The Archaeology of Glass in South Asia: The State of the Field and New Directions

Alok Kumar Kanungo and Mudit Trivedi

Abstract:

This article provides a review of the state of South Asian glass studies. It presents a survey of the emergent trends, animating questions and new discoveries that currently structure the interpretation of vitreous materials in the South Asian archaeological record. It engages with the historiography through providing summary accounts of the papers read at the 'International Conference Cum Workshops' held from the 21st to the 25th of January 2019 at IIT Gandhinagar that focused on the History, Science and Technologies of Ancient Indian Glass. It provides first a thorough review of the burgeoning use of elemental compositional analysis of vitreous materials in South Asia. It draws attention to the manifold possibilities that detailed studies of artefact typology, distribution and variability hold in clarifying the development, growth, trade and use of glass ornaments and objects in the region and as traded beyond over the last two-thousand years. It provides reflections on the need for training in experimental and ethnoarchaeological methods for the advancement of the field, and how such relationships between archaeological questions and the present predicaments of traditional crafts communities may be responsibly entered into and advanced.

Keywords: *Glass, South Asian glass Ethnoarchaeology, Glass working, Glass making, Archaeometry.*

In the study of South Asian glass, two historiographical moments of synthesis and clarification tower above the field. The first, was

the monograph *History of Indian Glass* authored by M.G. Dikshit which in 1969 provided a first and still enduringly compelling narrative for the history of glass in the region. Another major collective evaluation of the state of scientific interdisciplinary research on ancient Indian glass had been made in 1986 when the *Archaeometry Session of the XIV International Congress on Glass,* was held in New Delhi. Subsequent to these, two volumes, the 2004 publication of *Glass Beads in Ancient India: An Ethnoarchaeological Approach* by the first author drew attention to the continued valence of ethnoarchaeological possibilities towards a better understanding of the complexity of the South Asian vitreous archaeological record and its taphonomic specificities. These three volumes, each separated by a generation, encapsulate the major typological, technological, cultural and ethnoarchaeological questions archaeologists have asked of vitreous materials.

Since their publication, a multitude of site-specific studies, regional analysis and subcontinental syntheses of trends have been published (Francis 1990, 1991; Kanungo 2006a, 2010, 2013; Kanungo and Brill 2009; Kanungo and Misra 2004; Kanungo and Shinde 2005; Kanungo *et al.* 2010; Singh 1989) and yet, no collective reckoning with the state of glass studies had been attempted. This article communicates some of the shared concerns, new insights and directions and questions that were posed during an 'International Conference Cum Workshops' held from the 21st to the 25th of January 2019 in IIT Gandhinagar that focused on the History, Science and Technologies of Ancient Indian Glass[1]. Through these discussions, the article presents a summary assessment of the field of archaeological glass studies in South Asia.

Emergent trends in the field of glass studies: chemistry, typology and variability

The last two decades in particular have seen a dramatic change in the kinds of knowledge that can be generated about South

1. For a full programme and detailed abstracts of the conference, please visit: http://events.iitgn.ac.in/2019/aig/#

Asian glasses, and consequently in the range of questions posed to the material. This shift owes its greatest debt to the emergence of elemental analysis through LA-ICP-MS (Laser Ablation Inductively Coupled Plasma Mass Spectrometry), which allowed for the quasi-non-destructive analysis at the ppm level of the chemical composition of glass objects. Through a pioneering series of analyses, distinctly South Asian sets of compositions have been discerned as well as a set of distinct spatio-temporal and chemical compositional groups of "mineral-soda-alumina glass" (Dussubieux *et al.* 2010, hereafter m-Na-Al glass). As facilities and expertise to undertake such research become increasingly available in South Asia, we stand at the cusp of a landslide of new data and analyses with which we can hope to understand South Asian glassmakers and their chemical knowledge, their change and transmission in ways previously unknown.

Similar questions attend the issues of the typology, distribution and variability of South Asian glass assemblages. Renewed attention to these questions has allowed recent scholarship to pose a range of questions to the accumulated data about the origin and spread of techniques, the relative intensity and shifts across periods of their trade and consumption and the deeply historic shifts in attitudes towards glass use in South Asia across different periods, regions and communities.

The mid to late twentieth century witnessed a phase of research into glass when several researchers witnessed traditional crafts persons in moments of sporadic and episodic production. Their valuable documentation of crafts processes and workshops thus came at a time when these communities laboured under heightened duress from the pressures of the postcolonial industrial economy. The situation today of such crafts communities is ever more precarious and dire. Glass studies in South Asia then stands at a juncture of considerable opportunities and responsibilities, our interventions into ancient knowledge stand as testimony to South Asian life-ways that are increasingly close to extinction. The following sections provide a more detailed assessment of each of these sub-fields and the emergent directions in them.

Elementary aspects of South Asian glass: Mineral soda - Alumina glass and beyond

South Asian glasses have long been identified to be distinctively high in alumina relative to all other recipes of glass (Brill 1987, 199; Bhardwaj 1987). The major oxide chemistry of glass was sufficient to indicate that this distinctive signature was the result of the use of *reh*, a distinctive efflorescence naturally occurring post - monsoonal rains in several South Asian soils. Reh, appears to have been used in the subcontinent as a soda-rich mineral resource and has been used as the flux in the major family of South Asian glass.

Dussubieux's landmark analysis (Dussubieux *et al.* 2010), presented a detailed and complex picture of five clear compositional groups based on the trace element chemistry measured via LA-ICP-MS. As Dussubieux points out, the m-Na-Al groups present a complex and shifting mosaic of distributions, which connect diverse sites and regions from across the Indian Ocean. To take but two examples, these compositional groups have helped phase a new connected glass-culture: Southeast Asia, Sri Lanka and South Asia have been shown to be connected in the m-Na-Al group 1 between the 4th century BCE and the 5th century CE (Dussubieux and Bellina 2018; Lankton *et al.* 2006) with a distinct network in Potash glass (Dussubieux 2016). Similarly a medieval complex of glasses, m-Na-Al Group 2, links diverse regions in East Africa with Southeast Asia and Western Indian coast including sites like Chaul (Dussubieux *et al.* 2008). Once trace element chemistry is available for increasingly diverse and well sampled, well dated assemblages, we stand at the cusp of being able to understand the production, trade and exchange and use of South Asian glass is truly revised.

