carried off from the Mughal Treasury by the Persian ruler Nadir Shah in 1739 (Meen and Tushingham 1968: 10-11).

STONE PREFERENCES: HIGHEST LEVEL

In Islam as in all civilizations, we find several levels in the use of ornamental stones which correspond to the situation and the wealth of the owner. The ultimate details of this manifestation are of course conditioned by the availability of materials; but the Islamic empire (and subsequently the Islamic civilization) being what it was, there was an enormous trade in all types of commodities, including precious and semi-precious stones. For example, the best-known Abbasid Caliph in the West, Hārūn al-Rashīd (who ruled from A.D. 786 to 809 and was a considerable connoisseur of precious stones), sent the jeweler Ṣabāḥ (who happened to be the grandfather of the great scientist and philosopher al-Kindī) to Ceylon to buy precious stones. These were certainly the great precious stones as we know them, not only because it is for an enormous variety and quantity of such that Sri Lanka is still legendary today, but also because of ample contemporary literary testimony concerning the stones held in highest esteem. For an example of the latter, the *Book of Stones* by Pseudo-Aristotle (actually an Arabic work of approximately al-Rashīd's time—Ruska 1912) says that the pearl, the ruby and the emerald 'and their kind' are preferred by people over other

precious stones; and al-Bīrūnī in his stone book gives the exact same three as *the* outstanding gems (Wiedemann 1911: 348 and *loc. cit.*, footnote 1).

On the other hand, Jahāngīr (Rogers and Beveridge I 1909: 298) goes out of his way to mention the quality of the Yemeni *carnelian* in rings sent him by Shāh ᶜAbbās of Iran. This strikes us as doubly curious since carnelian is a massive and at best only semi-transparent and semi-precious stone, and since India itself is the great source of the finest carnelian on the market today, coming from stream-borne pebbles presumably exploited since ancient times. Furthermore, and despite numerous other Islamic literary references early and late to the surpassing quality of Yemeni carnelian, the latter does not seem to be on the market today.

For wearing the best stones, there seems to have been a certain timeless style in which stones and pearls of fabulous quality and size predominated, the metallic elements generally occupying a very subservient rôle. These stones were typically bored and strung into necklaces, bracelets, turban festoons, etc., and were passed on in one way or another, restrung, sometimes recut, and reused from age to age. Not only literary sources from earliest to latest times but inscriptions of the 15th, 16th, 17th, 18th and 19th centuries on many of the stones themselves document the phenomenon of reuse in the same form. And we may be quite sure that a great number of the stones in a collection like that of the Iranian National Treasure and that of the Topkapi Treasury in Istanbul saw use at many and often much earlier courts (see speculations on two notable cases, one of a 500-carat red spinel in the Bank Melli, Tehran, and the other of sections of a huge emerald crystal in the Topkapi—Jenkins and Keene, forthcoming).

As we have indicated above, the premier stones in Islam differed little from the premier stones of today, or for that matter, of India in pre-Islamic times, where already in the *Ratnapariksa* (Finot 1896: 171) we find the canonization of the traditional 'nine gems' still reigning in that country today; they are diamond, ruby, chrysoberyl cat's eye, 'hyacinth' (zircon?), topaz, sapphire, pearl, coral and emerald. The notable exception for early Islam is apparently the diamond—although, as we have seen, it was known and used in royal jewelry it would seem that it did not come into great prominence until later centuries, particularly in Mughal (16th-19th century) India, the Ottoman Empire (16th-20th century) and 18th and 19th century Iran. Aside from the diamond, however, and leaving open the possibility that we draw a false conclusion concerning its prevalence in medieval Islamic times, the obvious 'big three' were: corundum (including not only the varieties of shades of red and blue, but also the other colors such as green, yellow, violet); pearls (which, when of fine quality, beautiful form and large size, were, perhaps surprisingly, on a par with rubies in cost); and emerald. Another very important stone was the red spinel, the so-called balas ruby, discussed above, which came in truly legendary size and quality, as the 500-carat example which has survived in the Iranian National Treasure shows. Another of 414 carats is in the Kremlin Museum, one of 361 carats in the British Crown Jewels (the 'Timur Ruby') and another, of 270 carats, in the Iranian Treasury (see, for the above-mentioned Iranian Treasury stones, as well as citation of the others, Meen and Tushingham 1968: 67). It is clear that these are not freaks when we see the 'necklace' of twenty red gem spinels (Meen and Tushingham 1968: 66) of which three are estimated at between 175 and 200 carats each, with the overall *average* for the twenty being over 100 carats each! One must assume that the huge 'rubies' encountered in historical literature are spinels, and that when they are referred to as 'red *yāqūt*' this is merely a mistake on the part of the chronicler. For example, Hārūn al-Rashīd is supposed to have had a 'red *yāqūt*' of 14½ *mithqāls* weight (Wiedemann 1911: 346), which comes to over 300 carats, whereas no gem quality *corundum* ruby of anything distantly approaching this size is known ever to have existed.

STONE USAGES: NON-NOBLE

Turning to what we might call popular jewelry, that which might have been patronized by the middle to upper middle classes, we have a real body of extant pieces from which to draw conclusions, but no literary and relatively little pictorial documentation. In fact, the vast preponderance of all the extant Islamic jewelry falls into this category, and constitutes practically the sum total of our knowledge of the historical evolution of styles in settings, as well as a very large part of our detailed and concrete knowledge about how the stones were combined and what stones were used in most historical periods.

1
Sheet-constructed hollow gold bracelet, decorated with granulation, engraving and repoussé, set with pink sapphire (right), garnet (left), and turquoise-glazed white quartz (center). Greatest dimension 3 in. (76 mm.). Iran, probably 12th century. Metropolitan Museum of Art acc. no. 59.84, purchase, 1959, Dick Fund.

