Volume 24 No. 4. October 1994

The Journal of Gemmology

The Gemmological Association and
Gem Testing Laboratory of Great Britain

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VOLUME 24

NUMBER 4 OCTOBER 1994

Cover Picture

The Hope Pearl in its crown setting. *Photograph: Mikimoto.*
(See The Hope Pearl p. 235)

ISSN: 1355-4565

Editorial

The first two papers in this issue of the *Journal* concern pearls. The Hope Pearl is famous through a connection with Tavernier in 1669 and derives its name from being part of the Hope collection of gems in the 1830s.

Over time this collection has been dispersed but parts are still identifiable notably in the Smithsonian Institution and in the Natural History Museum, London. This is the first modern professional gemmological description of the Hope Pearl to appear in print.

The roots of gemmology lie in the application of mineralogical, physical or chemical techniques to the solution of gem problems and the second pearl paper extends this concept to the discipline of biomineralization. There is considerable research today into how organic tissues secrete and deposit solid matter and the application of some of these ideas has led the authors to conclusions of importance to the future of the cultured pearl industry.

The third paper takes us from sea level (or below) to high in the western Himalayas where the gems of Afghanistan are the subject of renewed exploration and development. To date, however, their historical background has been the result of much speculation and a thorough summary of the known records, long overdue, is published in this issue. Some famous gems in the world's regalia may well have their origins in northern Afghanistan and the evidence is assessed.

Papers on Burmese gems have been increasing in frequency in the past few years and here the first of two accounts of the jades of Myanmar by two authors on the spot in Yangon deals with their composition. The constituent minerals and chemistry of a representative range of different coloured jades are described and related to an extensive set of illustrations.

Two short papers complete the contents of this issue: new dendritic opals are described from Zambia and a new appearance in the trade of a star ruby imitation is reported by Dr Schmetzer. The latter material is dyed star corundum and is plainly being produced to tempt the unwary public; however, advice on how to recognize these treated stones is clearly outlined.

R.R.H.

The Hope Pearl

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Abstract

The Hope Pearl and its crown setting is described and the history of the item is reviewed. The pearl was examined by fluorescence emission spectrometry, reflection spectrophotometry, X-ray fluorescence analysis and X-ray radiography. Surface features and the X-ray radiograph proved it to be a natural blister pearl. A peak at 620nm in the fluorescence emission spectrum indicates the presence of porphyrin in the coloured base of the pearl. The reflection spectrum confirms the presence of porphyrin as well as displaying a trough at 700nm characteristic for a black pigment found in Black-lip pearls from the *Pinctada margaritifera* oyster.

Introduction

In 1993 the London Laboratory was privileged to examine one of the larger pearls known to exist. The Hope Pearl was purchased by H.E. Mohammed Mahdi Al-Tajir in 1974 from Gerards, the Paris jewellers (personal communication). The pearl formed part of the Christie's exhibition in 1989 called *The glory of the goldsmith - magnificent gold and silver from the Al-Tajir collection*. Last year, under a loan agreement, the pearl was to be taken from London to Tokyo to be the centrepiece of an exhibition arranged by K. Mikimoto & Company. The pearl was examined by X-ray radiography and its surface was closely inspected before departure, and the laboratory was asked to assess whether any

Fig. 1. The Hope Pearl, viewed from the front (left), from the right-hand side (centre) and from the back (right). *Photos: Mikimoto.*

ISSN: 1355-4565

damage had been suffered by the pearl when it was returned to London. Once in Japan much more extensive research was carried out at the Mikimoto Pearl Research Laboratory at Toba, Toba-shi, Mie-ken.

Description and History

The Hope Pearl (Figure 1 and cover picture) is roughly drop-shaped with irregular channels on the surface around the base. The narrower top of the pearl is white in colour with a bright orient whereas the broader base graduates to an iridescent greyish-purple. The narrow top end of the pearl is capped with a gem-set, red-enamelled, gold-coloured metal arched crown pendant fitting. The item measures approximately 9cm in length from the top of the crown fitting to the base of the pearl. The broader base of the pearl varies in width between approximately 3cm to 4cm (Figure 2). The whole item of jewellery weighs 134.6 grams.