This section comments on four aspects of current research, as presented at the conference, that serve to enhance our knowledge of South Asian glass through chemical data and pose new questions. These four relate to considerably different periods: First, the origins of vitreous technologies in Indus era faience. Second, the chemical analysis that has forced the questioning

of the hitherto asserted centrality of Arikamedu in early historic South Asian glass networks. Third, the promise offered by isotope analysis to add another much added layer of source-analysis to the study of the chemistry of South Asian glass. Finally, this section also communicates, the innovative research by Maninder Gill on the translation of glass technologies in the context of new demands and new objects in medieval India with the coming of tiled decorations in Mughal era architecture (Gill and Rehren 2011, 2014, 2017).

Proto-glass and Faience in North-west South Asia

A series of new results regarding the origins of vitreous technology in the north-west part of the South Asian subcontinent were also communicated. In this region, published analysis of the glaze on steatite beads from Mehrgarh and Nausharo, dating to c. 4400-3700 BCE have long established the high alumina nature of these glassy materials (Bouquillon *et al.* 1995). In the past two decades, accumulating evidence has pointed to the richness of the Indus faience tradition and mounting evidence suggests an extension and diversification of this technology in unexpected locales: specifically in the western extents of the Indus civilization and during its later phases owing to recent finds such as those at Sanuali (McCarthy 2008; Miller 2008; Uesugi *et al.* 2017). At the conference, Mark Kenoyer and Ivana Angelini reported new results from their continuing analysis of faience artefacts from both Harappa and Mohen-jo-daro (Kenoyer 1994; Gu *et al.* 2016).

Kenoyer stressed the portability and the lack of large infrastructure that Harappan craftspersons needed in making faience. On the basis of both excavated finds and his experiments he spoke of the Harappan ability to make faience in small specially made crucibles which on account of being unremarkable had previously been unrecognized as faience production debris. He also pointed to the technical excellence of the Harappans in creating distinctive faience eye-beads that combined on a single artifact, red and white glaze — a feature that is presently proving to be exceptionally difficult to reproduce. This is on account of the Iron (for the red glaze) and the plant ash both acting as fluxes

on the silica. Kenoyer also provided a short account of the care taken by the Indus Valley craftspersons in sourcing the right kinds of steatite which when fired would glaze. He also communicated the results of recent re-examinations of the glazed steatite 'button seals' whose function may need to be re-thought, on account of traces of surviving glaze which have now been observed and which would make them less usable as seals than perhaps as ornaments of some kind. Angelini reported how close attention to the glaze-body interface confirms the use of efflorescence techniques of glazing on all samples and possible insights into when the colouring agents were added, as the percentages of copper varied between the glaze, the body and the core of the sampled artifacts.

Bhuvan Vikrama communicated the interesting finds from the recent Archaeological Survey of India (ASI) excavations at the sites of Sakatpur Mustakil, Dist. Saharanpur, where a series of faience working furnaces and extensive faience artifacts of the Harappan style were found. The nature of the evidence further testified to the regional diversity of Late Harappan faience and raised new questions about the distribution of centres of production, especially in the Upper Ganga valley. Extended analysis, sampling artifacts across several such Indus sites and regions, offer great promise towards an understanding of the development and elaboration of the technology and expertise underlying the earliest vitreous industry in South Asia.

Towards building the desired familiarity with faience as a material and its specific demands on the craftsperson, Kenoyer and Massimo Vidale led a detailed multi-day workshop aimed at the experimental replication of Harappan Faience Technologies. Their plan involved using a range of source materials (Sabarmati river sand, rock crystal and combinations of both) alongside *sajji khar* (plant ash) to first fire the combination of silica and flux to make a frit. A small kiln was constructed where on the first evening three crucibles (also made using local materials of clay and straw) were fired. These crucibles were notably of a type known from Harappa and were small flat sided bowls in morphology and attention to their condition and post-firing state was an essential part of the

demonstration of how to be attentive to remains of such traces, much modified taphonomically in the archaeological record.

The next day, the crucibles were opened and the partially vitrified frit was ground down to a size as fine as possible in agate mortars. This was then divided and one part particles of copper extracted from a heated copper wire were introduced as a colourant. Kenoyer then fashioned a range of artifact forms using the ground frit as bound by acacia resin (*babul ka gond*). These shapes included a range of shapes known from Harappan assemblages including beads, rings, a vessel and the small tablet seals. These were then placed in another crucible (similar to those used previously for the frit, but sealed with additional clay) and especially prepared calcined bone was used as separators. These were again fired in the kiln and left to cool. The crucible was opened to reveal a range of variation in the degree to which glazing had occurred and proceeded, with some artifacts light and frothy in a recognizable blue faience similar to Harappan materials, others which had turned red (understood as on account of inclusions from the sandstone mortar used). Kenoyer also used the special Hazara steatite (which Randall Law 2011, has demonstrated to have been the preferred Harappan source) to fashion replicas of the Harappan seals. Kenoyer then fired these to demonstrate how Harappan pyrotechnological virtuosity had included such knowledge of how to produce excellent white and enhanced hard steatite for their quintessential seals from a material that is sparsely distributed, heterogeneous in composition and only one source produced the aesthetic results they valued.

The faience reproduction workshop introduced and engaged all participants in the care and systematic outlook and planning which experimental archaeology demands, and especially to the infrastructural, fuel and labour demands which the pryrotechnological products demand. In demonstrating the care and attention needed in both making frit and faience artifacts the workshop made clear how much the glassy phase demands of craftspersons, and a renewed appreciation of the extraordinary excellence of the Harappan artifacts.

Arikamedu: Chemical analysis and the Francis Jr. Hypothesis

At the conference, Laure Dussubieux' paper drew on her decade long study of the compositional groups of glass in Southeast Asia (especially sites in Thailand, Vietnam and Myanmar). She demonstrated how influential models, such as the Arikamedu centric story advanced by Peter Francis Jr. which suggests Arikamedu as a major centre of glass production and of technology transfer and / or the movement of craftspersons were in need of re-evaluation in light of the elemental analysis of glass from these sites.

