Studies in Ancient Indian Glass-I: Glass as Mentioned in Kautilya's Arthasastra
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Source: *East and West*, Vol. 15, No. 1/2 (January 1964 - March 1965), pp. 62-68
Published by: Istituto Italiano per l'Africa e l'Oriente (IsIAO)
Stable URL: https://www.jstor.org/stable/29754869
Accessed: 23-10-2018 08:21 UTC

Studies in Ancient Indian Glass - I

Glass as Mentioned in Kautilya's Arthasastra

Glass is a commonplace household article in everyday use. Familiarity and long association with this material ordinarily does not evoke any interest amongst us regarding its origin. Transparency, brilliance, decorative qualities, the easiness with which it can be moulded into different fancy shapes and above all its cheapness have contributed to a great extent to the increasing use of glass in the modern world; but it is scarcely remembered that in order to attain this distinction this fragile material had to go a long way through research and experimentation after its accidental discovery.

It is a great commentary on human ignorance that the exact place or the period in which glass was first introduced are not known. Pliny, the well-known writer who flourished in the first century A.D., wrote in his *Natural History* (1) that some old Phoenician travellers used large blocks of nitrum for their ovens while cooking in the desert areas. The fire came in contact with the sand and produced a material similar to glass which probably led to the discovery. The reasons which Pliny adduced seemed sound in the initial stages but scientists soon refuted the theory as a higher degree of temperature than the common oven fire was required for the fusion of sand into glass. There is a difference of opinion on this point (2) as the exact nature of the earliest produced glass is not known; but scholars are all agreed that the product was first fabricated either in Syria or Palestine (3) and about the possibility of its homotaxial development at different centres. The earliest known specimen of true glass was found at Tell Asmar (4) in Mesopotamia and is attributed to circa 2700-2600 B.C. on stratigraphical considerations. It is, however, in Egypt that we find this material used for a considerable length of time. Fragments of a glass rod (5) bearing the insignia of Amenemat III of the XIIth Dynasty are dated 2050-2000 B.C. Three glass goblets inscribed with the cartouche of King Thothmes III (1501-1449 B.C.) are known (6). During the reign of Amenhotep II (1448-1420 B. C.) the manufacture of glass is said to have received a great impetus in Egypt. But the most remarkable finds are those from the city of Tell el Amerna, (7) established by Akhnaton (1450-1400 B.C.), where the extensive remains of a glass house and glass in various stages of manufacture have been recorded; and form the chief source of knowledge regarding the fabrication of glass in

(1) *N.H.*, I, 65.

(2) For different views see Trowbridge, « Philological Studies in Ancient Glass » (University of Illinois, 1930), p. 96 and foot-notes.

(3) HARDEN, « Ancient Glass » in *Antiquity*, VIII, (1933), p. 413 ff.

(4) FRANKFORT, *Iraq Expedition of the Oriental Institute*, 3rd Report, 1932-33, Beck's Report.

(5) NEUBERG, *Glass in Antiquity*, (London, 1949), p. 8.

(6) *Ibid.*, p. 11.

(7) PETRIE, *Tell el Amerna* (London, 1874), p. 25

Ancient Egypt. Many museums abound in specimens of Egyptian glass which can reasonably be dated anterior to circa 1000 B.C. ([8]) Egypt, however, was not the only country where glass was fabricated and used in antiquity. Literary and archaeological data from Syria and Palestine has conclusively shown that the knowledge, diffusion and the spread of the use of glass was an established practice in the Ancient World in the second millennium B.C.

