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THE CONTRIBUTION OF GLASS STUDY TO EAST ASIAN ARCHAEOLOGY

A Panel at the Fourth Worldwide Conference of the Society for East Asian Archaeology, Beijing, 2-5 June, 2008

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The Fourth Worldwide Conference of the Society for East Asian Archaeology, held at the Institute of Archaeology of the Chinese Academy of Social Sciences, Beijing, from 2-5 June, 2008, included for the first time a special session focusing on 'The Contribution of Glass Study to East Asian Archaeology.' In spite of stiff competition from the six other concurrent panels, the glass panel was well attended, with approximately forty people squeezed into the seminar room.

While glass study has not yet made a great impact on the thinking of most archaeologists working in East Asia, we thought it would be worthwhile to introduce to a wider audience two complementary strands in current glass research: new techniques in the chemical and physical analysis of ancient glass, along with studies highlighting the usefulness of glass analysis in understanding the broader archaeological context. Our panel of nine presenters included representatives from most of the major groups working on early glass in China, Korea and Japan, fulfilling our second mission for the panel, to provide an opportunity for those involved in glass research in East Asia to get to know each other in a relaxed and supportive environment.

Professor AN Jiayao 安家瑶 from the Institute of Archaeology, CASS, opened the session with a warm welcome to all and a brief overview of glass research in China. Dr. Insook LEE 李仁淑, Director of the Busan Museum (釜山博物館), and a great pioneer in glass research in Korea, next reviewed some of the major issues in Korean glass study, concluding with a number of photographs of glass objects, both ornaments and vessels, excavated on the Korean peninsula.

Our third speaker, ZHAO Hongxia 赵虹霞, scientist in the laboratory of Professor GAN Fuxi 干福熹 at the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai, spoke on some of the earliest Western eye-beads found in Central China, presenting analytical results for eleven examples excavated from the Xu Jialing tomb 徐家岭 in Xichuan 淅川, Henan 河南 Province, dating to the early Warring States period, ca. 500 BCE. Using the nondestructive techniques X-ray diffraction (XRD) and Proton Induced X-ray Emission (PIXE), Miss ZHAO and her colleagues showed that these eye beads were made from soda-lime-silica glass, with the interpretation that these beads were imported from western Asia, rather than made in China where, slightly later, eye-beads were made from Chinese glass rich in lead and barium. Because PIXE measures only the outer surface of the glass, even though the beads appeared to be in excellent condition, the chemical results showed the expected depletion in soda and enrichment in alumina resulting from surface weathering of the glass.

Miss ZHAO also discussed some of the recent research activities of the Shanghai group, delivering a presentation by Professor GAN Fuxi, who was unable to attend the session. Professor GAN reviewed three types of artificial silicates, faience, frit and glass, produced in early China, suggesting that the earliest glass made in Central China belonged to the potash (potassium)-lime-silicate system. In addition, there were three major origins for early glass found in China: while some glass objects, such as the eye-beads from the Xu Jialing tomb, were clearly foreign imports, others were produced in China using local raw materials and either imported or indigenous techniques. Dr. GAN's presentation concluded with a very useful timeline of glass types in China.

Sergey LAPTEFF, Special Researcher at the Miho Museum, Shiga City 甲賀[市] (Japan), spoke next on the Far East and early Indian Ocean trade networks, presenting work done jointly with Dr. Sunil GUPTA, Allahabad Museum, India. The authors discuss the importance of Indo-Pacific beads, small, monochrome, drawn beads most likely produced at a number of locations in South and Southeast Asia, as an artefactual signature of this long distance trade. Further, they suggest four possible 'trade routes' for Indo-Pacific beads coming to Japan, most prominently in the Middle and Late Yayoi Periods (200 BCE-CE 250), based on the locations of bead finds in Southeast Asia, southern China and northeast Asia. All of these routes, whether by land or by sea, involve staging areas in southern China, in Guangdong 广东 – Guangxi 广西 or in the Yangzi 樣子 estuary. More detailed evidence for the various routes, based on quantitative chemical compositional data, will be an important addition to our understanding of early exchange systems. A highlight of the presentation was the illustration of beads and other materials from the Bronze/Iron Age site of Phum Snay in northwest Cambodia, the site of Dr. LAPTEFF's recent excavations.

