High-Tin Bronze Mirrors of Kerala, South India

High-tin bronze (copper with 20-30% tin) has been used in various ancient cultures to make mirrors. This alloy, also known as speculum, has a bright reflective surface when polished. In Ancient China, decorated mirrors were widely made from the Chou dynasty onwards for cosmetic, decorative and other uses. Typical Han Chinese mirrors were often cast from leaded high-tin bronze with about 25% tin and 5% lead (Meeks, 1993). There are examples of mirrors from the Roman world which were also leaded high-tin bronze. A variation during Roman times utilized low-tin bronze alloys, but with a tin coating on the reflective surface. Mirrors in antiquity represent a special class of metal object requiring specific metallic properties. In addition to technical studies of ancient mirrors, observations of traditional metallurgical crafts may also be used to increase our understanding of mirror production using high-tin bronze alloys.

A distinctive traditional process for making cast, high-tin bronze mirrors exists in several small villages in South India. The process received little attention from archaeologists, anthropologists or metallurgists, until the first publication of the process by Mukherjee (1978). There are, however, many aspects of this specialized traditional craft which were not considered at that time. As this traditional craft may yet vanish, the opportunity was taken to observe and document the process recently in the Allepey district of Kerala. There still remain several small, specialised groups of metal craftsmen utilizing the distinctive material properties of high-tin bronze to produce mirrors as well as bells, musical instruments and wrought vessels. Such utilitarian objects of high-tin bronze also appear to have been commonly used in Ancient India, so study of the traditional craft adds an additional perspective for the archaeological mirrors.

The metals craftsmen at the village of Aranmula in the Allepey District of Kerala, about 15 km from Changanur on the banks of the Pamba river, were visited on several occasions in 1992-93. Most helpful was a Mr. A. Gopalakrishnan (Fig. 1), one of the few artisans who still carries on this traditional craft, which he claims has been in danger of dying out altogether. Economically, it was the interest of foreign tourists at a nearby ashram (religious commune) which has helped revive the craft. Mr Gopalakrishnan makes polished high-tin bronze mirrors mounted in brass handles. The high-tin bronze mirrors,
The mirror blank was then mounted with wax onto a thick rectangular wooden polishing block with a rear handle. The blank was then carefully polished with even pressure against a hessian cloth placed on a wooden board, using coarse and fine polishing powders consisting of burnt mound material mixed with powdered mirror alloy and oil for lubrication. The polishing took several days. Final buffing was given with finely crushed red oxide (hematite) which is also used to clean the mirror face from time to time when it tarnishes. The oval mirror was removed from the polishing block by melting the wax. The polished mirror was fitted, using wax, into a handle frame made of brass. Mr Gopalakrishnan of Aranmula advised that to prevent tarnishing, the mirror should be given a polish occasionally using red oxide or vermilion, while grease was to be cleaned off by rubbing the surface with solidified coconut oil.

Metallographic sections of a finished mirror from Aranmula and an as-cast alloy fragment from Malakkara were examined using optical microscopy and the JEOL electron probe microanalysis (EPMA) at the Wolfson Archaeological Science Laboratory at the Institute of Archaeology, UCL. Structures of both show predominantly delta phase with the eutectoid matrix of alpha plus delta. EPMA confirmed the identification of delta phase with 32-34% tin, while the eutectoid had lower concentrations of tin. The microhardness ranged between 390-440 VPN. The high-tin alloy has a typical silver-white colour and it is hard, brittle and relatively corrosion resistant. When polished, it has optical effects which are responsible for the catoptric or mirror-like properties. It is noteworthy that craftsmen from both villages used approximately the same alloy compositions with 32-34% tin.

The contemporary mirror makers of Aranmula believe that their technique has indigenous local origins. Mr Gopalakrishnan said that his trade had a history of at least five hundred years passed down through generations, practised only by acharis (master craftsmen) who had the status of Brahmins. Reportedly, they had migrated from Sankarakoil in Thiruvallur, Tamil Nadu, to Kerala about 700 years ago. These acharis claimed Pandyan decent. Mr Gopalakrishnan said that the local technique for mirror casting had been divined by his ancestors through a vision of the Goddess.

There is a legend about the origin of the Aranmula mirrors which was told by Mr Janardhana Achary of Malakkara. In the 16th century, the Raja of Aranmula brought to the village some bronze craftsmen from Tamil Nadu in order to make ornaments and musical instruments for the temple. Growing fat and lazy on the products of the land granted to them, the

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**Fig. 1.** Mr Gopalakrishnan makes and sells high-tin bronze mirrors in the village of Aranmula in the Alleppey District of Kerala. His foundry is one of the few remaining that make mirrors using traditional techniques.