In India very few critical studies about glass have been published. ([9]) With the known contacts that the Indus Valley Civilization, the oldest yet known in India, had with ancient Sumer it was expected that at least a few remains of glass should have been discovered in Mohenjo Daro or Harappa, the chief cities where large-scale excavations of that Civilization have been directed. Since no finds of glass were reported at these sites it was at one time believed that true glass was unknown in India during the Chalcolithic period. But this opinion requires a reconsideration in the light of the latest discoveries in South India. At Maski, ([10]) well known for its Aśokan edicts, a few bangles of glass are associated with the Chalcolithic levels, and are dated circa 1st millennium B.C. These belong to the plain monochrome variety of glass and its use in a sophisticated product like a bangle shows they were the inheritance of a long experience in the art of fabrication of glass. Plain glass bangles, in an admittedly Chalcolithic context, have also been obtained at Periano Ghundai ([11]) and Dabarkot [12] in Northern Baluchistan and at Turbat and Shahi Thump in Southern Baluchistan. ([13]) Moreover in the Indus Valley itself the people of Mohenjo Daro and Harappa are known to have made extensive use of articles from faience, a composition resulting from powdered quartz grains fused at low temperature with the addition of lime. Some of the articles like beads and inlays were found treated with a glaze or frit which does not materially differ from glass. Archaeologists like Sir John Marshall ([14]) and others have, therefore, come to the conclusion that though no true glass has been recovered from Mohenjo Daro and Harappa, the authors of these cultures had perfected a composition which very nearly approached glass.

The tradition about the use of glass in India is further corroborated by the finds associated with the painted grey-ware cultures which succeeded Harappa cultures in the Gangetic Valley.

ff.; PETRIE, *Arts and Crafts of Ancient Egypt,* (London, 1909), p. 119.

([8]) Cf. H. C. BECK, « Glass before 1000 B.C. » *Ancient Egypt and the East* (1934), pp. 7-21; see also Possing, *Glass vessels before Glass blowing* (Copenhagen, 1940), p. 7.

([9]) Technological data and analysis of ancient Indian glass can be studied in the following:

SANA ULLAH in *Annual Report, Arch. Survey of India,* 1922-23, p. 1.

B. B. LAL, « Studies in Early and Mediaeval Indian ceramics-Some Glass and Glass-like artefacts. *Bulletin of the Deccan College Research Institute,* XIV, No. 1, pp. 48-58; « Examination of Some Ancient Indian Glass Specimens », *Ancient India,* No. 8, pp. 17-27; « Glass beads from Arikamedu », *Ancient India,* No. 15; Y. P. VARSHNEYA, « Glass in Ancient India », *The Glass Industry,* (Dec. 1950), pp. 632-634; J. D. RENADE and J. K. ZOPE, « Barium in the Glass Beads from Tripuri in Dikshit », *Tripuri* - 1952, pp. 136-139; M. TORANTI and W. G. N. VAN DER SLEEN, « L'Analise Chimica Aiuta L'archeologia », *VETRO* (Oct. 1960) Vol. IV, No. 23, pp. 19-24.

([10]) B. K. THAPAR, « Maski: 1964 » A Chalcolithic Side of Southern Deccan » *Ancient India,* No. 13, pp. 106-107.

([11]) STEIN, « An Archaelogical Tour in Waziristan and Northern Baluchistan », *Memoirs A.S.I.,* No. 37, (Calcutta 1929), pp. 40-41.

([12]) *Ibid.,* pp. 60-61.

([13]) STEIN, « An Archaeological Tour in Gedrosia », *M.A.S.I.,* No. 43 (Calcutta, 1931), pp. 55, 93.

([14]) MARSHALL, *Taxila,* II, p. 683; Mackay mentions a few artefacts which are closely similar to but not exactly of glass from Mohenjo Daro. *M.I.C.,* Vol. II, pp. 576, 578 and 582.

Beads and bangles associated with these wares are known from Rupar ([15]) near Ambala, at Hastinapur ([16]) near Merath and at Alamgirpur ([17]) near Delhi. The precise date for the PG Ware is not yet determined but the cultures associated with it are roughly dated between 1000-700 B.C.