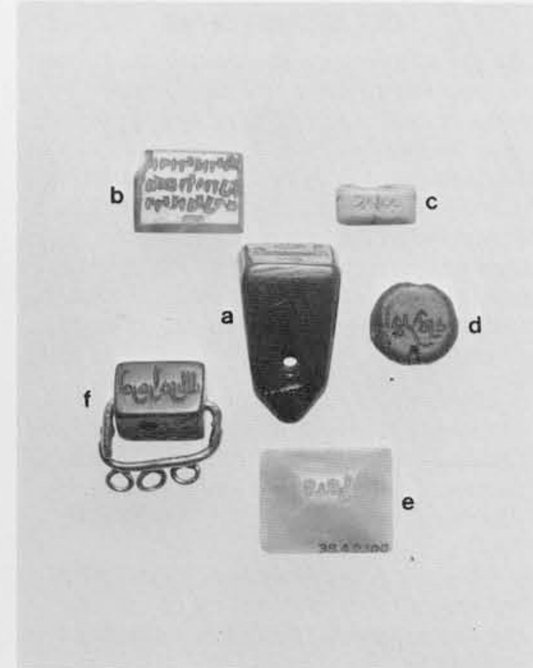
While the jewelry which features extraordinary stones and pearls generally subordinates the individual stones, whatever their value, to the overall decorative effect, this is for a variety of reasons even more obvious in the case of what for the sake of convenience we may call 'bourgeois' jewelry. Here, the stones typically occupied a relatively less important position in the whole, with a greater importance given to the setting and the interplay between stones and setting. Since large numbers of the settings survive, sometimes with the original stones still in place, we can see exactly how the elements were orchestrated. And what we see is an overwhelming subordination of the individual elements, particularly of considerations of their intrinsic value, to the total impact of color and design.

First, in much of the finest extant medieval Islamic jewelry the goldwork seems to have predominated over stones. But where stones do form an important part of the overall effect in Islamic jewelry, it is always, still, the *overall* effect which is the over-riding consideration. This is as true of late Indian or Moroccan as of medieval Persian or Egyptian pieces. A Persian gold bracelet (MMA acc. no. 59.84) provides a type illustration of most of these points: the whole is hollow-constructed of thin sheet gold, ornamented by fine repoussé (heads at the ends of the shank near the clasp), granulation, and engraving (the latter being emphasized by the addition of a black substance, probably bitumen). All these elements combine animal (heads in repoussé), floral and epigraphic (the engraved inscription) and purely abstract ornamentation (the granulation).

Second, most interesting conclusions are prompted by what we see in the types and arrangement of the (extant) stones used. In the flanking positions we find (left) garnet and (right) pink sapphire, whereas in the dominant central position (where there was obviously a felt need for a 'turquoise') we find a turquoise-glazed milk-white quartz! Certainly a real turquoise would have been used had one of sufficient size and quality been available (in a quite similar piece from the same workshop, now in the Boston Museum of Fine Arts, a turquoise *sealstone* is used in the same position). But the point to emphasize is that there was no overwhelming objection to the use of a 'counterfeit' stone *in the dominant position* in such a fine piece, even when such valuable stones as pink sapphire (or rose-colored ruby) was used as well. Obviously color was *the* consideration.

Although we have relatively little

2
Sheet- and wire-constructed gold pendant, decorated with granulation, engraving and (on reverse only) applied twisted wire, set (on obverse) with garnets, turquoise and other precious stones, probably pink tourmalines. Height 3-1/8 in. (79.5 mm.), width 1-7/8 in. (47.5 mm.). Iran, 12th century. Metropolitan Museum of Art acc. no. 1977.9, purchase, 1977, Richard Perkins Gift.



3a-f
Group of sealstones in the Metropolitan Museum of Art:
a Center, pendant, jet. 15/32 x 13/32 x 13/16 in. (12 x 10.5 x 27 mm.). Acc. no. 39.40.141.
b Upper left, ringstone, carnelian, inscribed in Hebrew. 1/2 x 13/32 x 3/32 in. (12.5 x 10.5 x 2.5 mm.). Acc. no. 40.170.158.
c Upper right, ringstone, turquoise. 3/8 x 3/16 x 3/32 in. (9.5 x 4.5 x 2.5 mm.). Acc. no. 48.101.68.
d Right center, flat circular bead, lapis lazuli. 13/32 x 1/8 in. (10.5 x 3.25 mm.). Acc. no. 38.40.98.
e Bottom, ringstone, carnelian. 19/32 x 1/2 x 3/16 in. (15 x 12.5 x 4.5 mm.) Acc. no. 38.40.100.
f Lower left, pierced and pendant-mounted square prism, hematite (gold mount). Stone dimensions 13/32 x 9/32 x 9/32 in. (10.5 x 7 x 7 mm.). Acc. no. 1975.118.
All Iran, 10th-11th century. **a-e** Excavations of the Metropolitan Museum of Art at Nishapur, 1935-39 and 1947, Rogers Fund. **f** purchase, 1975, Rogers Fund.

medieval Islamic jewelry with the original stones in place from anywhere other than Iran, the latter material at least gives the impression that this pink/red/violet range of colors conjoined with turquoise enjoyed considerable popularity, as would seem indicated by the just-discussed bracelet as well as the gold pendant.

Another large body of datable stones, despite their being most often devoid of their original settings, is that of sealstones, a major and ubiquitous form in the Islamic world. The overwhelming favorite was carnelian, reputed to have the practical advantage of not sticking to the wax. Practically every other stone was at times used for this purpose, and some others which enjoyed considerable popularity, aside from the chalcedonies, include jasper, hematite and rock crystal.

