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Cover Picture

Fabergé carving of John Bull, made from purpurine, lapis lazuli, white quartzite, jasper, aventurine quartz and sapphire (eyes).
Photograph by E. A. Jobbins

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The composition of an opaque red glass used by Fabergé

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Abstract

Opaque red glasses used by Fabergé in decorative carvings have been analysed by electron probe microanalysis and inductively coupled plasma spectrometry for major and minor elements. They are alkali-lead-silica glasses coloured by cuprous oxide (cuprite). The use of the terms purpurine and hematinon to describe the glass is discussed and purpurine provisionally preferred. The analyses are compared with those of red glass from the first and second millennia BC, and with those of aventurine glass or goldstone.

Introduction

An opaque red glass called hematinon or purpurine has been used by Fabergé as an ornamental material in the manufacture of boxes and carved figures. The present interest in the material arose as a result of discussions in 1984 between Mr A. K. Snowman and Mr G. C. Munn, of the firm of Wartski, and Mr E. A. Jobbins, then of the Institute of Geological Sciences, during which it became apparent that there was no general public knowledge of the composition of the glass, and in particular of the cause of its intense red colour. A programme was thus put in hand to remedy the first of these deficiencies firstly in the Geological Museum and subsequently in the British Museum (Natural History). At the same time one of us (SH) was carrying out similar investigations in Helsinki. The work in Helsinki and London was linked by a mutual friend, Mr Simo Laine, and this paper is a summary of our investigations so far.

Historical background

Opaque glass with a colour described by different authors as 'sealing-wax red' or 'sang de boeuf' has been made in the Mediterranean region from the 15th century BC. Pliny mentions an opaque red glass (Pliny, reprint 1971, p.157) and seems to imply that it was made locally in Roman times (Vose, 1980, p.31). Bimson (1981) has described glass of this type in the Mosan enamels which date from the 12th century AD. The Chinese made a true copper red glaze of similar hue in the early 15th century, but the technology was not thoroughly established (Rose Kerr, personal communication). At the beginning of the 18th century a method for making an opaque 'strong lively red' glass called porporino was discovered in the Studio del Mosaico in Rome (Röttgen, 1982, p.25). A similar method was known in Venice in the 18th century (Pylyaeva, 1888, p.339; Snowman, 1962, p.69), probably even earlier (Dillon, 1907, p.207). In that century the glass was used, for example, for snuff-boxes and buttons in Venice (Pylyaeva, op. cit.). There is a late 18th century golden pendant cross set with polished hard-stones and opaque red glass in the British Museum (Jeweller's Art, 1978, p.22, II), but in most cases glass of this type is found in 19th century Roman micromosaics; these were often set in frames of opaque red glass. At that time the glass was occasionally used in the manufacture of snuff-boxes and Florentine-type mosaics. By the 19th century, studies were being conducted in France to discover the 'recipe' for opaque red glass and Weyl (1951, p.422) states that M. von Pettenkoffer and E. Hautefeuille independently rediscovered the way to make hematinon in the mid-1800s.

In the late 1800s hematinon and aventurine glass were being produced in A Salviati's glass factory in Venice (Zulkowski, 1897, p.134). However, in the obituary of Leopold Bonafédé (Zapiski, 1878, p.88) it is stated that L. Bonafédé, who was chief chemist both in the Imperial Glass Factory and in the Factory's mosaic department in St Petersburg from 1858 to 1878, rediscovered a method for producing the long-forgotten purpurine, which became world-renowned; he was also the first to make aventurine glass in Russia.