The long-drawn-out tradition about the use of glass is again noted in the Mauryan period (400-300 B.C.) where we have ample data, both archaeological and literary, to conclude that glass of a very high quality was manufactured in India. The finds from archaeological excavations prove that the glass industry had reached a high degree of perfection. The most positive evidence is obtained in the glass seals from Patna ([18]) which are found to have been inscribed with Brahmi letters in the Mauryan characters. Recently a black glass seal has been recovered from Maheshwar ([19]) which has the representations of an elephant and symbols like the swastika and the triangle-headed banner which are frequently represented on Indian coins. This seal is attributed to *circa* 300 B.C. and is of great technological importance, since it is known to have been anealed to remove the internal strains in the glass. The use of moulds in the Patna seals and the process of gradual cooling noticed in the Maheshwar specimen are important landmarks in the technological advance in the manufacture of glass during the Mauryan period. A similar high degree of skill is reflected in some glass discs of polychrome glass in possession of the author of this article. These discs are cut from long rods of black and red cane glass and have in them red canes arranged in such a way as to form a legend which reads « KAMI-KASA » in characters of about 300 B.C. These discs are reported to have been found at Kosam. They do not emanate from stratified deposits but the palaeography of the legend is sufficient to attribute them to the Maurya period. ([20]) This evidence is again consistent with similar specimens from Taxila ([21]) where black glass beads are found treated with spiral canes in red. Besides, the archaeological evidence above cited is also corroborated by literary evidence of the period in which extensive use of glass is indicated. When the Patna seals were published, Rai Bahadur Manaranjan Ghosh in a paper entitled « Use of Glass in Ancient India » published in J.B.O.R.S., Vol. X, pp. 195-97, had directed the attention of scholars to the use of the word « *Kācha* » (Glass) in early works like the *Śatapatha Brāhmaṇa* and the Vinaya Pitaka and in the medical treatises like *Suśruta* and *Charaka*. The *Śatapatha Brāhmaṇa* ([22]) men-

([15]) SHARMA Y. D., « Excavations at Rupar », *Lalita Kala*, No. 1-2, p. 125.

([16]) LAL B. B., « Excavations at Hastinapura », *Ancient India*, No. 4, pp. 13, 20, Plate LIII, 1-2.

([17]) *Indian Archaeology*, a Review for 1958-59, p. 54.

([18]) Five Brahmi seals of glass (with inscriptions in positive) were found in the excavation at Bulandibagh and Kumrahar in Patna. One of these is described as Mauryan or even Pre-Mauryan, another ascribed to *circa* 250 B. C., and the rest there are dated 200 B. C. These are published by K. P. JAYASWAL, « Brahmi seals newly discovered at Patna », *J.B.O.R.S.*, Vol. X, part III, (Patna, 1924), pp. 189-192 and Plate; and « Some unpublished seals » *J.B.O.R.S.*, XX, part i, (Patna 1934), p. 4 and Plate II, cf. also *A.S.I.A.R.*, 1926-27, p. 139, Pl. XXXI, i.

([19]) The seal from Maheshwar has been described and illustrated in *Jour. Numismatic Society of India*, Vol. XV, part ii, pp. 5-8; and in the Maheshwar Excavation Report by Dr. Sankalia. cf. Sankalia-Subba Rao and Deo, *Excavations at Maheshwar and Navda Toli*, p. 220. The analysis was published by Lal: in *BDCRI*, XIV, i, pp. 57-58.

([20]) These discs are to be illustrated in my forthcoming work, « Indian Beads, a study », to be published shortly.

([21]) Cf. BECK, Beads from Taxila, *M.A.S.I.* 65, p. 31; Plate I, 26.

([22]) *Śatapatha Brāhmaṇa*, XIII, 2, 6, 8; *Lomāni śiyamte yat-kāchān-āvayaṁti Lomān-yev-āsya saṁbhawaṁti*. Achyuta Grantha Mala, Banaras, p. 1319.

tions the use of glass beads. The *Mahāvagga* ([23]) section of the *Vinaya Piṭaka* alludes to the use of shoes ornamented with glass as forbidden to the Buddhist Bhikshus. The *Chullavagga* ([24]) similarly forbids the use of glass bowls. The medical treatises indicate the use of glass vessels in pharmacies. ([25]) Rai Bahadur Manoranjan Khosh in his paper had also adduced evidence from Kautilya's *Arthaśāstra,* a work which admittedly belongs to the Mauryan period, in support of his arguments regarding the use of glass in ancient India. But his treatment did scant justice to the many important sociological and technical aspects of glass which are reflected in this work. Hence it is proposed to deal with these problems in a fuller way with a view to knowing how glass was looked upon during the Mauryan period.