STONE USAGES: LOWER LEVELS

As in most other societies, there was in Islam a whole world of stones used for ornamental purposes, ranging downward from the chalcedonies and jaspers through a variety of colorful but soft stones. These also exhibit a wide range of sophistication and control in lapidary technique and stand outside the scope of the present paper, despite the fact that in themselves they constitute an extremely interesting subject of study.

CUT STONE FORMS

As for mineralogy and gemology, it has been popular to deny any significant developments in the applied art of cutting stones in medieval times, particularly in the Islamic world. A typical statement in this regard, and again by what should be a well-informed authority in the matter (Meen and Tushingham 1968: 66, where the authors are discussing the previously mentioned string of large spinel 'rubies'), follows:

> Until the end of the eighteenth century, eastern lapidaries rarely faceted the precious stones on which they worked. The string of red spinels illustrates a technique they frequently used.
>
> The rough gems were polished without any attempt at faceting or making the shape symmetrical. Each was then drilled.

However, such a well-known source as Tavernier gives quite specific testimony to the habitual practice of faceting diamonds (1678 London ed., *Travels in India*, Bk. II, pp. 134 and 142). While this testimony is to the effect that faceting was done to hide flaws in the stone, rather than to bring out the maximum light play, it should at least have prompted another look at the evidence. One obvious example would be the miniature paintings produced in 16th and 17th century India, where representations abound of colored stones which are not simply covered over with small facets in the manner described by Tavernier, but are cut quite symmetrically in what might today be called 'emerald cut,' although a number of these are in the form of regular polygons (hexagons and octagons). The likelihood that all these stones were cut in Europe is rather remote.

In addition, Meen and Tushingham's above-quoted statement is discredited by concrete artifacts. The most remarkable of these, and those on which this presentation will focus, are from the earlier period and are of Iranian origin. While it may be true that the Islamic lapidary often, like his ancient counterpart, was loath to reduce the size of a precious stone more than necessary to make its beautiful color accessible, it is a mistake to look only at those highly valuable stones when forming an appraisal of Islamic lapidary achievements.

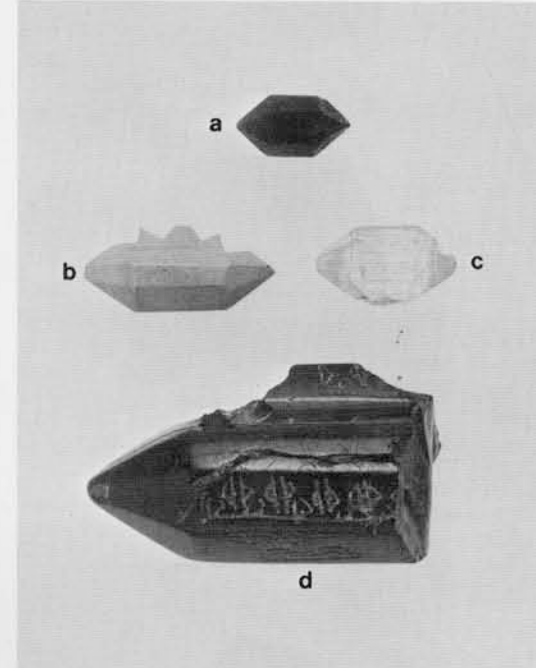
As we have seen through available literary accounts (under the heading "Islamic Gemstones and Gemology"), the medieval Islamic lapidary had many abrasives available to him, including not only (the presumed) quartz, garnet and corundum, but also diamond. Also, the enormous body of datable wheel-cut vessels, particularly of glass and rock crystal, demonstrates very clearly the efficient use of these abrasives, of control as well as high artistic sensibility in their use (Lamm 1929-30, Oliver 1961, etc.). For present purposes, the most significant aspect of the cutting of this truly enormous body of material is the obvious high degree of control in the application of the cutting wheel to the object being cut, including frequently a precision of polygonal configuration which often suggests some sort of guide to radial division. The most pertinent examples in this connection are the pentagonal, hexagonal and heptagonal necks on glass and rock crystal bottles. One must conclude that this cutting was done by craftsmen who, by virtue of long practice, were able to achieve what to the interested but unpracticed seems impossible.

A related phenomenon is the early Islamic pendant form which copies that of the natural doubly terminated quartz crystal in a variety of materials. Although the natural quartz crystal is always a hexagonal prism terminating in a hexagonal pyramid, the man-made versions are as often octagonal in section.

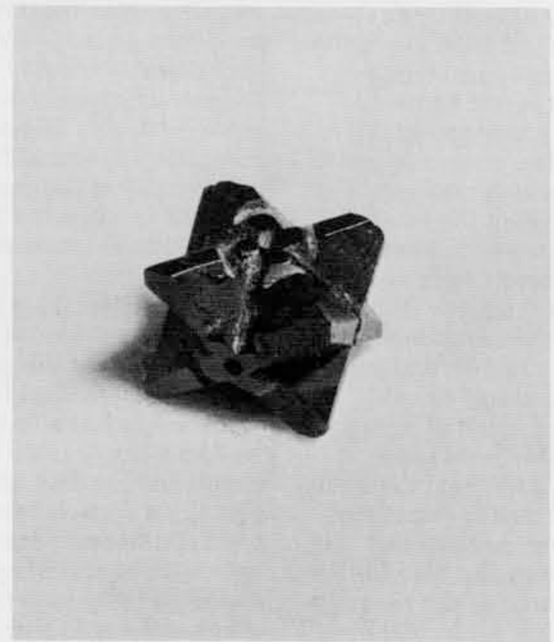
The most remarkable achievements in polygonal and polyhedral faceting are to be met in the form of stone beads, particularly those from the Metropolitan Museum's excavations at Nishapur in eastern Iran. Among these we may single out two for consideration.