Dussubieux demonstrated a number of clear trends in the compositional data: first that in Southeast Asia, a potash glass likely originating from the Laos/ Vietnam area was the principal type in the region. When Indian glasses did arrive in that region, in the 2nd to 4th centuries BCE, they are of a type known from Eastern India and Uttar Pradesh (m-Na-Al 2) and not from South India. In addition, Arikamedu in this period itself has a preponderance (45% of all) of a glass type that is not Indian in its composition either, pointing to a need to again revisit our interpretation of the site (Dussubieux 2016; Lankton *et al.* 2006).

Building on her work of identifying and tracking the different groups within mineral soda alumina glass, as discussed above, she pointed to how some sub-groups of this glass do travel eastwards in the last few centuries BCE and CE, but they are neither regular nor extensively distributed in that region. In fact, the clearest evidence for regular and well established contact with eastern India occurs only in the period after 1000 CE when such compositional groups again begin to be found in places such as Cambodia and Sumatra. In addition, she summarized her assessment of the chemical composition of Indian glasses as distinct groups of mineral soda alumina glasses, communicating the identification of a new group as presently known solely from finds from Zanzibar.

Dussubiuex repeatedly stressed how the analysis of a series of well excavated, provenienced and dated beads, bangles and

waste-debris from glass production and processing sites excavated throughout South India and Sri Lanka would help establish on a much firmer basis the range of glasses in which production was actually occurring in these regions.

Isotope chemistry: a new horizon beyond trace element groups

Thomas Fenn's case study of Indian glass beads in Eastern and Southern Africa added another layer of complexity by addressing the challenges of trying to identify the provenance of glass. He particularly addresses the challenge of attempting to combine the insights of artifact typology, archaeometry and isotope studies. Fenn spoke of three broad issues: the first that artifact typologies which grouped visually identical beads in Africa had on recent isotopic analysis been found to bear very widely distinct proveniences, outlining the greater need for such studies. Second, that much more work needed to be done to isolate Indian compositional and isotopic signatures for periods when the bead trade from India to Africa was at one of its peaks, especially in the periods between 1000-1250 and 1400-1650 CE.

Ironically, this remains a period when Indian glass beads are better known from well-excavated African sites than in the context of medieval Indian assemblages. Lastly, Fenn spoke about the need to provide greater baselines for Indian glass than the few isotopic signatures for *reh* and for Kopia glass that had resulted from the collaboration between Alok Kanungo and Robert Brill (Kanungo and Brill 2009). He emphasized how more work was required to distinguish these from presently isotopically unstudied Southeast Asian glass. Once we had established isotopic baselines, Fenn added, we could hope to separate regional signatures and begin to understand which regional polities across the Indian ocean rim, at different points in time, exerted the maximum influence over trade networks in such ways that beads of that region travelled the furthest and in greatest numbers.

Tradition and translation: Mughal era glazed tiles and South Asian Glass

Maninder Singh Gill presented the results of his study investigating early Mughal architectural tile-work. He presented his innovative work as a case study of the interaction of indigenous Indian glass tradition in the context of a cosmopolitan court culture, which drew equally in its political and material cultures on central and South Asian traditions (Gill and Rehren 2011, 2014, 2017).

Gill described his meticulous fieldwork and preparation for elemental analysis that isolated two groups of Mughal era architectural polychrome tiles, distinguished primarily on account of the number of colours they could produce and which parsed in time and geography as well. The earlier Delhi-Agra group which is displayed in the monuments built from 1550-1625 CE differed from the later Punjab-Lahore group on account of the angularity of quartz grains, and most importantly in being a high alumina, low magnesium glass, i.e., indicative of a mineral soda flux. The Punjab group in contrast displayed a low alumina, high magnesium composition typical of a plant ash composition, indicating that in the first period of Mughal constructions an indigenous recipe had been used to produce the glass for the tiles.

Gill went on to describe his efforts that have isolated the key colourants, including the distinct innovation of a Lead Stannate derived orange in the second period. He also described his efforts to understand the source glass production which must have supplied the tile makers and his own fieldwork in the Akrabad-Jalesar area, including efforts to replicate the making of reh glass, from firing the sand-mineral efflorescence in a furnace as well as studying other still extant methods of frit-glazing pottery.

In each of these cases, renewed and concerted engagement with the chemical and pyrotechnological expertise that underlay glass worlds has yielded fundamental new insights. These have changed our notions of the origins of vitreous technologies, and the manner in which they came to be translated and transformed

across cultural encounters in successive epochs. A range of studies resolved similar new insights through a focus upon particular artifacts.

In the looking glass? new questions of distribution, variability and typology of glass artifacts in South Asia

While glass beads constitute perhaps the defining early historic South Asian ornament, a geographical sense of their varied production, consumption, exchange and use remains a desideratum (Abraham 2013, Basa 1992, Kanungo 2001a). Many contributions at the conference presented communications that stressed the need for regional databases, and their relative success in using varied methods to achieve a sense of control over mutinous and diverse trends in variation.

This section communicates a brief overview of a range of new studies which pose new questions to early historic and early medieval beads in South Asia and of South Asian origin. It then turns to reviews of the state of much understudied glass artifacts in South Asia, namely the assemblages of glass vessels and glass bangles which proliferate over the last thousand years in a still unknown typological complexity.

Beads unbounded: new directions in the study of South Asian glass beads

Over the last two decades, an increasing and almost overwhelming amount of data has forced a re-evaluation of the early historic assemblages of glass beads. In this historiographical context, Sharmi Chakraborty addressed the important issue of how we assess such a scenario of glass beads and their use in a regional perspective. Most usefully, she addressed the special challenges which regularly face us in South Asian archaeology – where the data as reported over the last hundred years is far from standardized, and even basic attribute data or photographs of finds are not always available. Despite these limitations, Chakraborty provided salutary examples of the utility of using new methods,

such as cluster analysis, to reveal key trends in the shifts in colours and shapes across regions such as inland and deltaic/coastal early Historic Bengal.

Her analysis was revealing in the degree to which she demonstrated that our extant data does reveal very interesting regional trends, which can serve as the basis for further research and instrumental analysis in the future. A few examples of these included the preponderance of barrel shapes in Indo-Pacific types, the marked increase in black beads in Kusana period and the widespread use of false agate glass beads in a region where there was no shortage of raw agates or stone beads indexing complex issues of the archaeology of value, preference and choice (Chakraborty 1995, 2012).