The word « *Kācha* » for glass is mentioned ten times in the *Arthaśāstra.* In Adhikaraṇa 2, Adhyāya 11, Sutra 35, the jewels considered worth preserving in the royal treasury are enumerated. The others not specified are to be classified as « Glass-gems ». ([26]) In the same context the duties of a Suvarṇādhykṣa (Superintendent of Gold Jewellery) are mentioned; he is supposed to have the knowledge of *Kṣepaṇa* i.e. the setting of glass fragments in gold ornaments (Adhi. 2, Adhyāya 13, Sūtra 41) ([27]) for which five parts of gold were required ([28]) (Adhi. 2, Adhyāya 13, Sutra 44). The commentary of the Arthaśāstra ([29]) has explained this as *KāchakarmaṇahMaṇi-samyojana-karmaṇah* which makes it clear that the practice of setting glass in ornaments was very common in those days. These settings were required to be *Prisita* i. e. hollow at the back ([30]) according to Adhikaraṇa 2, Adhyāya 13, Sūtra 46. The goldsmith is ordered to make a clear distinction between false jewels and those made of glass ([31]) (Adhi. 2, Adhyāya 14, Sūtra 60). Ksiraswāmī's commentary explains this by saying *Kācham-Kāchharaṇopāyah* ([32]) and thus shows that glass alone could be used for the identification and its comparison with the fragments used in the ornaments.

These references point to the use of glass in ornamental work during the Mauryan period but the Arthaśāstra mentions glass in other contexts also, by which we are able to obtain some

([23]) *Mahavagga,* V, 8, 3; (*S.B.E.,* XVII, p. 23). *Na Bhikkave Kācha-mayā Pādukā dhārētavvā.* (Shoes ornamented with glass are not to be worn).

([24]) *Chullavagga,* V, 9.1 *Na Kācha-mayo Pattho Dhārctavvo.* (No bowls made of glass should be kept).

([25]) Suśruta (Calcutta, 1885) p. 93 *Anu śastrāṇi tu tak-sāra-sphaṭika-Kuruvinda = jalok-āgni... Kācha = sphaṭika = pātreshu śitaleshu śubheshu.* Sutra 46, 450-55. *Susruta,* (ed. Om Prakash), p. 156.

([26]) *Arthaśàstra,* 2, 11, 35. *Śeshāh Kāch-maṇayah* (Shamasastri's Text, p. 77).

The rest are *metallic* beads (Shamasastri's Trans. p. 86).

The word Kacha has been translated as metal because the commentary uses the expression *Kācho Dhātudravyamayah.* But this seems not to be the case.

([27]) *Arthaśāstra,* 2, 13, 41. *Kshepaṇah Kāchārpaṇādini* (Text, p. 87). Kshepaṇa Guṇa and kshundra are the three kinds of ornamental work. The work further explains Kshepaṇa as setting of glass in gold.

([28]) *Arthaśāstra,* 2, 14, 44. Arpayet Kācha-karmanah Pañch-bhāgaṁ Kāñchanaṁ (Text, p. 87) « for setting of jewels in gold five parts of pure gold (is required) » (Translation, p. 101).

([29]) Sorabjee, « *A new Commentary of Arthasastra* », p. 31.

([30]) *Arthaśāstra,* 2, 13, 46. Prishita-Kācha-Karmaṇah Urayō hi bhāgāh paribhāṇḍaṁ dvau vāstukaṁ chatvāro vā vāstukaṁ trayah Paribhāṇḍaṁ (Text, p. 88).

Prishata usually means speckled. According to the commentary the meaning of *Prishita* is « Mixed Glass work ». In this setting of *ajouré* work the contrast between the opaque setting and the transparency of the set jewels is implied. (Tran. p. 101).

([31]) *Arthaśāstra,* 2, 14, 60. *Kācham vidyāt.* (Text, p. 93). (The State goldsmith) shall infer deception. (Trans. p.107).