The first is a jet bead 9.5 mm. square, in the form of Kepler's 'stella octangula' or two symmetrically interpenetrated tetrahedra. Another jet example of this form comes from the same excavations, strung with 25 other jet beads (MMA acc. no. 40.170.697), but this latter piece cannot compare with the former in perfection of form. The degree of perfection embodied in the better of the two insures the certainty that it was indeed interpenetrated tetrahedra which the cutter had in mind, despite the fact that in practice this form can be (and in the present case almost certainly was) made by appropriately notching the edges of a cube. Thus the feasibility of freehand cutting is assured, although a good eye and hand are necessary for the freehand production of even a nearly regular cube.

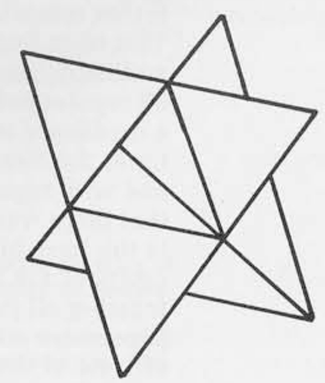
4
Wheel-cut glass bottle. Height 2-15/16 in. (74.5 mm.), width 15/16 in. (24 mm.). Islamic, 9th-10th century. Metropolitan Museum of Art Acc. no. 1972.10.1, purchase, 1972, Fletcher Fund.



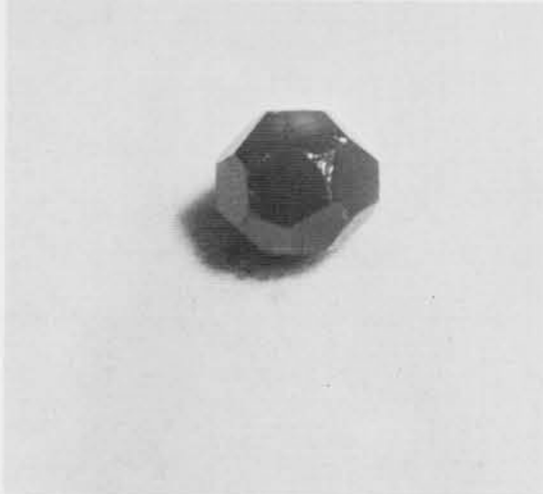
5a-d
Group of three pendants and a natural quartz crystal in the Metropolitan Museum of Art:
a Top, natural doubly terminated quartz crystal. Length 9/16 in. (14.5 mm.). Acc. no. 96.9.470c, purchase, 1896, by subscription.
b Left, pendant (steatite?). 7/8 x 3/8 x 11/32 in. (22 x 9.5 x 8.5 mm.). Acc. no. 48.101.240.
c Right, pendant, rock crystal. 5/8 x 3/8 x 5/16 in. (16 x 9.5 x 8 mm.). Acc. no. 48.101.200.
d Bottom, pendant, (fragmentary), jet. 1-5/8 x 7/8 x 13/16 in. (41 x 22 x 27 mm.). Acc. no. 40.170.604.
b, c, d Iran, 9th-10th century. Excavations of the Metropolitan Museum of Art at Nishapur, 1935-39 and 1947, Rogers Fund.



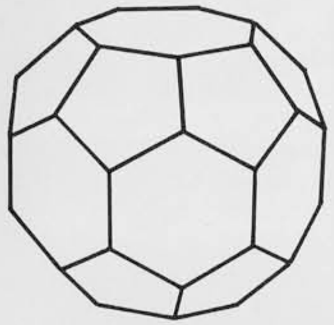
6
Jet bead in the form of two symmetrically interpenetrated tetrahedra (see Fig. 7). 3.8 in. (9.5 mm.) cubed. Metropolitan Museum of Art acc. no. 48.101.247. Excavations of the Metropolitan Museum of Art at Nishapur, 1935-39 and 1947, Rogers Fund.



7
Perspective drawing of two symmetrically interpenetrated tetrahedra, Kepler's 'stella octangula,' embodied in jet bead pictured in Fig. 6.



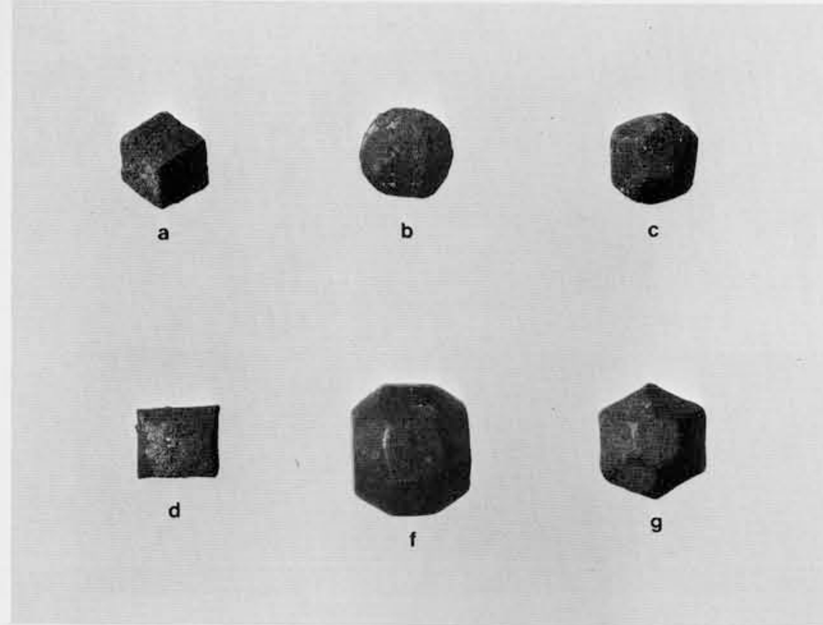
8a-c
Carnelian bead with 23 faces (see Fig. 9). Maximum dimensions 5/16 x 23/64 in. (8 x 9 mm.). Iran, 10th-11th century. Metropolitan Museum of Art acc. no. 48.101.82. Excavations of the Metropolitan Museum of Art at Nishapur, 1935-39 and 1947, Rogers Fund.