Shinu Abraham communicated the present state of her on-going research on the openings that the analysis of a sample of c. 5000 beads from Pattanam have afforded into the complex which since Peter Francis Jr.'s formulation has been known as the Indo-Pacific beads complex. Abraham underlined the need for regionally standardized attribute recording systems and databases that would allow a more nuanced analysis of this phenomenon of glass beads that is not only far-flung and extensive, but profuse and long-lived. She pointed to how 75% of the total c. 100,000 glass beads at Pattanam are understood as Indo-Pacific, and are mostly monochrome; but alongside which there is a percentage of other bead types that include the False Beryl, the Gold in glass beads and rare but potentially important types of banded, faceted and biconical beads that might be temporally limited and useful for further analysis (Abraham 2013, 2016).

Contextualizing these discussions from Southern and Eastern India, Wijerathne Bohingamuwa presented both a synthetic review of the voluminous evidence of glass production and use in ancient Sri Lanka. He provided both a site-wise and period-wise appraisal of the evidence for glass in Sri Lanka communicating the need for Indian archaeologists to understand the staggering scale of early historic Sri Lankan glass assemblages.

Bohingamuwa provided an evaluation of the present state of evidence for the temporal shifts in glass intensity in Sri Lanka and its place within the Indo-Pacific beads phenomenon. His review pointed to the complex issues that attend the interpretation of the dense evidence from Sri Lanka and the variability within sites as to when the peak intensity of Indo-Pacific beads occurs. He also reported new results that add to the corpus of glass production sites known in Sri Lanka. He reviewed the complex and debated issues of what raw materials were used, and the possibility that cullet was imported to supply to vast amounts of production known to have taken place over the first millennium CE. Notably, he demonstrated the profusion of glass has historic peaks, inter-site and temporal variations and laid out an agenda for further research not only in the region but also in South India to adequately compare the two closely linked regions (Bohingamuwa 2017).

Joanna Then-Obłuska's corpus of publications have provided an exemplar for the present state of the field in glass bead studies, combing a programme of recording multivariate standardized attributes of each bead, full publishing the entire dataset often across several sites in a region and providing high quality illustrations of the same (Then-Obłuska and Dussubieux 2016; Then-Obłuska 2013).

Then-Obłuska, presented new evidence to the South Asian audience of Indian beads as traded to Northeast Africa in the period between the 1st and 6th centuries CE. Drawing on her recent detailed analysis of glass beads from three different zones — Upper Egypt and the region around Quseir-al-Qadim, Nubia and the tombs associated with the 5th century Makurian polity of Sudan. She pointed out how the distribution of Indian glass beads in this part of Africa can be seen to begin with very exceptional finds only in the Egyptian zone in the Late Ptolemaic/Roman period at Qusier.

Subsequent to that, in a time of great trade, up to 50% of the coastal sites and up to 40% of the inland site bead assemblages come to be dominated by Indo-Pacific beads. While in Nubia, the

fraction of assemblage is smaller in the context of the finds in royal tombs and in the form of specially crafted anklets, with selective and judicious use of colours, especially selecting those for which no stones were available making clear the value and prestige these goods carried.

Similar unexpected complexities were presented by Bernard Gratuze, who communicated new and challenging evidence to the theme of 'the circulation of South Asian glass beyond South Asia'. He spoke about the recent discovery and identification of a range of Indian glass beads in early medieval Europe in two distinct clusters. The first group of finds were from Western Europe and France in the period between 500-800 CE and as recovered from Merovingian era elite burials. The second and more puzzling group was that as recovered from Northern Germany, Denmark and Sweden in the 7th and 8th centuries.

Bernard Gratuze provided an object lesson in how archaeometry is more robust when it follows upon detailed and attentive study of the attributes of artifacts. He described how over the last decade, the close morphological study (by Constantine Pion *et al.* 2013) of up to 5000 small Indo-Pacific beads had isolated different groups based on how they had been finished (heat rounded or cold cut edges). Working independently of Pion, Gratuze described how he had been analyzing beads and coming to a similar conclusion that there were many different elemental groups — only one of which was distinctively South Asian in origin. His second example, of distinctive red/orange beads, presented an elemental signature outside of all major compositional groups of the time. These glasses which were distinct from mixed soda-potash glass as well as South Asian high alumina glass, were on very careful study of the Rare Earth Element trace concentrations likely to be local Scandinavian mixtures of South Asian glass with others and matched waste glass found still in crucibles at these sites (Pion *et al.* 2013; Pion and Gratuze 2016; Sode *et al.* 2017).

Together these set of results, methodological comments and reflections amply reflect the challenges that attend the study of

the South Asian glass bead. We can only expect that in another two decades we may understand typological change, fluctuations in distributions and the repeated and marked shifts in exchange networks and currents of desire and value in far greater detail.

Of bottles and bangles: uncharted territories in South Asian glass

In many ways, the exceptional status accorded to the glass bead in South Asian archaeology has meant that other regularly found glass artifacts have been far less studied. The two most prominent categories relate to social and technological developments in glass worlds in South Asia which also remain ill-understood. These are – the emergence of the local itinerant glass bangle maker in various parts of the subcontinent at different points in time. The other relates to the proliferation of blown glass vessels, both through Indian ocean trade networks and their local manufacture. As both of these developments likely date to within the last thousand years they also draw attention to the very poor state of our knowledge of the archaeological trends of medieval glass in South Asia, a period which Dikshit characterized as the period when the glass industry really took off and came into its own.

Three communications spoke directly to the challenges and affordance of early medieval and medieval glass assemblages.

Kurush Dalal and Rhea-Mitra Dalal reprised their celebrated glass finds at Sanjan. They recounted the unexpected nature and density of vessel glass and the challenges it posed in excavation, recovery and curation – but also even more in identification – especially as the study of vessel glass in India remains in its infancy. Talking about the cultural specificity of the site of Sanjan, especially in light of its association with the Parsi community, they detailed the range and density of 10th to 12th century glass tableware that they had recovered, including bottles, vials, footed plates, distillation apparatus, goblets and other items such as buttons (Mitra and Dalal 2005).