The crown fitting has been set with 70 diamonds in the arches and the pendant ring part of the fitting, and three rectangular natural emeralds, four round natural rubies and two blue lozenge-shaped pastes are set in the front part of the band of the crown fitting. The blue, orange, and green 'gem-shapes' on the reverse part of the crown band (Figure 3) are small enamelled geometric shapes giving an appearance of set gems. In addition to these small areas of enamel there is also a large area of red enamel on the cap underneath the arches of the crown.

The pearl itself is reputed to weigh 450ct or 1800 grains. As its name implies, the pearl formed part of the famed collection of the London banker Henry Philip Hope, which was assembled in the early 1800s. The collection, which was catalogued by Bram Hertz in 1839, is probably best known for the 45.52ct deep-blue Hope Diamond. The previous history of the pearl is sketchy but reference (Dickinson, 1968) is made to it having been purchased in India by Jean Baptiste Tavernier, the jewel merchant, in the mid-seventeenth century. The pearl is believed to have been sold to Louis XIV, possibly when the two met in 1669 (Tavernier, J.B., English translation 1889).

Henry Philip Hope died in 1839 and the pearl was passed down through the family. Mr A.J. Beresford-Hope loaned the pearl to the South Kensington Museum (Streeter, 1886) at some stage subsequent to its opening in 1881. The pearl was sold with other gemstones from the Hope collection in 1886 by the auctioneers Christie & Manson. Garrard & Co. of London purchased the pearl and it is known that it was being offered for sale in 1908 at £9000 (Kunz and Stevenson, 1908). As mentioned above the pearl was purchased in 1974 for a figure that has been quoted at $200,000 (Newman, 1981). At some time prior to this the pearl had been exhibited at the Smithsonian Institution in Washington (Taburiaux, 1985).

Investigation methods

In addition to microscopic and fibrescope examination the following techniques were also used in examining the pearl:

Ultra-violet fluorescence

The fluorescent colours emitted by a pearl when irradiated by ultra-violet light may yield information concerning the species of the mother oyster (Sawada, 1958; Miyoshi *et al.*, 1987 a and b).

Fluorescence emission spectrometry

The different fluorescent colours emitted by pearls originating from certain oysters can produce characteristic fluorescence emission spectra. Black pearls from the black-lipped *Pinctada margaritifera* (Miyoshi *et al.*, 1987 a and b) and pearls from the Mabe *Pteria penguin* can be distinguished from other pearls by the presence of a peak at 620nm in their fluorescence emission spectra (Figure 4), which is due to the presence of porphyrin. The fluorescent

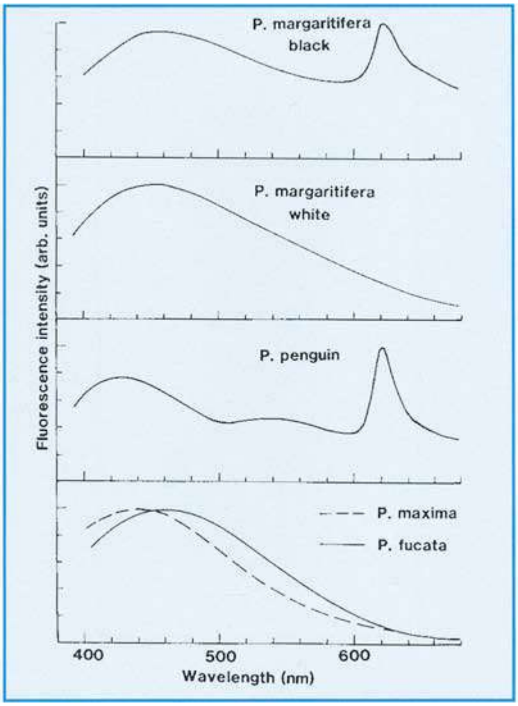

Fig. 4. Fluorescence emission spectra of the nacre from different types of oysters, showing how the nacre from *Pteria penguin* and the black nacred *Pinctada margaritifera* differ from the nacre of other oysters by the presence of a peak at 620nm.

emission characteristics of the coloured base of the Hope Pearl were measured with a Nihon Bunko spectrofluorophotometer Model FP770 at an excitation wavelength of 400 nanometres.