9
Perspective drawing of model of 23-faced carnelian bead pictured in Fig. 8.

Our second example from among the Nishapur beads, however, cannot be derived from a cube nor indeed by any reasonably feasible method from any other figure. The object is a dark carnelian bead 8 x 9 mm., which has 23 faces: 14 pentagonal, 7 hexagonal and 2 heptagonal, all rather remarkably regular, given the scale. This is, in fact, a form which mathematically cannot exist, when the faces are all regular polygons. However, I have made a cardboard model, approximately six times the dimensions of the piece itself and with regular faces, the result being that there was only the slightest distortion, in the form of a slight 'dishing' or concavity of the faces, when one had brought together all the edges. This bead is an impressive artifact, not only from the point of view of the technical means (whether manual or to some degree mechanical) necessary for its execution, but also for the sophistication (particularly on the part of a cutter of carnelian beads!) evidenced by the awareness that such a form could be made. And while this example strikes us as perhaps the most remarkable, it is by no means an isolated case of this kind of sophistication, but is rather part of a very considerable phenomenon (not to say school) in early Islamic art of the use of complex polyhedral forms as art imagery, particularly in the centuries from roughly the 10th through the 12th or 13th, and apparently at its most sophisticated in Iran.

The material from the Nishapur excavations provides us with our best cross-section of this phenomenon, with complex polyhedral forms in not only the stone beads but also in bronze weights, as well as a remarkable though apparently simple bronze dish, the form of which is actually a section from the surface of a truncated icosahedron. Not from the excavations at Nishapur, but of the period and reportedly (and believably) from the site, are the gold earrings with elements of



10a-f
Group of six bronze coin weights:

a Top left, cubic (6 faces). Now in Tehran.

b Top center, 34 faces (see Figs. 11, 12, 13, 14). 9/16 in. (14 mm.) cubed. Metropolitan Museum of Art acc. no. 40.170.282.

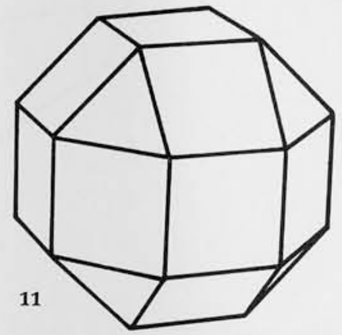
c Top right, pentagonal dodecahedron (12 faces —see Fig. 15). Now in Tehran.

d Lower left, tabular (6 faces). Now in Tehran.

e Lower center, structure uncertain, but 'girdle' is octagonal. Now in Tehran.

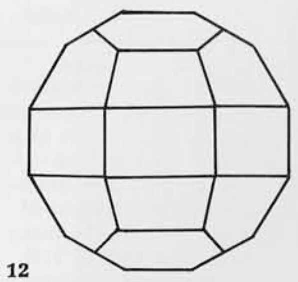
f Lower right, truncated hexagonal bi-pyramid (14 faces). Height 23/32 in. (18.5 mm.), diameter 13/16 in. (20.5 mm.). Metropolitan Museum of Art acc. no. 40.170.281.

All Iran, 10th-11th century, Excavations of the Metropolitan Museum of Art at Nishapur, 1935-39 and 1947, Rogers Fund.

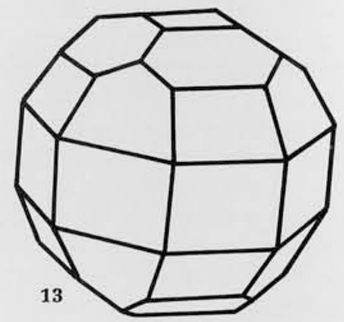


11

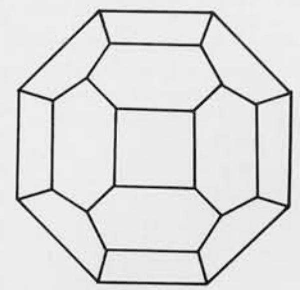
11
Perspective drawing of the small rhombicuboctahedron, one of the 'Archimedean' semi-regular solids (26 faces —see Figs. 12, 13, 14 for form probably derived from this).



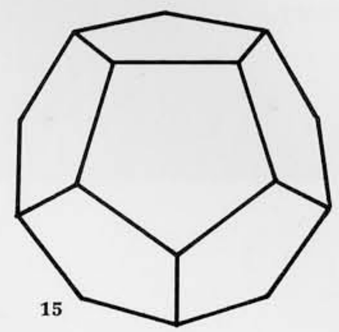
12



13



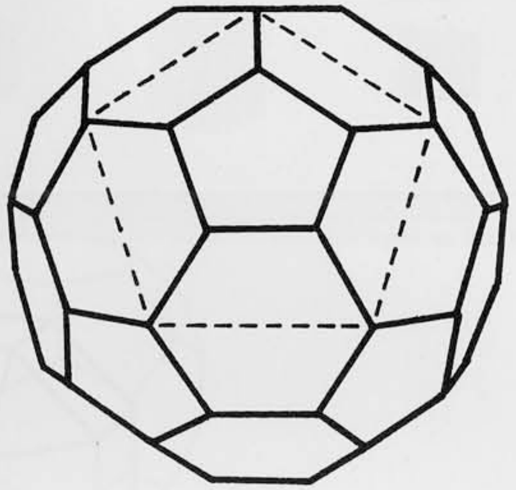
12, 13, 14
Three different perspective views of the structure of the bronze weight 40.170.282 (Fig. 10b). See Fig. 11 for probable inspiration).



