

Women in Science at IUCAA

Since 2015, every year, 11 February is celebrated worldwide as the 'International Day of Women and Girls in Science'. This year's theme was 'Investment in Women and Girls in Science for Inclusive Green Growth'. This year, to celebrate this day, IUCAA, Pune organized a special programme for girl students and women teachers from schools across the city. Pushpa Khare (Utkal University, Bhubaneswar, Odisha) delivered a talk on foundations of Astronomy and major concepts involved. She talked about fundamental tenets of the universe, different celestial phenomena and bodies like the galaxy, solar system, stars and black holes. She also discussed in detail about how study of the universe is possible due to various types of radiations, including X-rays, gamma rays, UV rays, infrared rays and radio waves. She discussed about the temperature, mass, distance, and chemical composition of stars, concepts of galaxies, expansion of the uni-

verse, dark energy and speed of celestial bodies. She gave a broad overview of different significant projects of IUCAA like TMT, LIGO and Square Kilometre Array (SKA) projects. While simplifying concepts in the local language (Marathi) to the girl students, Khare encouraged them to take up a career in astronomy as more and more opportunities are opening up.

IUCAA also released a short film honouring the contribution of women astronomers from India and the globe (<https://www.youtube.com/watch?v=ASK-CmRQSlSk>), while showcasing young women astronomers currently working in the centre. The film featured tributes from women scientists working in IUCAA to global women scientists who are either forgotten or not recognized for their significant contribution to development of Astronomy.

Sonal Thorve (IUCAA) gave a talk on 'Astronomy without telescopes'. Samir

Dhurde (IUCAA) gave an introduction to the event in the presence of Somak Raychaudhury (Director, IUCAA).

This entire programme was webcasted (YouTube) and many school girl students from all over Maharashtra watched this live streaming.

Every stream of science has a rich history where women scientists have contributed immensely to solve fundamental mysteries of scientific progress. Science and gender equality are both vital for the achievement of the internationally agreed development goals, including the 2030 Agenda for Sustainable Development. In view of this, there is a need to celebrate 11 February each year with greater vigour and organized efforts to inspire more girls and women in science and research.

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MEETING REPORT

Ancient Indian glass*

The Archaeological Sciences Centre at the Indian Institute of Technology Gandhinagar (IITGN) has pursued a programme of organizing 'History, Science and Technology' workshops that focus upon a selected archaeological artifact class or material. The aim of these events has been to expose a selected group of students with an acute sense of specific problems and opportunities that are involved in the study of that material. This has taken shape in the motivation to host a conversation between the leading experts of the field, and equally to provide hands-on training in the ethnoarchaeological, experimental and scientific prospects of that particular field of archaeological research.

*A report on Conference-cum-Workshop on 'History, Science and Technology of Ancient Indian Glass' held at IIT-Gandhinagar, from 21 to 25 January 2019.

After publishing the results of the first workshop of the series on stone beads¹, the second workshop focused on ancient Indian glass. The experts included archaeologists who have had extensive experience of South Asian glass, and archaeological chemists with expertise in the elemental analysis of glass. In addition, it included established ethnohistorians and ethnoarchaeologists of South Asian glass and vitreous materials, alongside craftspersons who brought their lifelong and inherited skill, expertise and knowledge.

The five-day conference-cum-workshop involved four days of academic presentations and two field trips, that together covered veritably all aspects of the study of glass. These ranged from the origin of glass and faience, to the manufacturing techniques developed at different times in South Asia, and the regional distribution of key artifacts both within

and as traded far outside the region. Valuably, the talks also included detailed introductions and extended examples of the analytical chemistry of ancient glasses. Finally, the field trips gave exposure to the contemporary traditional glass-working and a world-famous archaeological heritage site of India.

This was organized into several panels; the first of these on 'Glass in General' included a series of foundational introductions to the study of glass. Prior to this, Thilo Rehren's (The Cyprus Institute) keynote introduced the chemistry of glass as a matter of three different components: the sand/quartz base to which a flux is added alongside the third component – a variety of 'spices' to colour, opacify and lend it special qualities. His talk provided an overview of the complexity involved in the study of trace element contributions from both the flux and colourants. He also stressed the need

to locate all archaeometric analyses within a sense of the contemporary glass cultures and elite networks of political economy that sustained them.