**Figure 2.** The mould and crucible are attached allowing the molten metal to be cast simply by inverting the assemblage. The mould may be seen above the crucible which is covered by burning charcoal in the front centre of the photograph.
Raja threatened to withdraw their privileges and evict them from his territory. After prayers and discussion, a widow Smt Parvati Ammal had a dream in which Lord Parthasarathy revealed to her the secret of combining copper and tin in the right proportions to make a shining metal with a reflective crystal surface. They made a crown of this material for the Raja who relected and encouraged them to use the metal for Valkannadi (mirrors), one of eight articles in the Ashtamangalya sets. Traditionally this type of mirror was used only by royalty and brahmans because of its ritual associations and also in tantric worship in shrines such as Sabarimalai.

Metal mirrors were also one of the asthamangalayam or eight auspicious items which were important for the prosperity of each household. Mirrors were also one of the asthamangalayam which formed the wedding trousseau of Nambruthi and Nair brides of Kerala. Mirrors as an item in the asthamangalayam as described by the acharis are depicted as early as the Kushan period in a Jaina votive tablet of the 1st-2nd centuries AD (Czuma, 1985).

Different types of mirrors are also commonly depicted in Indian sculpture as being held by deities, celestial maidens and dancers from the early historic periods into the medieval period in North and South India. Stone sculptural panels and friezes depicting such mirrors include the Sunga Yaskhi from Barhut (3rd century BC), the Kushan Yaskhi or Tree Goddess from Sanghol (1st century AD) and several from the medieval period such as a Hoysala dancer and a deity from Konarak and two apsaras (celestial maidens) from Khajuraho (Keay, 1981). A few archaeological finds of mirrors are reported from widely separated contexts such as the tanged planar mirrors from the Indus valley civilisation (c. 3000 BC), others from the Nilgiri megaliths (mid to late 1st millennium BC) in southern India, and from Sattavahana hoards (1st century BC - 2nd century AD). However, scarcely any analytical work is reported, except for two mirrors from the Gandharan grave culture of the 1st millennium BC found at the important archaeological site of Taxila. The reported compositions of the two mirrors are 22% and 24.8% tin (Marshall, 1951).

One suspects that the use of high-tin bronze has a long history in the Indian subcontinent, particularly in Southern India, to make wrought and quenched bowls, gongs, cymbals, coinage, mirrors and other items. The accounts by traditional craftsmen agree that mirror making from Arannula has certainly some local antiquity. The numerous iconographic representations of mirrors in Indian art represent use and associations of distinctive metal products. When viewed from a metallurgical perspective, however, the investigation of high-tin bronze mirrors reveals fascinating insights into technical accomplishments and fine craftsmanship.

Sharada Srinivasan and Ian Glover

References


Gopalakrishnan, A. 1992, personal communication.

Janarthanan Achary, M.S. 1992, personal communication.


From the Director’s Desk

The Director and the Trustees of IAMS welcome our new Trustee, Professor Peter Ucko, the recently-appointed Director of the Institute of Archaeology, University College London.

In the light of the changes to the *IAMS Newsletter*, which in the past concentrated on work done within our research group, members of the Scientific Committee of IAMS proposed to widen the orbit of *IAMS* to become a refereed journal of archaeometallurgy starting with the next issue, No. 21. *IAMS* will publish compact reports on ongoing research and we are inviting our colleagues to contribute papers. Peter Clayton and John Merkel will continue to be the editors of *IAMS*, assisted by members of the Scientific Committee.

Subscriptions will be invited for Volume 3 (parts 1 and 2) of *Researches in the Arabah: The Ancient Copper Mining and Smelting in the Western Arabah*, edited by Ben Rothenberg and C. Tim Shaw, which is now going to press. These volumes will contain the final reports of all excavations carried out by IAMS between the years 1964 to 1990 on the mine and smelting sites, dating from the Late Neolithic period to medieval times, of the south-western Arabah. These reports also contain numerous specialist reports on all the finds, plus hundreds of photographs, drawings and maps. Subscriptions received for Vol. 3 (parts 1 and 2) before the date of publication will entitle the purchaser to a 50% price reduction, and for a similar reduction for Vol. 1 (*The Timna Mining Temple, 1988*) and/or Vol. 2 (*The Ancient Metallurgy of Copper, 1990*).

During the past few years, IAMS has been involved in cooperative projects with the Supreme Council of Antiquities (SCA) and Cairo University in Egypt. Along with the SCA, in April 1995 IAMS co-sponsored the first International Conference on Ancient Egyptian Mining and Metallurgy and Conservation of Metallic Artefacts. In the following summer, IAMS presented a summer course in archaeometallurgy at the El Tabbin Institute of Metallurgical Studies (TIMS). In the summer of 1996, along with conservation staff from the SCA and Cairo University, the Institute of Archaeology at UCL presented a summer programme on archaeological conservation at the Tabbin Institute. Dr Merkel lectured on the conservation of metallic artefacts. The second conference on Ancient Mining and Metallurgy and Conservation took place on 14-16 April 1998. IAMS was again a co-sponsor for the conference. The Institute of Archaeology UCL and the Royal School of Mines, Imperial College, were also sponsors from the UK.