In addition to this, they pointed to other items of the glass assemblage such as distinctive Syrian glass eye-beads and bangles that had been recovered as still intact from the Tower of Silence. Dalal stressed several important questions — the clear lack of any evidence for recycling at Sanjan, in the form of extensive debris. They noted how the relative lack of any glass from the other mounds at Sanjan perhaps suggested that the issues of glass as a material varied widely. To some, it was valued, perhaps proscribed in the minds of others. They cautioned as to how in the complex hierarchy of substances that mark Indian social organization, along lines of purity and pollution amongst others, glass in different periods and contexts will likely leave complex archaeological traces.

Veerasamy Selvakumar provided a thorough and thought-provoking review of the evidence for the production, use and status of glass in Tamil Nadu. He pointed to the problem of the lack of glass prior to the Early Historic period in South India, and even then, in contexts which exclude megalithic burials, alluding to a complex cultural transition. Selvakumar added that this was especially problematic, in light of the assertions that have been made for the centrality of sites like Arikamedu as production sites. His talk also provided a very rich account of the historical evidence on glass-makers and especially the caste of bangle traders and makers known from Tamil inscriptions. Tracking the *Balukuvaryan* and the *Valayaikara Chettis* from the 12th century onwards, Selvakumar connected their status within Tamil society with an assessment of the symbolisms and associations of the glass bangles as markers of prosperity, marital status which specially marked certain festivals and ritual status.

Mudit Trivedi focused on the much neglected category of glass bangles — which are usually reported as 'profuse' but are rarely studied in any detail. Ironically, this is especially true for the medieval period when they are most common. Trivedi reviewed the assumptions of their cultural origins and early studies made of the artifact type that continue to inform their extant typology of monochrome and bichrome in India and compared this to the

far more detailed typological systems that attend to pre-Roman La Tene glass bangles and Islamic glass bangles. His talk drew upon the ongoing analysis of an assemblage of 4000 glass bangles from the site of Indor (District Alwar, Rajasthan), where extensive radiocarbon dating of medieval assemblages has allowed for the seriation of the bangles and the isolation of types as they change almost every 50 years over the medieval period.

This assemblage includes types that are seemingly produced on the *khalbut* (or cone method as known from Purdalpur/ Purdilnagar) but also other types which could likely have only been produced using a two-mandrel technique. Drawing on ethnographic literature he posed the question of whether archaeological bangle working debris such as at Indor, suggested a model of an itinerant churihar and the specific types of kilns that they are known to have made. If we do not consider such possibilities, we remain, as Alok Kanungo has argued, neglecting the evidence at hand, owing to the expectations we have received of what a bangle-making workshop should look like. Drawing upon the opportunities afforded by the Indor data, Trivedi thus revisited the questions of chronological change, typological diversity and cultural significance of the glass bangle as an artifact type.

In these ways, a focus on the artifact opens up new possibilities in not only the social history of these glass worlds but also for the social history of these glass makers. The next section reviews the range of concerns that have recently been expressed about how archaeologists interact with, learn from and are responsible to the few craftspersons who continue to practice non-industrial traditional techniques today.

Glass ceilings: Crafts persons and archaeologists today

The historiography of South Asian glass is punctuated by moments when deep insight has resulted from moments of contact between an archaeologist and a craftsperson. Ancient technological puzzles have become our interpretative guides and keys to our assemblages with a few minutes spent at the workshop, observing

techniques, asking questions and absorbing knowledge from the few communities of crafts persons who have inherited and deploy their knowledge in the face of the cruel combined forces of industrial competition, the devaluation of handcrafted goods, impossible competition over raw materials and myriad other forms of economic precarity. While concerted fieldwork is rarely a part of archaeology master and graduate programs the field as a whole shares an indebtedness to these craftsmen, and this demands of us a need to take stock of the ways in which we have engaged with these craftsmen, and how we continue to do so.

Jan Kock and Torben Sode communicated a precis of their work over the last several decades on Indian glass crafts - of primary glass production, beading and bead-work and mirror-making. Focusing on the latter, they described how over medieval Europe (and elsewhere in the world), convex hot-lead coated mirrors were known from Scandinavian Viking deposits to Italian monuments but the technology of their production had been ill-understood (Kock and Sode 1995, 2002; Sode and Kock 2001). They communicated their sense of wonder upon first visiting Kapadwanj where they first encountered and documented the process of the manufacture of this distinctive mirror type and the networks through which it is finished into final artifacts and traded. Kock also spoke about his relationship with the previous generation of crafts persons at Kapadwanj, Muhammad Sisgar, grandfather of Ahmed Basir Sisgar who too was a resource person, and present at the conference. Alongside this, they also presented vignettes of their similar ethnoarchaeological documentation of primary glass production at Jalesar, glass crafts at Purdalpur and of the extensive use of such mirrors in traditional costumes in both Europe and India.

The conference included a field trip to visit the last surviving workshop producing traditional mirrored glass at Kapadwanj. Ahmed Basir Sisgar, proprietor of the workshop, who had also attended the conference, led the group to his workshop. His workshop continues to operate a large tank furnace from which crafts persons produce blown blooms from raw molten glass,

which are coloured with lead and then shattered to various sizes for export and local crafts use, especially in textiles.

The field trip to Kapadwanj was especially useful as it brought together many of the complexities which presentations had alluded to: the attrition in capacities for traditional crafts to sustain themselves and reproduce and a first-hand sense (for the first time for most participants) of the skill, technical excellence and physical endurance which glasswork demands. Discussions on site led by the first author of this article, stressed the need for a more pro-active and responsible approach to ethnoarchaeological engagement with crafts communities and the need on our part to listen and attend to their challenges, difficulties and collaborate in ways where our own institutional capacities may build more bridges than those which only supplement our research questions. In this spirit, the discussions on site ranged not only from the challenges of working with crafts communities who are operating under pressures of slimming economic margins, their challenges in sourcing raw materials from cullet to *ranga* (processed galena source), and in addition, attended through the examples of two abandoned furnaces to the vital questions of learning how to recognize and document in detail the special taphonomic processes that attend to the (mis)recognition of much debated primary glass production in the archaeological record. A deep sense of thankfulness and an indebtedness to the Sisgar family for their spirit of collaboration and their openness for this essential component of the workshop must be put on record.