15

15
Perspective drawing of the pentagonal dodecahedron, one of the 'Platonic' regular solids (12 faces—see Fig. 10c).

16
Cast bronze dish in the form of a section from the surface of a truncated icosahedron (see Fig. 17). Height, 3/4 in. (19 mm.), width, with handle, 4-3/4 in. (120 mm.). Iran, 10th-11th century. Metropolitan Museum of Art acc. no. 37.40.30. Excavations of the Metropolitan Museum of Art at Nishapur, 1935-39 and 1947, Rogers Fund.



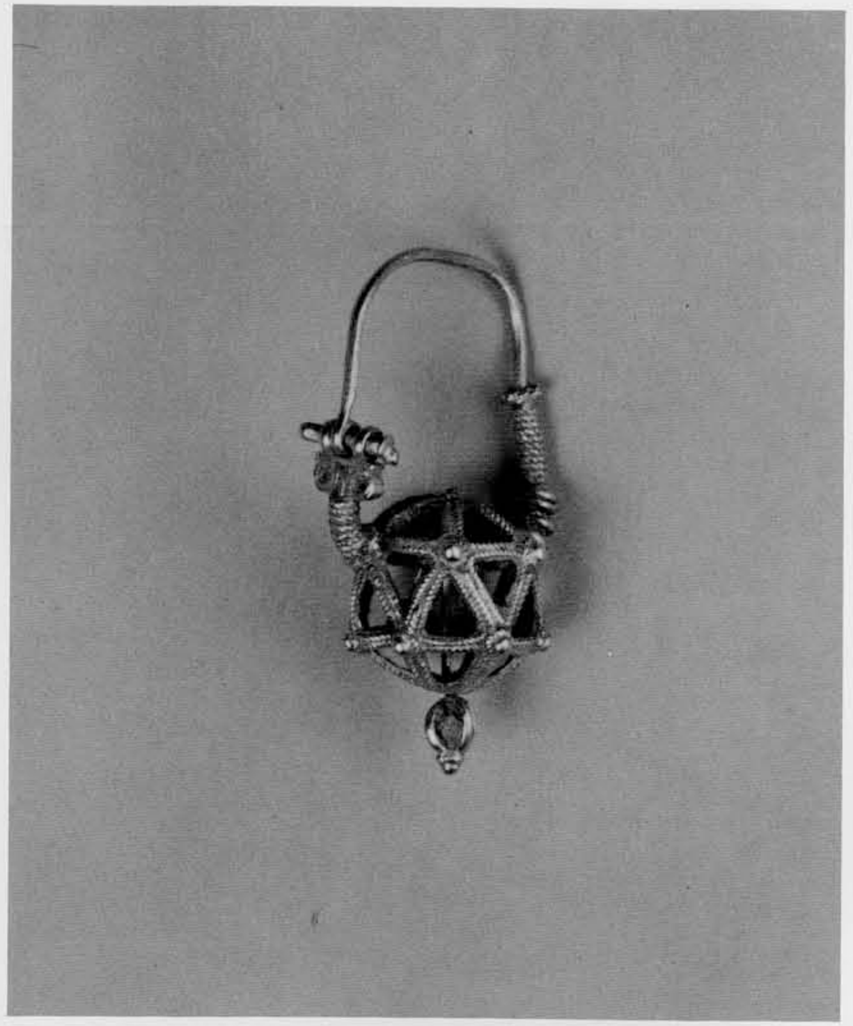
17
Perspective drawing of the truncated icosahedron, one of the 'Archimedean' semiregular solids (32 faces), broken line showing section used as structure of bronze dish 37.40.30 illustrated in Fig. 16.

dodecahedral and icosahedral form.

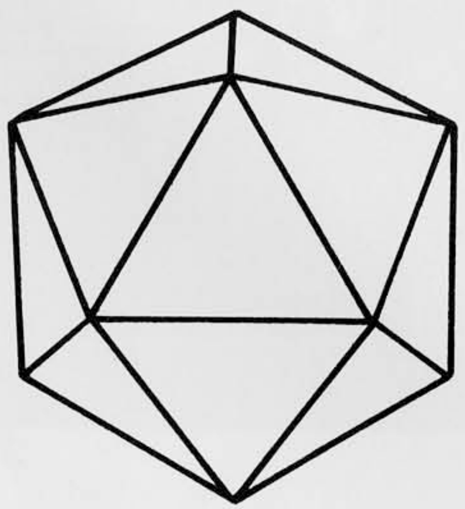
Aside from the truly polyhedral (regular, semiregular and quasiregular) forms, Islamic precious and semiprecious stone objects, contrary to popular conception, are highly characterized by sophisticated and controlled cutting, including various types of faceting. The faceting of the later period, particularly in India, has been dealt with above; but what we can here demonstrate for the first time is that *faceting of set stones* (in the major shape-altering sense in which we think of it) was being practised systematically, in Iran at least, specifically in Nishapur if not in other centers, in the 10th and/or the 11th century.