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*Sadly Alan Date died in January 1988

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Fig. 1. and Cover Picture. Fabergé carving of John Bull, made from purpurine, lapis lazuli, white quartzite, jasper, aventurine quartz and sapphire (eyes). *Photo by E.A. Jobbins.*

A tazza in the possession of the British Museum was described in the Slade catalogue (1871) as being of 'opaque red glass, of a very brilliant colour, and full of crystals. It is made with copper, an imitation of antique purpurine and is a product of the imperial manufactory of St Petersburg under the direction of the chemist Leopold Bonafédé. From the Universal Exhibition at Paris, 1867'. Gros-Galliner (1980, p.158) states that the tazza was certainly made in the Fabergé workshops but she does not supply independent supporting evidence, and the early date of the piece and its exhibition are inconsistent with the chronology given by Snowman (1979, p.152). This states that Peter Carl Fabergé took control of the firm in 1870, and that the first exhibits of the House were at the Pan-Russian Exhibition in Moscow in 1882. The earliest Fabergé pieces incorporating purpurine probably date from about 1880 and the source of the material is attributed to Petouchov in the Imperial Glass Factory in St Petersburg (Bainbridge, 1949). In all probability the person in question is Sergei Petrovich Petukhov* who was chief chemist in the Factory and made, among other things, smalti (opaque coloured glass) for mosaics (Sokolovskaja, 1982, p.294).

In *Steklodelie* (Glassmaking) Petukhov describes the appearance of purpurine and aventurine glass under the microscope, which were both made by him in the Imperial Glass Factory (Petukhov, 1898, p.30). Nowhere in the book does he take credit for the rediscovery of purpurine or refer to L. Bonafédé or M. von Pettenkoffer in connection with it. It seems likely that he had contacts or knowledge either of the work carried out in France, of the opaque red glass from Italy or of Bonafédé's purpurine. L. Bonafédé himself had worked in the Russian Mosaic Studio in Rome before he was invited to Russia in 1851 together with his brother Giustifiano, who was director of the Studio. In addition, in Bonafédé's and Petukhov's time many Russian artists, some of whom had either trained in the art of mosaic work in Rome (Butikov, 1974, p.18) or visited mosaic producing factories like A. Salviati's in Venice (Seleznev, 1896, p.76), were making mosaics in a number of churches including St Isaac's Cathedral in St Petersburg (Seleznev, 1896, p.74-5), and for these mosaics Petukhov's smalti was also used (Sokolovskaja, op. cit.).

Purpurine was used in the Fabergé workshops to the best effect in association with natural stones (Figure 1) such as lapis lazuli, sunstone, quartzite and obsidian, and Bainbridge comments 'personally I call this the rarest of all the substances, natural and artificial, used by Fabergé'. Purpurine has also been used by Fabergé's competitors. (Habsburg, 1986, p.290, 335, and this paper).

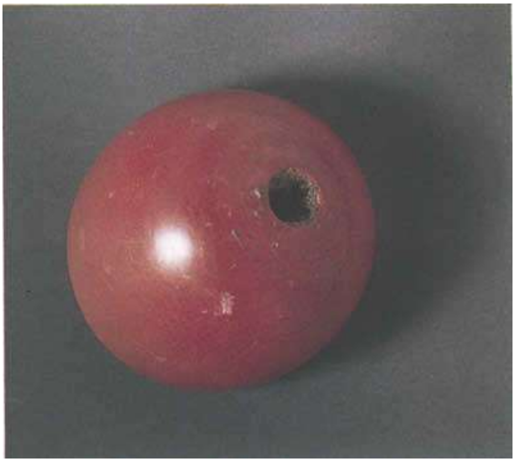

Fig. 2. Red glass from Fabergé hand seal. *Photo by F. Greenaway.*

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*Transliteration based on ISO recommendation R9-1968.

Analysis of glass from Fabergé hand seal

The piece of glass supplied by Mr G. C. Munn for analysis comes from a hand seal signed by Fabergé's chief workmaster Michael Perchin (Figure 2). The seal was contained in a fitted hollywood box and was probably made about 1900 (G. C. Munn, personal communication), three years before Michael Perchin died. The glass is egg-shaped, drilled at one end and measures 32.9 mm (maximum length) by 27.0 mm (maximum diameter perpendicular to the length). The piece had been broken at one time and repaired with a water-soluble glue. In order to carry out the analyses it was soaked in water to separate the components, and a few fragments adjacent to the main break were taken for preparation of a polished section and for dissolution. The piece must originally have weighed just over 52 g.