Throughout the conference, a range of other resource persons were present and vital to the learning of all participants without making any paper presentations. These comprised three sets of master crafts persons. The first amongst these were two crafts persons (Nandlalji and Krishan-ji) from Banaras Beads Limited (BBL). The second group was of stone-bead crafts persons from Khambat, Anwar and Pratap-bhai, who had also previously been an invaluable part of the previous History, Science and Technology of stone beads workshop in 2015. The third were a group of women from the Rabari (Meghaben and Ashaben) and Miri (Sakinabe,

Madinabed and Zanab) communities, who demonstrated the care, attention and detail that the traditional beading work typical of the Kutch area requires and demands. It is from these resource persons and the generosity and patience with which they answered all questions put to them by the participants that the conference attempted to foster a considered mode of engagement with the glass crafts and traditions of India. While our studies must remain rooted in rigorous studies of their pasts, this exercise may best advance by standing as close as we can to the present crafts persons, learning from them to build stronger and more attentive accounts of the past of these crafts, but also understanding their challenges and predicaments as well.

For many of the participants, observing the lamp-wound beads was their first experience of the working of glass at close quarters. At once, interaction with the master crafts persons from BBL covered a range of topics and conversations. These ranged from the specificities of melting canes, combining colours, the clay separators used on the wires beads were wound around, the rates and kinds of failures, to the kinds of innovations in design they are regularly challenged to make. Participants also asked them questions about how they saw their role, of training other crafts persons, making design innovations and as within the multinational presence and reach of their company. While the academic arm of the conference instilled the relevance of such interactions to all participants, these resource persons, the crafts persons who were as much part of the conference as anyone else, shared their insights and observations on all questions and made the question of the history and future of glass crafts in India, not merely an academic one.

In a similar vein, the presence of the stone bead chipping (Anwar-bhai) and drilling (Pratap-bhai) master craftspersons provided avenues for many discussions. As none of the students from the first History, Science and Technology workshop (that had focused on stone beads) were also attending this workshop, their presence allowed these students to witness, interact and experiment with these craftspersons and come to grasp the complexities of

working with and drilling stones. Engagements with them moved from the basics of stone-identification to the reduction process and its complexities as well as the bow-drill apparatus used for drilling and its body-techniques.

Equally, their presence allowed discussions to resituate the focus on glass and the oceanic world of glass beads within the anterior and foundational craft that had first forged such widespread and far-flung networks in India. In the persons of Anwar-bhai and Pratap-bhai[2], inheritors of those histories of mastery and skill, conference participants were encouraged to think about these networks not solely as networks through which raw materials and finished products moved, not only in terms of the economies and polities that has thrived on such trade. Rather, in learning from them, all participants learned to think through the excellence and mastery which working these complex materials to scales of pre-industrial mass production requires.

In these ways, the efforts at engagement and in altering the inherited modes of archaeological engagement, the workshop attempted to bring the shadows of the crafts persons who stood behind the glass workshops at Chaul, at Khambat, or Papanaidupet and those who stitched these beads painstakingly into ornaments and clothes, into stark focus. Yet, beyond these efforts to build more inclusive and integrated modes of engaging with the material pasts and presents of crafts in South Asia, can we think of any cultural interventions that would instil a mass commitment to the use of such crafts products? In a world where archaeology pre-eminently learns from the communities of crafts persons who face ever-increasing economic hardships what measures should we take to ensure that our ethnographic field research and engagements do not remain as one-sided as they presently are?

---

2. Anwar Bahi and Pratab Bahi are two traditional artisans who performed/reproduced ancient glass objects in this workshop.

Artefacts of historiography: Emergent questions in South Asian glass history

How are we to reconsider the history of South Asian glass in light of these new developments? What points of departure should inform us? In conclusion, this article draws on the overviews at the conference given by the first author of this article.

We can begin by dismantling unhelpful debates over the origins of glass, glass making and widespread use in South Asia that rely solely on stray textual references as the chronological arbiter. To do so, is to relativise a series of otherwise difficult to understand textual references (in the *Satapatha Brahmana*, the *Arthasastra* and other texts) which have been much debated, and neither philology nor contextual reading can clarify their correlation with specific glass technologies (Kanungo 2008). If we step back to consider the wider problem of the relationship between text and archaeology, and attempt to understand the cultural worlds these texts arose in and their metaphorical allusions to glass and glass making, therein we can then presume much familiarity with the material.

Collating the archaeological evidence for glass in South Asia and studying the distribution by period amply demonstrates that by the Early Historic period (300 BCE - 400 CE) glass was not an item restricted to a few elites. Rather, its use was so widespread, it even drew partial prohibitions in the Buddhist *vinaya*. In its disciplinary programme, it makes clear that not only are *Bhikkhus* not to ornament their slippers but that shoes beaded with glass beads were a type so well-known that they were enumerated amongst the specific list of such prohibited footwear (*Mahavagga* V.8.3, Rhys Davids and Oldenburg 1882:23).

Despite this, a problem persists in Indian archaeology surrounding what we consider adequate evidence for the primary production of glass. On account of our expectations, both of the forms of evidence and a misunderstanding of the taphonomic processes that are active, we have discounted much evidence

that has been before our eyes and at the edge of our trowels. At Kopia, unambiguous evidence for a furnace has been found (Kanungo 2013; Kanungo and Brill 2009; Kanungo *et al.* 2010). The distinctive form and non-structural clay-only materials of the kiln, it must be stressed, were of a kind that have been commonly mistaken for hearths, if not 'altars'. If we could only let go of our expectations of both primary and secondary glass production sites in scale, we might be more alive to the kinds of traces which glass production leaves behind and which are easily observed in ethnoarchaeological fieldwork.

We must be alive to archaeological traces left by the seasonal exhaustion, destruction and rebuilding of kilns, the repeated abandonment of workshops and the profusion of the kinds of debris that they leave behind. Ethnoarchaeological fieldwork as conducted at Purdalpur/Purdilnagar and Papanaidupet makes clear trends visible, in a geography of waste heaps, fuel stores and workshops which we can expect to feasibly recover in excavations and even on survey (Kanungo 2001a, 2001b, 2004a, 2004b, 2006b, 2014, 2016). If only such finds, of the debris of glass production and its processing were more readily recognized and reported, we could build a denser history of glass working in South Asia and its modes of organization of labour, materials and workshops. When we find any vitreous slag or even a stray early vitreous find from prior to the early historic, we must weigh our own preconceptions and expectations against what the material evidence is actually teaching us.