Reflection spectrophotometry

The pigmentation of coloured pearls can also give rise to specific reflection spectra in the visible region for particular pearl-producing oysters (Wada, 1983). The reflection spectra for grey *Pinctada margaritifera* pearls display a trough at 700nm whereas the spectra for *Pteria penguin* pearls do not show the trough (Figure 5). A reflection spectrum was obtained from the iridescent greyish-purple base of the Hope Pearl using a CMS-35sp spectrophotometer from the Murakami Color Research Laboratory.

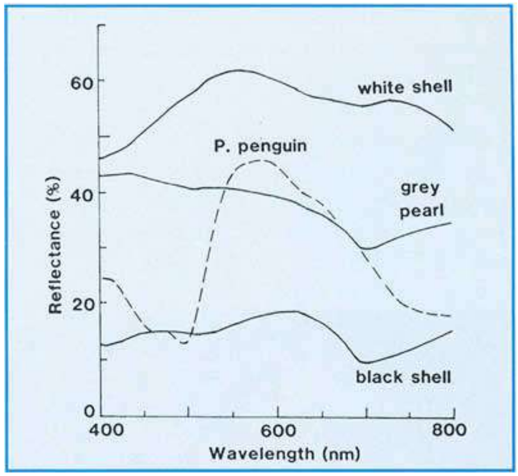

Fig. 5. Optical reflection spectra of a pearl and the shells of *Pinctada margaritifera* (solid curves) and the reddish-brown shell of *Pteria penguin* (dashed curve), which can be differentiated on the basis of a trough at 700nm in the spectra for *Pinctada margaritifera*.

X-ray fluorescence analysis

The main inorganic component of pearl is calcium carbonate. The chemical composition also includes some minor elements, of which the relative amounts of manganese and strontium have been found to be an important indicator of the species of the pearl-producing mother oyster.

Freshwater pearls can be differentiated from marine oyster pearls on the basis that the latter have lower concentrations of manganese and higher concentrations of strontium (Wada and Fujinuki, 1988). Amongst seawater pearls strontium is found in slightly greater concentrations in Black-lip *(Pinctada margaritifera)* and White-lip *(Pinctada maxima)* pearls than in Akoya *(Pinctada fucata)* pearls. The Hope Pearl was analysed for calcium, manganese and strontium by Energy Dispersive X-ray spectrometry using Seiko Model SEA 2001.

X-ray radiography

The internal structure of the Hope Pearl was revealed by X-ray radiography. In Japan the radiographs were obtained using a SOFTEX CMB-2 set. In London the specially designed X-ray set uses a Machlett fine focus diffraction tube with a molybdenum anode target.

Results and discussion

Visual examination of the reverse side of the Hope Pearl reveals the growth lines that prove the pearl was attached to the shell (Figure 6) and should therefore be described as a natural blister pearl. At higher magnification the striped pattern of overlapping platelets (Figure 7) characteristic of nacreous bivalves can be seen. The fact that light from the fibrescope could not penetrate very far through the surface of the pearl indicates that it consists mainly of solid calcium carbonate, and this was confirmed by the X-ray radiographs (Figure 8).

Fig. 6. Surface growth lines on the back of the Hope Pearl indicating its blister origin. 5x.

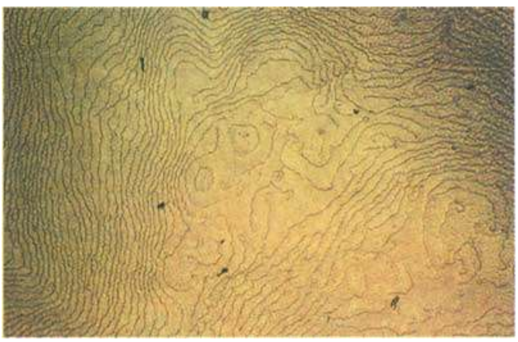

Fig. 7. Overlapping platy crystal structure on the surface of the Hope Pearl typical of pearls from nacreous bivalves. 25x.