When examined with a 10× lens the texture of the glass appears patterned with skeletal, dendritic or acicular structures. Under higher power magnification and in thin section these crystal structures are quite obvious (Figures 3-5), some measuring up to 2 mm in length.

The refractive index of the glass was measured in sodium light using a Rayner Dialdex refractometer on a polished fragment, and a mean value of 1.700 was obtained. Its specific gravity, determined in water, is 4.21. The glass is opaque but in light of sufficient intensity a spectrum of the reflected red colour may be seen in a hand-held spectroscope. This shows transmission in the red and absorption in the yellow, green and blue parts of the spectrum, a result that was confirmed and amplified by K. Scarratt using the Pye-Unicam PU8800/03 UV/visible spectrophotometer. He obtained a spectrum of transmitted radiation from a fragment of glass 0.85 mm thick, and the scan from 190-850 nm is shown in Figure 6.

The composition of the glass was determined by electron probe microanalysis (EPMA) of polished thin sections (for major elements) and by inductively coupled plasma spectrometry (ICPS) of solutions of the glass (for minor and trace elements). The results are given in Table 1, columns 1, 2 and 7.

The glass is essentially a soda-lead-silica glass with over 7% cuprous oxide. Crystals of the type illustrated in Figures 3-5 are narrower than the width of the electron beam (about 5 μm) and an analysis exclusive of glass could not be obtained. Nevertheless, although the figures given in column 2 include a small proportion of the elements from the surrounding glass, the value of 82.8% for Cu_2O and the relatively low values of all other elements suggest that the dendritic crystals are composed of cuprous oxide. An X-ray diffraction pattern of the red glass (5587F) obtained by S. Somogyi indicates the presence of an amorphous substance (the glass) and confirms the presence of cuprite (Cu_2O) as the only crystalline phase.

Webster was aware that there was more than one kind of purpurine for he states (1970, p.354) 'One of the purpurines…shows a structure resembling myriads of fern leaves…was found to have a

Fig. 4. Thin section (30μm) of glass shown in Figure 2; shows skeletal crystals of cuprous oxide in plane polarized light; field of view 4mm across.

Fig. 3. Crystals in red glass showing skeletal structure. *Photo by E.A. Jobbins.*

Fig. 5. Polished section of glass shown in Figure 2; shows skeletal crystals of cuprous oxide; field of view 0.6mm across.