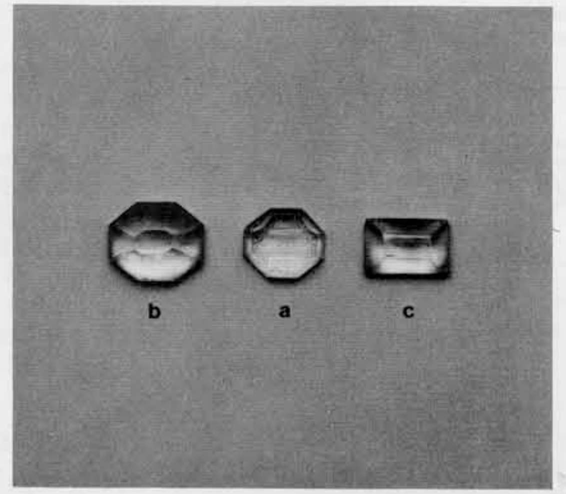
18
Pair of hollow sheet- and wire-constructed gold earrings, decorated with applied wire, granulation and hemispherical hollow bosses, each larger hollow element spherical, but with decoration creating the effect of a pentagonal dodecahedron (see line drawing Fig. 15). Height of each 1-3/8 in. (35 mm.). Iran, first half of 11th century. Metropolitan Museum of Art acc. no. 1979.7.3 a, b, purchase, 1979, Richard S. Perkins Gift, Rogers Fund, Louis E. and Theresa S. Seley Purchase Fund for Islamic Art, Norbert Schimmel, Jack A. Josephson, and Edward Ablat Gifts.

19
Sheet- and wire-constructed gold earring with applied twisted wire and shot, the large element actually a pierced sheet-constructed sphere, the applied wire, shot and piercing creating the effect of an icosahedron (see Fig. 20). Height 1-1/4 in. (32 mm.). Iran, first half 11th century. Metropolitan Museum of Art acc. no. 1979.96, purchase, 1979, Norbert Schimmel, in appreciation of Richard Ettinghausen's curatorship.



20
Perspective drawing of the icosahedron, one of the 'Platonic' regular solids (20 faces—see Fig. 19).





21a, b, c
Rock crystal ring sealstone (a) flanked by two pale amethyst ringstones in the Metropolitan Museum of Art:

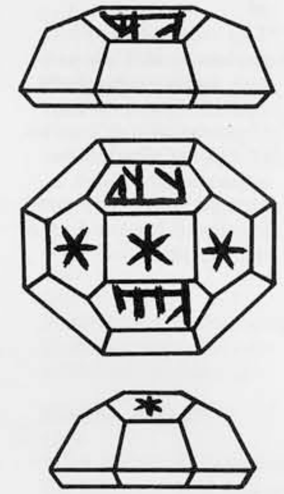
a Center, rock crystal. 7/16 x 3/8 x 3/16 in. (11 x 9.5 x 4.5 mm.). Acc. no. 1980.231. Gift of Mr. and Mrs. Habib Anavian, 1980. (See Fig. 22.)

b Left, amethyst. 1/2 x 7/16 x 9/32 in. (12.5 x 11 x 7 mm.). Acc. no. 48.101.62a.

c Right, amethyst. 7/16 x 9/32 x 3/16 in. (11 x 7 x 4.5 mm.). Acc. no. 48.101.62b.

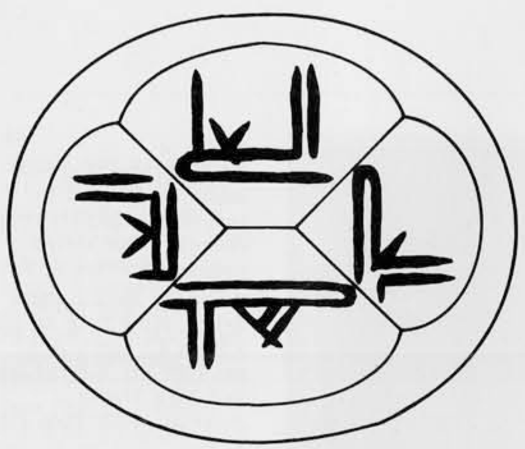
b, c Excavations of the Metropolitan Museum of Art at Nishapur, 1935-39 and 1947, Rogers Fund.

All Iran, probably 10th century (possibly 11th century).



22
Line drawings giving three views of the rock crystal sealstone 1980.231 (Fig. 21a). Top view reversed for reading of inscription. (See Fig. 21a as well as Figs. 11, 12, 13, 14.)

Two pale amethyst ringstones from the Nishapur excavations but without a dating context, had long intrigued me and suggested a relationship with the other polyhedral and faceted material from these excavations, but these suspicions were difficult to prove until the discovery of the rock crystal sealstone shown with the two amethysts. The analogies of shape between the sealstone and particularly the larger amethyst on the one hand, and the firm spatio-temporal fix provided by its inscriptional style on the other, tied together the whole group. The additional fact that the shape of the smaller amethyst relates closely to any number of other sealstones (including several from the Nishapur excavations) with the same inscriptional style as that seen on the rock crystal stone further strengthens the attribution of these pieces to the 10th-11th century. In fact, the very close similarity of form between the rock crystal sealstone and one of the bronze coin weights from Nishapur (MMA acc. no. 40.170.282) (both being similar modifications of the [small] rhombicuboctahedron) makes it seem highly likely, especially when considered with the inscriptional style and the shape analogies with the amethyst, that this remarkable little stone was cut in Nishapur.



23
Top view of sapphire sealstone in 11th century book cover from Spain, Metropolitan Museum of Art acc. no. 17.190.134. Sealstone, approximately 3/8 x 7/16 in. (9.5 x 11.5 mm.). Reversed for reading of inscription.

Further evidence for this kind of faceting in early Islam is a sapphire sealstone in an 11th century Spanish book cover (from the Cathedral of Jaca, now in the Metropolitan Museum, acc. no. 17.190.134), where it was obviously being re-used, since it is beautifully inscribed in Arabic with four of the ninety-nine Muslim 'Beautiful Names' of God. Whether this stone was cut in Spain or somewhere to the east, the inscriptional style is analogous with that on Persian sealstones, even to having the small asterisk-like device found on the rock crystal stone in question; and the shape also is analogous with that of the rock crystal one, being as it were a simpler version in which the top of an elliptical cabochon has been reduced to an elongated rectangular pyramid.