Fig. 8. Positive photograph of the X-radiograph taken of the Hope Pearl.

The presence of the organic component conchiolin is recorded on the radiograph negative (not shown) by a series of faint growth lines sweeping across the body of the pearl to its edge; this pattern is typical for a natural blister pearl which has grown away from the inner surface of the shell.

The coloured base of the pearl fluoresces a reddish colour under ultra-violet light, and this suggests the presence of porphyrin pigment known to exist in Black-lip (Iwahashi and Akamatsu, 1994) and Mabe pearls (Comfort, 1949).

The fluorescence emission spectra recorded under 400nm radiation contain a peak at 620nm (Figure 9), confirming that the pigment is porphyrin, which can be found in both Black-lip and Mabe pearls.

Porphyrin also gives rise to the troughs at 400nm and 500nm in the reflection spectra (Figure 10a and b). More importantly the trough at 700nm (Figure 10c) is characteristic for a black pigment contained in the Black-lip pearl.

The X-ray fluorescence analysis reveals concentrations (cation %) of 99.54% for

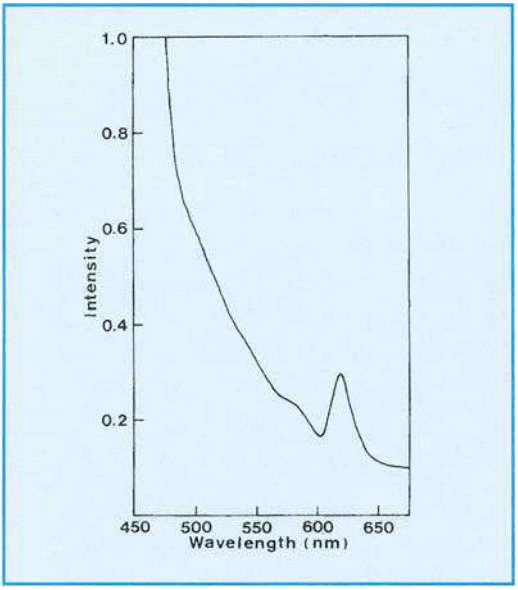

Fig. 9. Fluorescence emission spectrum of the Hope Pearl showing the presence of the peak at 620nm.

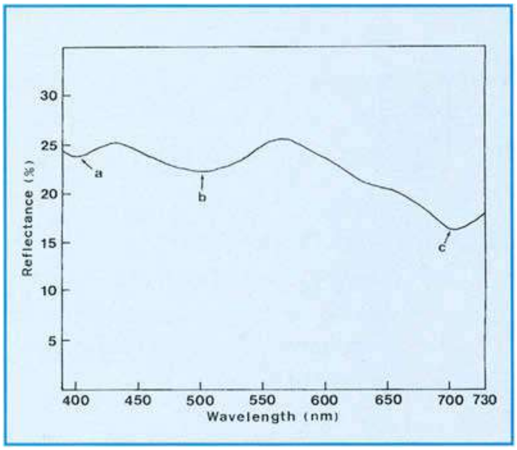

Fig. 10. Optical reflection spectrum of the Hope Pearl. The troughs at (a) and (b) relate to porphyrin, the trough (c) at 700nm is typical for a black pigment contained in *Pinctada margaritifera.*

calcium, 0.42% for strontium, and 0.04% for manganese. The relatively low concentration of manganese and high concentration of strontium point to a marine origin for the Hope Pearl.

Conclusions

The Hope Pearl is a natural blister pearl of solid nacre. The pigments present in the bronzed area indicate that the Black-lip oyster *(Pinctada margaritifera)* is the most likely source of the pearl.

Acknowledgements

The authors wish to convey their thanks to the owner, H.E. Mahdi Mohammed Al-Tajir, for his permission to publish this article.

SJK would like to thank his colleague Ana Isabel Castro who examined the pearl with him. He would also like to acknowledge all the assistance given by Mr Ryo Yamaguchi. Further thanks from the London author go to Nick Silver, who arranged for the London Laboratory's involvement in the project.

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