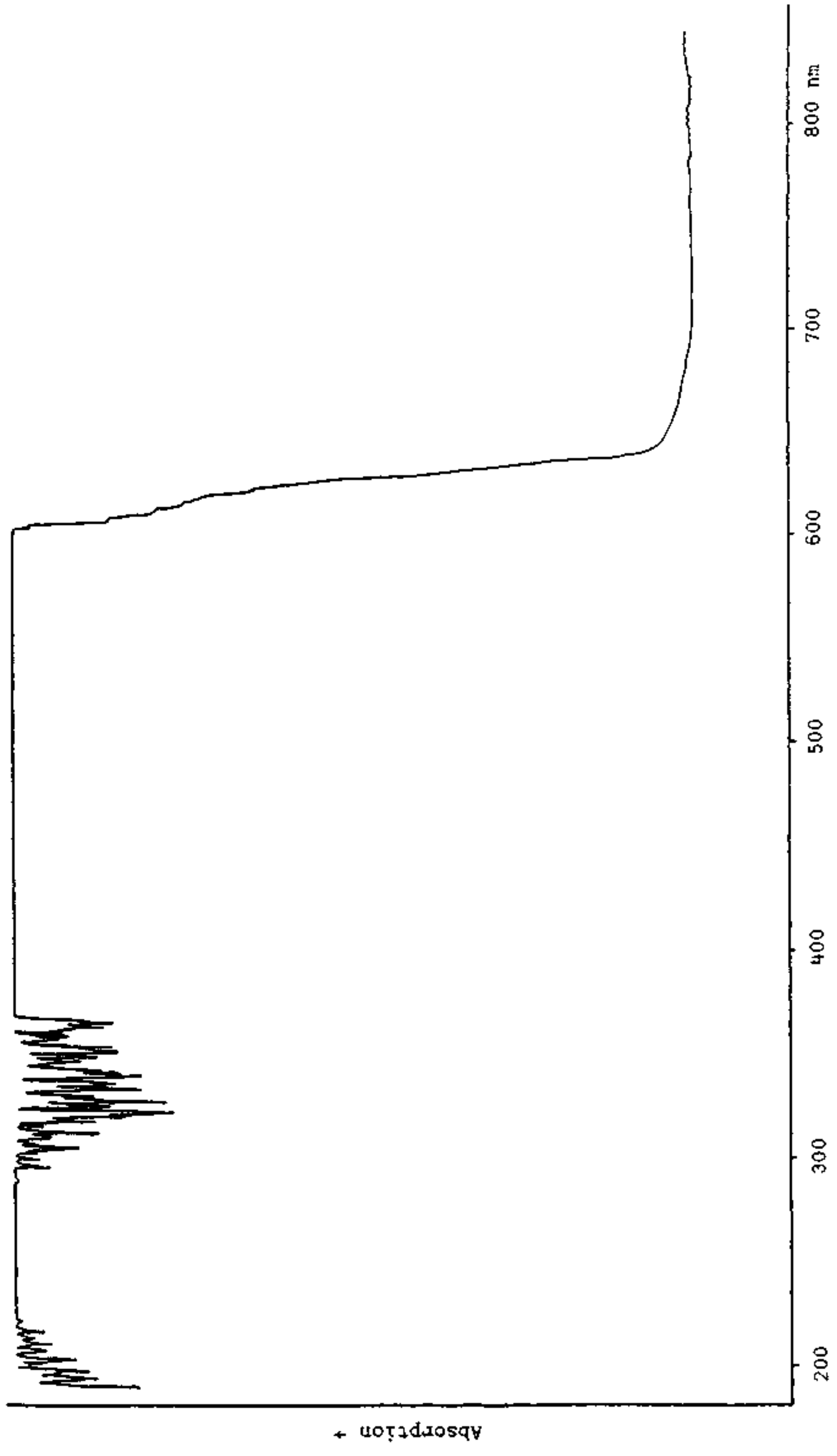

Fig. 6. Absorption spectrum of red glass from hand seal, using a Pye Unicam PU 8800/03 UV/visible spectrophotometer (Basil Anderson model) at room temperature. The span for the curve is four absorbance units, the band width was 2nm and the scan speed was 1nm/sec.

Table 1. Analyses of red glass and aventurine glass

Wt%	1	2	3	4	5	6	ppm	7	8
SiO_2	30.46	5.74	42.28	66.37	41.28	35.80	Ti	86	316
Al_2O_3	<0.2	<0.2	0.68	1.28	0.45	0.89	V	14	109
FeO	0.97	0.37	0.43	1.89	1.69	1.29	Cr	5	39
MgO	<0.2	<0.2	2.84	<0.2	0.10	tr.	Mn	110	6840
MnO	<0.2	<0.2	b.d.	0.93	0.19	1.50	Co	5	11
CaO	1.75	0.25	3.82	4.80	1.14	4.31	Ni	67	33
Na_2O	6.34	<0.2	9.46	12.26	4.20	6.31	Zn	15000	278
K_2O	<0.35	<0.2	1.43	2.17	2.36	2.60	Ge	0.9	0.9
Cl	0.35	<0.2	0.45	0.73	0.13	n.r.	Rb	3	12
Cu_2O	7.23	82.82	8.58	3.26	2.79	7.89	Sr	205	389
ZnO	2.80	<0.2	b.d.	<0.2	b.d.[1]	n.f	Y	0.5	3
As_2O_3	2.05	<0.2	b.d.	2.26	2.53	n.r.	Zr	3	2
Sb_2O_3	1.78	0.39	4.19	<0.2	2.87	n.r.	Mo	0.2	0.2
BaO	0.80	<0.2	b.d.	<0.2	0.09	n.r.	Ag	32	218
PbO	45.53	7.54	24.96	1.32	40.17	39.06	Cd	16	1
$-O=Cl$	−0.08	0.0	−0.10	−0.16	0.0	0.0	Sn	17	541
							Sb	2660	28
	99.98	97.11	99.02	97.11	99.99	99.55	Ba	5330	203

Notes: b.d. means below detection, tr. trace, n.f. not found, n.r. not reported and [1] presence confirmed by energy dispersive X-ray fluorescence; elements Fe, Mn, Cu, As, Sb, and Pb may be present in more than one oxidation state.