([32]) Cf. Sorabjee, *op. cit.,* p. 38.

more evidence regarding the sale of glass articles. The references cited below will show that dealing in glass was not considered to be an honourable profession.

Amongst the various punishments inflicted for stealing, it is ordained that a person stealing fruits, vegetables, hides etc., was to be fined with 12-24 paṇas; for stealing articles of higher value such as iron, wood, ropes etc., the fine specified was 24-48 paṇas and 48-96 panas for articles made of copper, bronze, tin, *glass* and ivory. ([33]) This shows how glass was classified amongst miscellaneous objects. This is further corroborated by the taxes which the glass-maker has to pay to the State. He is supposed to pay a tax of twenty coins. ([34]) (Adhi. 5, Adhyāya 2, Sūtra 23). The context shows that a dealer in costly materials like gold, silver and jewels had to pay 50; those selling cloth, copper and bronze had to pay 40; The merchants dealing in grain, decoctions, iron and carts were required to pay 30; but the Kārus (workers) in glass paid only 20 coins. This shows that the dealer in glass did not earn much so as to be taxed heavily. Adhikarana 7, Adhyāya 17, Sūtra 57 specifies ([35]) that the spies in the State should move about at night under the guise of merchants dealing in articles of glass and glass vessels. This again corroborates the view that selling of glass was considered to be a low profession. One is not, however, able to follow why the venders should ply their trade at night. The lowness of the profession is almost certainly due to the costly materials like jewels and gold in which India abounded during the Mauryan period. In fact classical literature in India often alludes to the comparison between costly jewels in contradistinction with glass.

The *Arthaśāstra* alludes to the making of glass only at two places. The passages indicating this are somewhat difficult to interpret and one feels that the difficulties are due more to the unfamiliarity of the commentators with the technique of glass-making than to the faulty text of the original.

Adhikarana 14, Adhyāya 1, Sūtra 12, lays down ([36]) that in order to punish the enemy, obstacles like the smoke of Puti, Karanja leaves... as in manufacture of glass, by burning cowdung etc., should deliberately be created. In fact this practice of waylaying the enemy is as old as the *Atharva Veda* (av. VIII, 3, 34) and it is not surprising that the *Arthaśāstra* should allude to it. The burning of the Karañja leaves produces a very strong and bitter smoke which is harmful to the eyes. In the same way the alkalis like potash included in a batch of glass

([33]) *Arthaśāstra,* 3, 7, 8. Tāmra-uritta-kaṁsa-kācha-danta-bhāṅḍādīnāṁ sthula-drauyāṇāṁ Ashta-chatu-ariṁ-śat paṇāvaraṁshan-navati-paraṁ Purvva sāhasa-daṇḍah. (Text, p. 192). « And for such articles of still greater value as copper, brass, glass, ivory and vessels etc., it shall range from 48 to 96 Panas » (Trans, p. 235).

([34]) *Arthaśāstra,* 5, 2, 23. Kācha-vyavahāriṇo mahā-kāravash-cha Viṁśati-karah. (Text., p. 241). « Merchants dealing in gold, silver, precious stones, pearls, coral, horses and elephants shall pay 50 karas. Those that trade in grains, liquids, metals (Loha) and deal in carts shall pay 30 Karas. Those that carry on their trade in glass (Kacha) and also artisans of fine workmanship shall pay 20 Karas. (Shamasastri's Trans. p. 293).

([35]) *Arthaśāstra,* 7, 17, 57. (On making peace and breaking it) Kācha-Kumbha-bhāṅḍa-bhāra-vya-ñjano vā rātrau pratishṭhet. ((Text, p. 314). « Or having disguised himself as a carrier of glass, beads, pots and other commodities, he may set out at night » (Tran. p. 371).

([36]) *Arthaśāstra,* 14, 1, 12 (means to injure the enemy). Putī-Karañja-patra... Kācha-go-śakrit-vasa-viṣhṭhaṁ andhikaro dhumah. (Text., p. 409). « The smoke caused by the burning of the leaves of Puti, Karanja... Kacha causes blindness ». (Tras. p. 476).