Conversely, we must also draw upon ethnoarchaeological data to question the interpretation of the evidence we do have. Even data that appear transparent, like the recovery of a discrete deposit of a profusion of Indo-pacific beads, might mean very different things depending upon the glass cultures which were operative in that particular context. Among, the Bondo of Malkangiri the first author has established (Kanungo 2002), that in one house, where two women lived, their store of three sets of bead-clothes would alone amount to a quintal of such beads.

Only when we begin to be alive to these dimensions of the complex pasts of South Asian glass worlds, will we be attentive to the 'when and why' of changes in Indian glass crafts traditions, especially in the pre-colonial era, a task in which archaeology can contribute but has hitherto has not. Each artifact is a mirror and a looking glass: we must think of own preconceptions, commitments and limits as we consider the broken bead, the bangle fragment and the bottle shard and the South Asian pasts they allow us to peer into.

Acknowledgments

IITGN acknowledges financial support received from the Indian Council for Historical Research (ICHR), Indian Council of Social Science Research (ICSSR), National Science and Engineering Research Board (NSERB-DIA), Gujarat Council on Science and Technology (GUJCOST) and Directorate of Archaeology – Gujarat State. We thank the International Commission on Glass and the Elemental Analysis Facility – Field Museum for timely support for a few international airfares for speakers to attend the conference. We also would like to thank Banaras Beads Limited for logistical support to make the live glass bead making display possible during the conference.

References

Abraham, S.A. 2013. In search of craft and society: the glass beads of Early Historic Tamil South India, in *Connections and Complexity: New Approaches to the Archaeology of South Asia* (Eds. *Shinu Anna Abraham, Praveena Gullapalli, Teresa P Raczek, Uzma Z Rizvi),* pp. 239-261. Walnut Creek: Left Coast Press.

Abraham, S.A. 2016. Glass beads and glass production in early South India: Contextualizing Indo-Pacific bead manufacture, *Archaeological Research in Asia* 6: 4-15.

Basa, K.K. 1992. Early glass beads in India, *South Asian Studies* 8(1): 91-104.

Bhardwaj, H.C. (ed.) 1987. *Archaeometry of Glass: Proceedings of the Archaeometry Session of the XIV International Congress on Glass, 1986, New Delhi, India*. Calcutta: Indian Ceramic Society.

Bohingamuwa, W. 2017. *Sri Lanka and the Indian Ocean Contacts: Internal Networks and External Connections*. Unpublished PhD thesis. Oxford: University of Oxford.

Bouquillon, A., B. Barthe´lemy de Saizieu and A. Duval 1995. Glazed steatite beads from Merhgarh and Nausharo (Pakistani Balochistan), in *Materials Research Society Symposium Proceedings. Materials Issues in Art and Archaeology IV*, vol. 352 (Eds. P. Vandiver, J.R. Druzik, J.L. Galvan Madrid, I.C. Freestone and G. Segan Wheeler), pp. 527–538. Pennsylvania: Materials Research Society, Pittsburgh.

Brill, R.H. 1987. Chemical analyses of some early Indian glasses, in *Archaeometry of Glass – Proceedings of the Archaeometry Session of the XIVth International Congress on Glass – 1986* (Ed. H.C. Bhardwaj), pp. 1–25. New Delhi: Indian Ceramic Society, Calcutta.

Brill, R.H. 1999. *Chemical Analyses of Early Glasses*, 2 vols. New York: The Corning Museum of Glass.

Chakraborty, S. 1995. Beads from Chandraketugarh, *Pratna Samiksha* 4: 32-53.

Chakraborty, S. 2012. Exploring the Pattern of Distribution of Beads of Early Historic Period of South Asia, *Pratna Samiksha* 4: 15-29.

Dikshit, M.G. 1969. *History of Indian Glass*. Bombay: University of Bombay.

Dussubieux, L. 2016. Potash glass: a view from South and Southeast Asia, in *Recent Advances in the Scientific Research on Ancient Glass and Glaze* (Eds. Qinghui Li and Julian Henderson), pp. 95-111. World Scientific Publishing Co Pte Ltd.

Dussubieux, L. and B. Bellina 2018. Glass ornament production and trade polities in the Upper-Thai Peninsula during the Early Iron Age, *Archaeological Research in Asia* 13: 25-36.

Dussubieux, L., B. Gratuze and M. Blet-Lemarquand 2010. Mineral soda alumina glass: occurrence and meaning, *Journal of Archaeological Science* 37(7): 1646-1655.

Dussubieux, L., C.M. Kusimba, V. Gogte, S.B. Kusimba, B. Gratuze and R. Oka 2008. The trading of ancient glass beads: new analytical data from South Asian and East African soda–alumina glass beads, *Archaeometry* 50(5): 797-821.

Francis Jr., P. 1990. The greatest trade bead of all time, *Ornament* 13(3): 78–81.

Francis Jr., P. 1991. Beadmaking at Arikamedu and beyond, *World Archaeology* 23(1): 28-43.

Gill, M.S. and Rehren, T., 2014. The Intentional Use of Lead–tin Orange in Indian Islamic Glazes and Its Preliminary Characterization. *Archaeometry* 56(6): 1009-1023.

Gill, M.S. and T. Rehren 2011. Material Characterization of Ceramic Tile Mosaic From Two 17th Century Islamic Monuments In Northern India, *Archaeometry* 53(1): 22-36.

Gill, M.S. and T. Rehren 2017. An analytical evaluation of historic glazed tiles from Makli and Lahore, Pakistan, *Journal of Archaeological Science: Reports* 16: 266-275.

Gu, Z., J.M. Kenoyer and Y. Yang 2016. Investigation of ancient Harappan faience through LA-ICP-AES and SR-μ CT., *Journal of Instrumentation* 11(4): 1-9, p.C04001.

Kanungo, A.K. 2000. Bondo Costume Ornaments, *Ornament* 23(4): 20-21.

Kanungo, A.K. 2001a. Glass Beads in Indian Archaeology: An Ethnoarchaeological Approach, *Deccan College Post Graduate & Research Institute Bulletin* 60-61: 337-353.