1. Mean of 6 analyses of red glass from hand seal; defocused beam covering glass and crystals.
2. Analysis of crystal in red glass from hand seal; the crystals are less than 5μm across and there is some contribution from surrounding glass.
3. Opaque red glass, 4th cent. BC, Nimrud; from Freestone, 1987, Table 1, Anal. 6.
4. Mean of 5 analyses of aventurine glass in regions with no visible crystals of copper; defocused beam.
5. Mean of 5 analyses of red glass from Fabergé egg 1; defocused beam covering glass and crystals.
6. Opaque red glass, late 19th cent. AD, Venice; from Zulkowski, 1897, p.135.
7. Mean of 2 analyses of minor elements in red glass from hand seal.
8. Analysis of minor elements in aventurine glass.

Analyses 1, 2 and 4 were carried out on a Cambridge Instruments Geoscan with Link Systems energy dispersive detector and computer. An accelerating voltage of 15kV, a specimen current of 5×10^{-9} amps and an electron beam focused to approximately 5μm were used. Limits of detection for each of the oxides are about 0.2 wt%.

Analysis 5 was carried out on a Jeol JCXA 733 electron microprobe system with three wavelength dispersive spectrometers. An accelerating voltage of 15kV, a specimen current of 20×10^{-9} amps and an electron beam focused to approximately 20μm were used. Standards used for the analyses comprised natural and synthetic minerals. Results were corrected using a ZAF-type correction program. Loss of alkalis during analyses were checked and was corrected for sodium using an empirical correction procedure suggested by Nielsen and Sigurdsson (1981).

Analyses 7 and 8 were carried out on the British Geological Survey (BGS) prototype Inductively Coupled Plasma Mass Spectrometer (ICP-MS). The instrument employs an inductively coupled argon plasma (ICAP) as the ion source operating at atmospheric pressure for production of ions for detection by a quadrupole mass spectrometer. The unknown samples are quantified using calibration against aqueous standards. The limits of detection are typically below 1 part per million in the solid for most elements on the periodic table (Gray and Date, 1983, and Date and Hutchison, 1987).

refractive index of 1.64 and a density of 3.77'. Two types of opaque red glass, one with constants close to these (RI 1.65, SG 3.81 and RI 1.658, SG 3.79) and the other with higher constants (RI 1.70, SG about 4.26) have recently been analysed in Helsinki.

Description of red glass objects examined in Helsinki

Four objects of Russian origin, made of an opaque red glass, three of them from the Fabergé workshops, were available for study.

Object 1 is a gold-mounted miniature egg pendant with a gold suspension ring, drilled at one end and measuring approximately 15.5 × 11.4 mm without the mounting. The ring is stamped K.F. in Russian characters. The pendant had been brought to a goldsmith because the mounting, which had no peg but had been attached to the pendant with a glue, had come off the drilled end. In order to attach the mounting back securely, a new peg was soldered to it and the drill hole made slightly larger and deeper with a dentist's drill for the peg, which was to be cemented into the hole. This produced a small amount of fine-grained powder which was later used for microscopic observations, X-ray diffraction and electron probe microanalysis (EPMA). Without the mounting the weight of the pendant is 3.71 g.