Laure Dussubieux's (Elemental Analysis Facility, Field Museum, Chicago) talk entitled 'Elemental compositions and glass recipes' provided a synoptic overview of the kinds of questions which can be chemically asked of glass artifacts. She usefully organized these into three kinds of questions. First come questions that can be asked of glass-making: (who made glass, where, with what technology, which ingredients, and what was the organization of primary production). Second come questions that we can ask of trade in glass: (who traded what, what trade in raw glass existed, how networks sustained varied trade), and finally questions of the use of glass. Thomas Fenn (University of Oklahoma) presented a third introductory foundational talk – which covered the prospects and challenges of using isotope systems to understand glass provenance networks. Bernard Gratuze's (CNRS Université d'Orléans, France) talk addressed the issue of the specificities of the transition from natron glasses to plant ash flux glasses and 'forest' glasses in the connected spheres of the Middle East and Western Europe at the end of the first millennium. This talk was a lesson in the kinds of detailed analysis that careful and innovative sample selection from well-dated assemblages combined with the precision of laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) can reveal. Stephen Koob (Corning Museum of Glass, New York) provided an introduction to the kinds of care which are demanded in the handling of glass. He provided a useful and detailed discussion of the preferred binders (paraloid B 72) that should be used in the conservation of glass. The last talk of the first day was by Joanna Then-Obluska, who provided a tour-de-force survey of the issues, challenges and attention to detail which the typological study of ancient glass beads demands. This talk admirably summarized the different methods by which ancient glass beads were made and provided excellent illustrations of their visible traces on artifacts.

The second panel focused on 'Proto-glass and faience'. Mark Kenoyer (University of Wisconsin, Madison) summarized the results of more than 20 years of the study of Harappan glazed

steatite and faience technologies. He provided the participants with a sense of the pyrotechnical virtuosity and playfulness with which they excelled at the manipulation of this material. He summarized not only the use of a range of instrumental techniques [ICP-MS, scanning electron microscope (SEM), and others] but also his extensive replication studies. Ivana Angelini (University of Padua, Italy) provided a second study of faience that involved small samples from both Harappa and Mohenjo-daro using confocal stereomicroscopy, X-ray powder diffraction alongside using the latter method with SEM for the study of vitreous slags. Bhuvan Vikrama (Archaeological Survey of India, Bhopal Circle) communicated the interesting finds from the recently excavated site of Sakatpur Mustakil, Saharanpur district, where a series of faience-working furnaces and extensive faience artifacts of Harappan style were found.

Three panels organized the discussion of 'Glass in South Asia'. Part 1 addressed ethnography and literature. Part 2 provided analytical surveys from 'Glass in different parts of South Asia'. Part 3 focused upon the present state of our understanding of the 'Circulation of South Asian Glass beyond South Asia'. In Part 1, Alok Kanungo (IIT-Gandhinagar) began by dismantling the unhelpful debates over the origins of glass, glass-making and widespread use in South Asia. He relativized a series of otherwise difficult to understand textual references (in the *Satapatha Brahmana*, *Arthashastra* and other texts) by pointing to how the metaphorical and allusive use of glass and glass-making must presume at least a few centuries of familiarity with the material. Turning to the evidence for production, he argued that the problem in Indian archaeology persisted on account of our expectations both on account of the forms of evidence and a misunderstanding of the taphonomic processes that are active. As a result, the distinctive debris of both glass production and glass-working is likely often misrecognized.

In the same vein, V. Selvakumar's (Tamil University, Thanjavur) talk provided a thorough and thought-provoking review of evidence for the production, use and status of glass in Tamil Nadu. The talk also provided a rich account of the historical evidence on glass-makers, and especially the caste of bangle traders

and makers known from Tamil inscriptions. Jan Kock (Aarhus University, Denmark) and Torben Sode (Glass Bead Trading, Denmark) presented over two papers, a precis of their work during the last several decades on Indian glass crafts – of primary glass production, beading and bead-work, and mirror-making.

Kanungo's talk on 'Glass crafts in northern India', in Part 2, exhorted participants to be attentive to the 'when and why' of changes in Indian glass crafts traditions. Shinu Abraham's (St Lawrence University, NY) talk concentrated on the revisions that the analysis of a sample of c. 5000 beads from Pattanam has afforded into the complex, which since Peter Francis Jr.'s formulation has been known as the 'Indo-Pacific beads complex'. Sharmi Chakraborty's (Centre for Archaeological Studies & Training, Eastern India, Kolkata) talk addressed the important issue of how to assess the scenario of glass beads and their use in a regional perspective using new methods such as cluster analysis in the case of early historic Bengal. Mudrit Trivedi's (University of Chicago) paper sought to revisit the questions of chronological change, typological diversity and cultural significance of the glass bangle, a much-neglected artifact type, as a new point of entry into the study of South Asian glass.