Junko FURIHATA 降幡順子, Senior Research Scientist at the Nara National Research Institute for Cultural Properties, Japan, presented two innovative radiographic techniques for the nondestructive study of glass objects. The first of these, computed radiography (CR), uses a micro-focus X-ray beam and specially prepared imaging plate to examine two important properties of glass beads: their relative density to X-ray penetration, and their manufacturing technique as shown by internal structure. With this method, glass beads may be separated into those with higher and lower lead content. Further separation into potash and soda glasses may be accomplished using another method, auto-radiography (AR). In this case, the weak radiation naturally released by potassium is detected by X-ray imaging, and large numbers of beads may be divided into soda and potash groups. Taken together, the two methods should prove very helpful in processing excavated glass beads into their respective chemical systems using nondestructive means. Representative samples from each group could then be studied more intensively, whether by X-ray fluorescence (XRF) or some other technique.

Brigitte BORELL then brought us back to early glass in China, reporting on a group of Han 漢 period glass vessels found in Guangxi Province. Dr. BORELL has identified seventeen cups and shallow bowls that form a coherent group stylistically, and, based on the nine chemical analyses now available, compositionally. While the low-lime potash glass is relatively common in Southeast Asia as well, the form of the vessels is recognizably Chinese, providing evidence that at least the vessels, if not also the glass itself, were produced locally. In addition, Dr. BORELL suggested that a vessel fragment illustrated in Wheeler's report on the excavations at Arikamedu is stylistically identical to the Guangxi group. While Han ceramics are being increasingly recognized in Southeast Asia (see the SEAA abstract by Sophie PERONNET at *http://seaa-web.org/arc-con-bei-abs.htm*), the Arikamedu fragment would be the only known example of a Han glass vessel found in South or Southeast Asia.

James LANKTON next presented a paper jointly authored by Insook LEE and Gyu-Ho KIM 金奎虎 reviewing the glass bead evidence from Byeonhan 弁韓 and early Gaya 伽倻 cemeteries at Gimhae 金海[市] – Yangdong-ri 良洞里 and Bokcheon-dong 福泉洞, both located in the far southern Korean peninsula. Dr. LEE had suggested in 1993 that there were four types of early glass in Korea, and we now recognize these as lead-barium glass from China, potash glass possibly from Southeast Asia, soda glass from South or Southeast Asia and lead-silica glass, with evidence for Korean production given by Dr. Gyu-Ho KIM in this panel. In order to explore the transitions from one glass type to another, we studied the chemical composition of glass beads from Gimhae–Yangdong-ri, finding support for a gradual transition from potash to soda glass from the 1st to the 5th century, with evidence for two types of potash glass and at least three types of soda glass. While previous work was based on the measurement of major elements only, the addition of trace element data from laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) has greatly increased the power of the chemical data, and we now find evidence for at least two exchange systems for early glass in Korea: one via Funan-controlled sites in Southeast Asia, and another

directly by sea from South Asia, with compositional evidence pointing toward glass bead production at Arikamedu. We look forward to similarly fine-grained data for glass found in southern China, a likely stop on the Glass Road from India to Korea.