Examination of the glass with a 10× lens and under higher power magnification showed the texture to be similar to that of the glass described above with the exception of some small almost crystal-free areas in its surface. Its refractive index, measured by the distant vision method using a Rayner Dialdex refractometer and sodium light, is 1.65. Using immersion oils of known refractive index and a Leitz SM-Pol polarising microscope, the refractive index of the glass powder was determined by the Becke line method. This gave a mean value of 1.658. The specific gravity of the glass, determined by hydrostatic weighing in distilled water at room temperature, is 3.79. The spectrum, observed by reflected light using a Beck prism spetroscope, is similar in pattern to that of the glass described above. An X-ray diffraction examination of the powder confirmed the presence of cuprite (Cu_2O); it also indicated the presence of an amorphous substance (the glass). The composition of the glass was determined by electron probe microanalysis of a polished surface obtained by embedding the powder in epoxy resin and prepar-

Fig. 7. Elephant carved in purpurine with rose diamond eyes.

ing a flat polished surface (maximum grain diameter after polishing 0.1 mm). The results are given in Table 1, column 5. The composition of the crystals in the glass was determined qualitatively with the electron probe microanalyser and the results (not given here) show major copper with some contribution from the surrounding glass.

Compared with the Cu_2O content of the red glass in column 1, the Cu_2O content of the glass is considerably lower. As mentioned above, the cuprite crystals are not homogeneously dispersed in the glass. This, coupled with the fact that the sampling area could not be chosen freely, may well account for its lower Cu_2O content.

Object 2 (Figure 7) is an elephant carving with rose diamond eyes and a downturned trunk. It is approximately 8.7 cm in height and weighs 396.50 g. On the front left foot the carving is engraved in Latin 'Fabergé' with inventory number 24340. Its refractive index, measured by the distant vision method, is 1.65. The specific gravity, determined by hydrostatic weighing, is 3.81. Examination with a 10× lens, microscope and spectroscope showed the glass to be similar to that of object 1.

Because preparation of the glass of the carving for quantitative analysis was out of the question, its composition as well as that of the glasses of the following two objects could only be deteremined qualitatively by the electron probe microanalyser or the scanning electron microscope, both fitted with an energy dispersive spectrometer. A carbon coating (soluble in acetone) was in part applied to the surface to prevent localized charging and any resulting distortion and deflection of the electron beam. These limitations on the technique of analysis mean that the levels of detection for different elements are higher than for properly prepared, polished and coated specimens. The energy dispersive X-ray spectrum of the glass of object 2 (Figure 8) shows major Si and Pb; minor K, Sb, Ca, Fe and Cu with traces of Na and As. It must be emphasized that the printed diagram has much poorer resolution than the original spectrum. For comparison, object 1 was also analysed under similar conditions. The resulting energy dispersive X-ray spectrum of the glass is similar to that of object 2.

Object 3 (Helsinki City Museum: 3145.139) (Figure 9) is a gold-mounted miniature egg pendant with a gold suspension ring, measuring approximately 15.0 × 11.0 mm without the mounting. The ring is stamped 56k and K.F. in Russian characters. Examination of the glass using a 10× lens, microscope and spectroscope showed no differences in the texture and spectrum from that of the hand seal in London. Its refractive index, measured by the distant vision method, is 1.70. The specific gravity of the glass was determined as follows. First the specific gravity of the pendant as such was determined by hydrostatic weighing. The weight of the gold mounting was then estimated by weighing a similar gold mounting of the same fineness; the length of the peg was estimated by X-ray radiography. Since the specific gravity of 56k or 14 carat gold is approximately known, the specific gravity of the pendant without the mounting can be calculated with some degree of accuracy. Thus the calculated specific gravity of the glass is 4.26. The energy dispersive X-ray spectrum of the glass (Figure 10) shows major Pb and Si; minor K, Sb, Ca, Fe, Cu and Zn with traces of Na and As.

Fig. 9. Gold-mounted miniature egg pendant.

Object 4 (Helsinki City Museum: 3145.146) (Figure 11) is also a gold-mounted miniature egg pendant with rose-cut diamond-set gold and silver ornament, in the form of a swallow, attached to the mounting. A gold suspension ring attached to the swallow is stamped E. S. in Russian characters. The egg is smaller than that in object 3, approximately 12.0 × 7.0 mm without the mounting.