CUT STONE FORMS: SUMMARY

While taking cognizance of the fact that most stones (particularly of the more precious varieties) used in Islamic jewelry, as in most ancient and medieval European jewelry, are cut in such a way as to preserve as much as possible of the beautiful and rare material, it has seemed important to devote the above somewhat detailed discussion to the establishment of the fact that there was in Islam from the early centuries a very highly developed tradition of faceting, including the production of some uniquely complex forms. And whatever the technical means employed (beyond the necessity for a flat lap, whether vertical or horizontal), the evidence is overwhelming that 'eastern' lapidaries did regularly (pun intended) cut the 'stones on which they worked' into complex and sophisticated shapes, albeit primarily for the interest value of the form itself rather than for the sake of maximum optical brilliance, the latter being the real achievement of the European lapidary.

Manuel Keene received a B.A. in Art from the Arkansas Polytechnic College in 1963, an M.A. in Painting from Kansas State University in 1966, and in 1968 a Full Fellowship in Islamic Art from the American University in Cairo, which he held until 1971 when he was awarded an M.A. in Islamic Art History by that institution. Since 1972 he has been a member of the curatorial staff of the Department of Islamic Art at the Metropolitan Museum of Art, New York. Mr. Keene has been a serious artist in painting since 1959, ceramics since 1964, sculpture since 1965, and jewelry since 1974. While at the Metropolitan he has pursued his study of jewelry art, of silversmithing and of stone cutting.

BIBLIOGRAPHY

Prologue

The literature on Islamic mineralogy is listed in the *Index Islamicus* (Pearson 1958, 1962, 1967, 1972 and 1977). Although obviously a very important part of the Islamic lapidary story, the hardstone vessel industry, except to demonstrate particular points, is outside the scope of this paper. The interested reader will find an extensive literature concerning the early Islamic rock crystal *corpus*, approachable through the Creswell *Bibliography* and the *Index* cited above. Appearing too late for inclusion in Creswell's "Supplement" but absent as well from the 1971-1975 *Index* "Supplement" is probably the best work to date on the origins and features of Islamic (Persian and Indian) jades (Skelton 1972). Speculations on the implications of a 9th-10th century nephrite belt fitting from the Nishapur excavations will be found in the forthcoming (1981) catalog of the Islamic jewelry in the Metropolitan Museum of Art, in the section on early Islamic jewelry by the present author.

Works Cited

Blochmann, H.
1873
The Áin i Akbarí by Abul Fazl 'Allámí. vol. I. Calcutta: Baptist Mission Press.

Creswell, K. A. C.
1961 and 1973
A Bibliography of the Architecture, Arts and Crafts of Islam to 1st Jan. 1960 and *Supplement Jan. 1960 to Jan. 1972.* Cairo: The University at Cairo Press.

Finot, Louis
1896
Les lapidaires indiens. Paris.

Haschmi, Mohammed Jahia
1935
Die Quellen des Steinbuches des Bērūnī. Bonn.

Heath, Sir Thomas
1921
A History of Greek Mathematics vol. II. Oxford: Clarendon Press.

Jenkins, Marilyn, and Manuel Keene
Forthcoming
"Djawhar" (="Jewel"–in English), *The Encyclopaedia of Islam* 2nd ed.

Lamm, Carl Johan
1929 and 1930
Mittelalterliche Gläser und Steinschnittarbeiten aus dem Nahen Osten. Berlin: Verlag Dietrich Reimer/Ernst Vohsen.

Meen, V. B., and A. D. Tushingham
1968
Crown Jewels of Iran Toronto and Buffalo: University of Toronto Press.

Oliver, Prudence
1961
"Islamic Relief Cut Glass: a suggested chronology," *Journal of Glass Studies* III: 9-29.

Pearson, J. D.
1958-1977
1958 *Index Islamicus 1906-1955.* Cambridge, England: W. Heffer and Sons Ltd.:: 1962 *Supplement 1956-1960.* Cambridge: W. Heffer and Sons Ltd.:: 1967 *Supplement 1961-1965.* Cambridge: W. Heffer and Sons Ltd.:: 1972 *Supplement 1966-1970.* London: Mansell Publ. Ltd.:: 1977 *Supplement 1971-1975.* London: Mansell Publ. Ltd.

Pliny
Natural History: 1962 translation by D. E. Eichholz. Cambridge, Mass.: Harvard University Press and London: William Heinemann Ltd.

Rogers, Alexander, and Henry Beveridge
1909
The Tūzuk-i-Jahāngīrī or Memoirs of Jahāngīr . . . vol. I London: Royal Asiatic Society

Ruska, Julius
1912
Das Steinbuch des Aristoteles. Heidelberg: Carl Winter's Universitätsbuchhandlung

Skelton, Robert
1972
"The Relations between the Chinese and Indian Jade Carving Traditions," *The Westward Influence of the Chinese Arts* (ed. William Watson). London: University of London: 98-110.

Tavernier, Jean Baptiste
1677 and 1678
The Six Voyages of John Baptista Tavernier . . . ("Made English by J. P."). London: Robert Littlebury.
Travels in India: 1889 translation by V. Ball. London.

Webster, Robert
1962
Gems: Their Sources, Descriptions and Identification, vol. II. Washington, D.C.: Butterworths Inc.

Wiedemann, E.
1911
"Über den Wert von Edelsteinen bei den Muslimen," *Der Islam II:* 345-358.
1936
"al-Mīzān" (="[Balance] Scales"–in English), *The Encyclopaedia of Islam III* 1st ed.