Talking about the cultural specificity of the site of Sanjan, especially in light of its association with the Parsi community, Kurush Dalal (Centre for Extra Mural Studies, University of Mumbai) and Rhea-Mitra Dalal detailed the range and density of 10th to 12th century glass tableware that they had recovered during excavations, including bottles, vials, footed plates, distillation apparatus, goblets and other items such as buttons. Massimo Vidale (University of Padua, Italy) and Angelini provided a detailed account of the development and origin of glassy materials at the site of Barikot in Swat valley, Pakistan, over the first millennium BCE, through to Kusana times. Wijerathne Bohingamuwa (University of Ruhuna, Sri Lanka) presented both a synthetic review of the voluminous evidence of glass production and use in ancient Sri Lanka. He provided first a site-wise and period-wise appraisal of the evidence and an equally valuable 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.

In part 3, Maninder Singh Gill (Art Conservation Solutions, Noida) presented results of his study investigating early Mughal architectural tile-work. He presented his 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. Gratuze 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 was from Western Europe and France in the period between 500 and 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. Fenn's case study of Indian glass beads in eastern and southern Africa added another layer of complexity by addressing the challenges of identifying the provenance of glass. 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. 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. The last paper of the conference, by Then-Obluska (Polish Centre of Mediterranean Archaeology, University of Warsaw) 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.

These diverse contributions brought together the challenges of studying the history, science and technology of ancient Indian glass in vivid detail. Considered together, they provided the best introduction to the complexities of regional diversity in glass traditions, the archaeometric challenges that stand before the field and the prospects of all we stand to learn from further investigations.

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 involved three sets of master

craftspersons which included two craftspersons from Banaras Beads Limited (BBL). The second group was of stone-bead craftspersons from Khambat (a chipping-grinding-polishing master and a drilling master). The third was a group of women from the Rabari and Miri communities in Gujarat, who demonstrated the care, attention and detail that traditional beading work typical of the Kutch area requires and demands.

For many of the participants, observing the lamp-winding of beads was their first experience of observing glass-working at close quarters. Interaction with the master craftspersons 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 that were wound around, the rates and kinds of failures, to the kinds of innovations in design they are regularly challenged to bring about.

In a similar vein, the presence of the stone-bead master craftspersons allowed the students to witness, interact and experiment with them 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.

All the participants also benefited from a specially invited workshop conducted by Mark Kenoyer and Massimo Vidale on the replication of Indus Valley faience technologies. The faience reproduction workshop was a truly unique component of the conference. It 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 pyrotechnological 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. In addition, the detailed demonstration of all parts of the process, the hands-on experience with all raw materials, and the ability to witness raw materials at various stages, as well as the transformation in them and the crucibles was invaluable.

The first of two field trips took participants to the last surviving tank furnace and traditional hot lead mirror workshop in Kapadwanj (Gujarat). It provided the kind of hands-on and on-site training that is impossible by any other means. The mirror workshop continues to produce convex hot lead-coated traditional mirrors, that find extensive use in local crafts, 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 (first time for most participants) of the skill, technical excellence and physical endurance which glasswork demands. The final component of the event was a field trip to the Archaeological Survey of India (ASI) excavations underway at Vadnagar, Gujarat.

The experts and participants at this truly international event were from 11 countries, including the United States of America, United Kingdom, France, Italy, Denmark, Cyprus, Poland, Malaysia, Thailand, Sri Lanka and India. It was gratifying to note that the participants represented 54 universities, research institutes, laboratories, museums and state departments.

The last major collective evaluation of the state of scientific interdisciplinary research on ancient Indian glass was made in 1987 (ref. 2). Similarly, the last monograph that had synthesized available data on the history of Indian glass was written a generation still earlier³. The conference-cum-workshop on the history, science and technology of ancient Indian glass aimed at filling precisely this gap. The description above has communicated the efforts made to provide as multi-faceted, thorough and valuable an experience to the next generation of researchers, who will, hopefully pose research questions and pursue methods of analysis that will build on, extend and exceed those reported here.