Kriengkamol TANTRAKARN, a Thai PhD student in the Department of Applied Chemistry at Tokyo University of Science, brought us up to date with the latest results in 'No-touch, onsite' glass analysis using portable X-ray fluorescence spectrometry (P-XRF), specially adapted for glass analysis. After reviewing a number of studies of ancient glass in the Middle East and Southeast Asia, jointly performed with his PhD supervisor Professor NAKAI, TANTRAKARN then presented several very useful comparisons of glass analytical data from polished *vs*. unpolished surfaces and P-XRF *vs*. LA-ICP-MS data for the same glass samples. While LA-ICP-MS is clearly a superior technique in terms of accuracy and range of trace elements measured, the P-XRF data was also excellent, supporting an important role for P-XRF in answering many archaeological questions. Further, the P-XRF results on unprepared samples, provided the samples showed little visible weathering, were also quite acceptable for many applications. This author was very impressed that the hard work and attention to detail of the Tokyo University of Science team have transformed P-XRF from a curiosity to a very useful tool in studying ancient glass.

Gyu-Ho KIM reviewed some of the earliest archaeological evidence for primary glass production in East Asia from seventh century Wanggung-ri, a Baekje 百濟 Kingdom site in southwest Korea with extensive evidence for both metal production (copper and gold) and glass manufacture. Ceramic crucibles, some with lids, were used to melt glass, most of which had a consistent lead-silica composition. Few finished glass objects were found at Wanggung-ri 王宮里, and it is likely that the lead-silica glass produced there was used elsewhere for glazing roof and wall tiles and pottery. Lead isotope analysis of the excavated glass links Wanggung-ri to nearby Mireuksa 彌勒寺, a slightly later Baekje site, as well as to the Asuka-ike 飛鳥池 workshop remains in Nara 奈良, Japan. Planned investigations including trace element measurement by neutron activation analysis (NAA) and LA-ICP-MS will help to clarify the relationships between these important early glass manufacturing centers.

AN Jiayao was our final speaker, reviewing evidence for the production of blown glass vessels at Datong 大同, an early capital of the Northern Wei 魏 Dynasty. Historical records in the chapter on Darouzhi 大肉氏 (Da Yuezhi 大月氏) people in the *Bei shi* 北史 suggest that in the mid-5th century Bactrians manufactured glass in the vicinity of Datong. Comparing the available compositional and stylistic evidence, Professor AN suggested that glass vessels found in a stone coffer at the Yingxian 应县 Pagoda, along with those from recently (2001) excavated Northern Wei tombs near Datong city, may represent evidence for this local glass vessel production. Further, quantitative, chemical compositional analyses would no doubt provide important evidence to illuminate this important transition toward increasing technological complexity and local substitution for imported luxury goods.

Taken together, the ten glass panel papers illustrate the importance of glass study as an interface between traditional archaeology and the scientific analysis of archaeological materials. Analytical technique remains a critical issue in the study of glass in Asia, and, while the innovative approaches presented by FURIHATA and TANTRAKARN extend the potential for nondestructive glass analysis, the existing limitation to surface analysis may always preclude the truly quantitative measurements needed for such fine-grained questions as origins and exchange mechanisms. For these archaeologically important issues, strategic sampling by such 'virtually non-destructive' techniques as LA-ICP-MS may open the way to future understanding.

The SEAA glass panel was organized by James LANKTON and LIN Yi-Xian 林怡娴 a PhD student at the University of Science and Technology, Beijing, whose poster presentation on excavated glass from Xinjiang 新疆 formed a useful extension to the panel presentations. Our sincere appreciation goes to all of the panel participants for their efforts and courage in presenting their work in English. We missed the participation of Dr. Robert BRILL, Corning Museum of Glass; Professor GAN Fuxi, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai; Dr. Sunil GUPTA, Allahabad Museum, India; Dr. Yoshi IIZUKA 飯塚義之, Institute of Earth Sciences, Academia Sinica, Taipei; and Dr. LI Quinghui 李青会, Department of Applied Chemistry, Tokyo University of Science, who were unable to attend this year's conference, but hope to see them all, plus other scholars working on glass in East Asia, at the Fifth Worldwide SEAA conference, in all probability to be held in Kyūshū, Japan, in 2012.