Kanungo, A.K. 2001b. Glass Beads in India: Lamp Winding & Moulding Techniques, *Man and Environment* 26(2): 99-108.

Kanungo, A.K. 2002. Bondo Beads: an Ethnoarchaeological Approach, *South Asian Studies* 18: 121-128.

Kanungo, A.K. 2004a. *Glass Beads in Ancient India: An Ethnoarchaeological Approach*. Oxford: British Archaeological Reports International Series 1242.

Kanungo, A.K. 2004b. Glass Beads in Ancient India and Furnace-Wound

Beads at Purdalpur: An Ethnoarchaeological Approach, *Asian Perspective* 43(1): 123-150.

Kanungo, A.K. 2006a. Excavation at Kopia 2006: A Preliminary Report, *Puratattva* 36: 103-111.

Kanungo, A.K. 2006b. Glass Bead Production Centres: An Ethnoarchaeological Assessment, in *Past and Present Ethnoarchaeology in India* (G. Sengupta, S. Roychoudhury and S. Som Eds.), pp. 411-27. New Delhi: Pragati Publishers & Kolkota: CASTEI, India.

Kanungo, A.K. 2008. Glass in India, *Encyclopaedia of the History of Science, Technology and Medicine in Non-western Cultures*, Alpha – G, Part 7 (H. Selin Ed.), pp. 1023-1033. Netherlands: Springer.

Kanungo, A.K. 2010. Antiquity of Glass in India: Excavations at Kopia, in *Archaeology of the Ganga Basin: Paradigm Shift* (V. Tripathi and P. Upadhyay Eds.), pp. 451-476. Delhi: Sharada Publishing House.

Kanungo, A.K. 2013. *Glass in Ancient India: Excavations at Kopia*. Triruvananthapuram: Kerala Council for Historical Research.

Kanungo, A.K. 2014. *Indian Glass Beads: Archaeology to Ethnography*. New Delhi: Research India Press.

Kanungo, A.K. 2016. *Mapping Indo-Pacific Beads vis-à-vis Papanaidupet*. New Delhi / Madrid: Aryan Books International / International Commission on Glass.

Kanungo, A.K. and R.H. Brill 2009. Kopia, India's First Glassmaking Site: Dating and Chemical Analysis, *Journal of Glass Studies* 51: 11-25.

Kanungo, A.K. and V.N. Misra 2004. Excavation at Kopia: A Preliminary Report, *Puratattva* 34: 116-126.

Kanungo, A.K. and V.S. Shinde 2005. Excavation at Kopia 2005: A Preliminary Report, *Puratattva* 35: 126-134.

Kanungo, A.K., V.N. Misra, K. Dutta, G.V. Ravi Prasad, M.G. Yadava and G.W.L. Hodgins 2010. Radiocarbon Chronology of Kopia, an Early Glass Manufacturing Centre in India, *Archaeometry* 52(5): 899-918.

Kenoyer, J.M. 1994. Faience ornaments from Harappa and the Indus civilization, *Ornament* 17(3): 35-39.

Kock, J. and T. Sode 1995. *Glass, glass beads and glassmakers in Northern India*. Vanlose: THOT Print.

Kock, J. and T. Sode 2002. Medieval glass mirrors in southern Scandinavia and their technique, as still practiced in India, *Journal of Glass Studies* 44: 79-94.

Lankton, J.W., L. Dussubieux and B. Gratuze 2006. Glass from Khao Sam Kaeo: transferred technology for an early Southeast Asian exchange network, *Bulletin de l'École française d'Extrême-Orient* 93: 317-351.

Law, R.W. 2011. *Inter-regional interaction and urbanism in the ancient Indus Valley : a geologic provenience study of Harappa's rock and mineral assemblage.* Kyoto: Indus Project, Research Institute for Humanity and Nature.

McCarthy, B. 2008. Faience in Ancient South Asia, in *Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures* (Ed. H. Selin), pp. 915-917. Netherlands: Springer.

Miller, H.M.-L. 2008. The Indus Talc-Faience Complex: Types of Materials, Clues to Production, in *South Asian Archaeology 1999* (Ed. E.M. Raven), pp. 111-122. Groningen: Egbert Forsten.

Mitra, R. and K. Dalal 2005. A Report on the Glass Vessels from Sanjan, 2002, *Journal of Indian Ocean Archaeology* 2: 62-68.

Pion, C. and B. Gratuze 2016. Indo-Pacific glass beads from the Indian subcontinent in Early Merovingian graves (5th–6th century AD), *Archaeological Research in Asia* 6: 51-64.

Pion, C., B. Gratuze and A. De Poorter 2013. Made in India: des perles en verre provenant d'Asie du Sud en Gaul merovingienne. *Bulletin de Liaison: XXXIVe Journees Internationales d'Archaeologie Merovingienne* 37: 69-71.

Rhys Davids,T.W. and Oldenburg, H. 1882 Vinaya Texts: Translated from the Pali. (The Sacred Books of the East Vol. VVII), (Oxford, Clarendon Press)

Singh, R.N. 1989. *Ancient Indian glass: archaeology and technology*. Delhi: Parimal Publications.

Sode, T. and J. Kock 2001. Traditional raw glass production in northern India: the final stage of an ancient technology, *Journal of Glass Studies* 43: 155-169.

Sode, T., B. Gratuze and J. Lankton 2017. Red and orange high-alumina glass beads in 7th and 8th century Scandinavia: Evidence for long distance trade and local fabrication, *Annales du 20e congrès de l'Association Internationale pour l'Histoire du Verre* 2015, pp. 326-333.

Then-Obłuska, J. 2013. Medieval transcultural medium: beads and pendants from Makurian and post-Makurian Dongola in Nubia, *Polish Archaeology in the Mediterranean* 22: 679-720.

Then-Obłuska, J. and L. Dussubieux 2016. Glass bead trade in the Early Roman and Mamluk Quseir ports—A view from the Oriental Institute Museum assemblage, *Archaeological Research in Asia* 6: 81-103.

Uesugi, A., I. Nakai, M. Kumar, K. Yamahana, Y. Abe, J. Shirataki, K. Toyama and V. Dangi 2017. A Study on Faience Objects in the Ghaggar Plains during the Urban and Post-Urban Indus Periods, *Heritage* 5: 140-165.