1. Kanungo, A. K. (ed.), *Stone Beads of South and Southeast Asia: Archaeology, Ethnography and Global Connections*, Aryan Books International, New Delhi; IITGN, Gandhinagar, 2017.
2. Bhardwaj, H. C. (ed.), *Archaeometry of Glass: Proceedings of the Archaeometry Session of the XIV International Congress*

On Glass, Indian Ceramic Society, Calcutta, 1986.

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

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MEETING REPORT

Anthropogenic impacts and their management options in different ecosystems of the Indian Himalayan Region*

The different ecosystems like snow or headwater from the northwestern to the northeastern Himalayan Region from mountains to riverine basins will be adversely affected due to rapid melting of glaciers/snow and erratic seasonal surface run-off flow. This may have direct or indirect implications on existing developmental interventions and economic activities such as hydropower projects, mass tourism, land-use components, biodiversity, riverine aquatic life, alternate livelihood options and above all human well-being. To know the primary status of climate change and related livelihood issues and to seek adaptive strategies, a series of four consultation meetings/workshops with a view to enhance capacity building of different representative stakeholders in different ecosystems of the Indian Himalayan Region (IHR) were organized.

Speaking to the audience on the occasion of all consultation meetings-cum-workshops, J. C. Kuniyal (JCK) (G.B.

Pant National Institute of Himalayan Environment and Sustainable Development) emphasized the need to create a healthy environment for a healthy life. He raised important environmental issues like solid waste problem and its management, black carbon emission, land-use changes and their impacts over the glacier environment and downslope regions with suitable mitigating measures. He reiterated the strong role of women in improving the Himalayan economy. He also deliberated on capacity building for women in rural areas to maintain their livelihood options, how to minimize solid waste problem under waste-to-energy initiatives and also how to combat climate change issues.

In the first meeting at Gagangir village in the Sindh Basin, Jammu and Kashmir (J&K), there were 74 participants. During the interactive session, the stakeholders, including senior citizens, public representatives of the village, government teachers and representatives from youth clubs during an interactive session raised issues related to deteriorating quality of drinking water supply, poor tourism development, poor road connectivity, need for upgradation of health and educational facilities, etc. They regretted how water bodies are being polluted by humans over the past decades. Project partners from the University of Kashmir highlighted the importance of environmental conservation and judicious use of natural resources. Natives spoke about deteriorating drinking water quality that causes waterborne diseases due to construction work of the Z-Morh road tunnel

near Gangangir in Ganderbal district, J&K. They mentioned that construction of the tunnel and indiscriminate dumping of debris have ruined the fragile environs along River Sindh.

The second workshop was conducted at CSIR-North East Institute of Science & Technology, Branch Laboratory, Lamphelat, Imphal Basin, Manipur, which had 25 participants, including officials, environmentalists, local residents, scholars and teachers. Here, Loktak Lake, the largest freshwater lake in North East India, covers about 61% of the wetland regime within Manipur River Basin. One of the representatives from the Loktak Development Authority, Manipur, raised concerns about the 'phumdis' (floating biomass) issue in Loktak Lake, causing excessive proliferation and choking of the central zone, deteriorating water quality, degrading catchment condition and siltation, and dwindling fish resources. This results in further deterioration of phumdi habitat in Keibul Lamjao National Park in Manipur. He also said the developmental activities for linking Loktak Lake with River Manipur have triggered fragmentation of useful wetland system. The Chief Conservator of Forest, Manipur spoke regarding poor diversity in the Changoung Forest in the Imphal Basin. This is due to repeated felling and burning of vegetation under jhum cultivation, heavy invasion by *Tithonia diversifolia*, *Lantana camara* and *Mikania*, etc. In the south Changoung, community forest protection needs to apply some scientific techniques. Floristic composition, corresponding

*A report on four consultative meeting organized under a National Mission on Himalayan Studies (NMHS) project titled, 'Anthropogenic impacts and their management options in different ecosystems of the Indian Himalayan Region'. Four consultative meetings were organized in 2017; first during 22–23 November at Gagangir village, Sindh Basin (Jammu & Kashmir), second from 1 to 3 December at CSIR-NEIST Branch Laboratory, Imphal Basin (Manipur), third on 7 December in Ranganadi Basin (Arunachal Pradesh) and fourth on 27 December at Gram Panchayat Bershaini in Parbati Basin (Himachal Pradesh).