([37]) Cf. Lal B. B. in *BDCRI,* XIV, p. 57.

should be equally harmful to the eyes and it seems to be the likely reason why the burning of glass is mentioned in the above list. The chemical analysis of many glass samples from excavated sites in India shows the presence of potash in an appreciable quantity. ([37]) Scientists have often commented on this feature in Indian glass. ([38]) We have therefore in this passage from the *Arthaśāstra* an important allusion to the smoke produced by the glass batch.

Another passage (Adhikaraṇa 2, Adhyāya 14, Sūtra 45) is somewhat corrupt and does not admit of easy interpretation. It would, therefore, be necessary to quote it in full.

> Abhra-paṭalaṁ ashṭakena Dvi-guṇa-vāstuke vā rupe bodhyate
> tasyāpihita kāchasyōdake nimajjata ekadeśah sīdati
> paṭalāntare vā suchyā bhidyate...

Dr. Shamasastri has translated this passage as follows: « In some pieces mica may be firmly laid inside with wax and covered over with a double leaf (of gold or silver); when such a piece of mica or glass inside is suspended in water one of its sides dips more than the other, or when pierced by a pin, the pin goes very easily in the layers of mica in the interior » (Shamasastri's translation, p. 106). Though the translation is quite literal the meaning in the orginal was not grasped properly by the old commentators of the Arthaśāstra ([39]) is to be seen when the words *Kāchasyodaka* seem to be interpreted as « in the acid of the jujube fruit » by Kshiraswāmi. Moreover, Dr. Shamaśāstri seems to imply that some test by specific gravity is probably intended in this passage. The allusion here is to the jewellers' settings or sockets in which the ornaments were fixed, and our interpretation of it is as follows:

In the initial portion we find that the process of « backing » glass jewels with the foil of gold or silver is intended. Often the ornaments in ancient India were decorated with gold foil in this manner and the practise is alluded to in some *Ratna-śāstra works.* ([40]) The second half of the sutra is clearly a reflection of what the author of the *Arthaśāstra* has seen while glass beads were being fabricated. It is said that when the molten glass (*Kāchasyodaka*) is poured in the mould (for the bead) some portion of it settles on one side (*Ekadeśāḥ sīdati*) or is covered by the gold foil. This ferrule of glass is pierced with a needle (for perforating the bead). This allusion to the piercing of glass beads with a sharp instrument like a needle appears somewhat unusual to a foreign scientist who is not well acquainted with the manner in which some of the old Indian glass is perforated. But to a student of Indian beads this method is quite familiar since many old specimens of glass are found pierced in this manner. In such beads the end from which the needle is inserted is quite smooth and rounded near the perforation but the opposite end is invariably found to have a burred edge. The practice is quite common in beads from several ancient sites in India. ([41]) The author of this article has seen it favoured by some craftsmen working in a small factory near Ghodegere near Belgaum in Karnataka who used muffle furnaces and dropped the ferrules on an earthen salver for puncturing them.

([38]) See especially *Vitro* (Oct. 1960).

([39]) Cf. Shamasastri's translation, p. 196 foot note.

([40]) FINOT, *Les Lapidaires Indien,* (en passim).

([41]) Cf. DIKSHIT M. G., « Beads from Kondapur », *Hyderabad Archaeological Series,* No. 16 (Hyderabad-Deccan, 1952), p. 16, Bead No. 188. DIKSHIT M. G., « Beads from Ahichchhatra », *Ancient India* No. 8, 53-60, Nos. 95, 58 etc.

It must be admitted that the passage in the original contains some grammatical peculiarities which cannot be overcome in the interpretation we have attempted, but the sense seems to be clear enough to those who are familiar with the technique of fabricating glass.

If the interpretation of the above two passages from the Arthasastra is accepted, it seems reasonable to accept the fact that its author was familiar with some of the technique in the manufacture of glass as seen during his times and that the art of glass making had reached a reasonably good standard. The corroboration of it is obtained from the archaeological specimens and it is a matter of satisfaction that an early work like the Arthasastra should allude to the current practices.

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