The refractive index of the glass, measured by the distant vision method, is 1.70. Its specific gravity was not determined because of the swallow

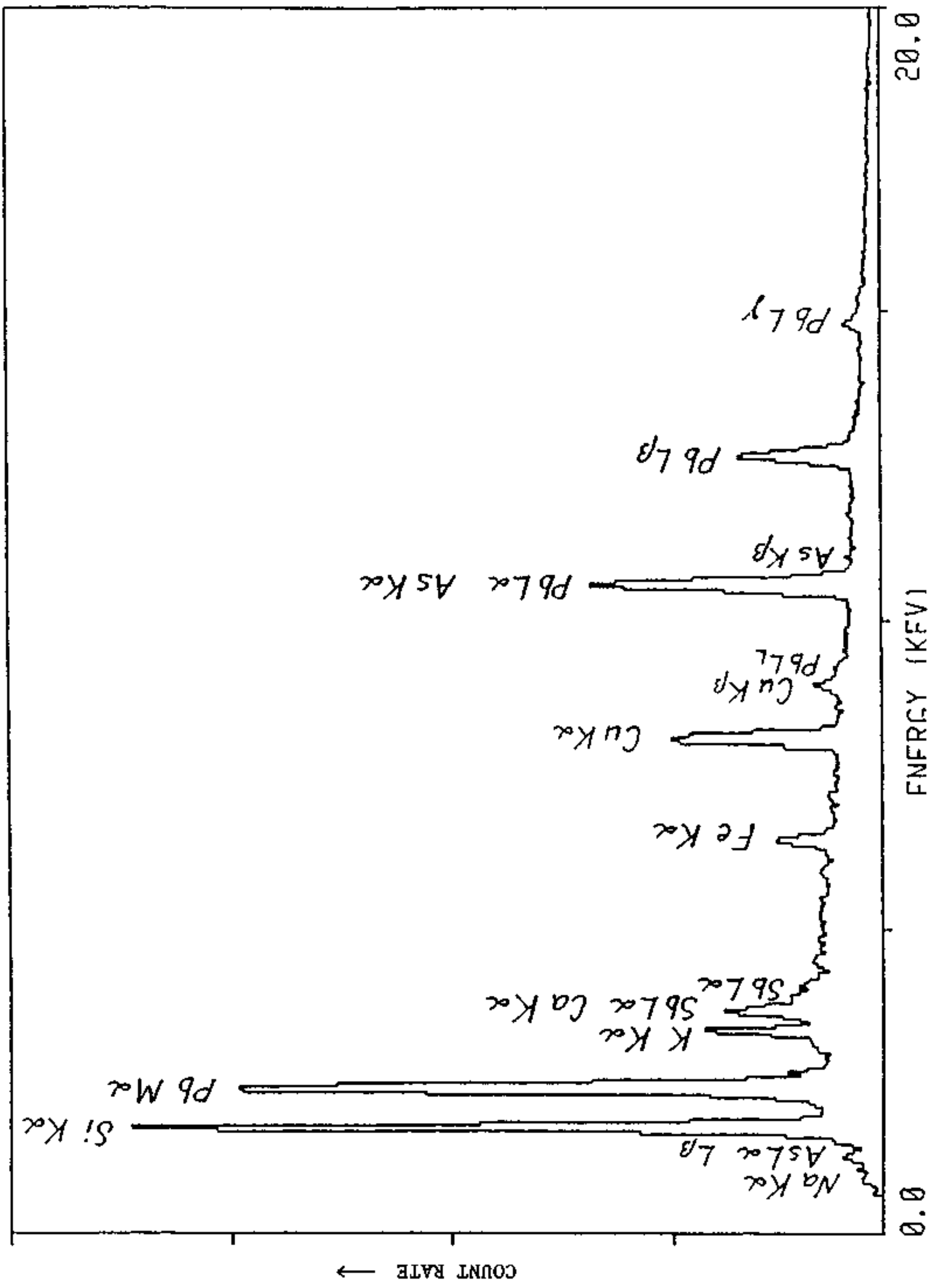

Fig. 8. Energy dispersive X-ray spectrum of purpurine elephant.

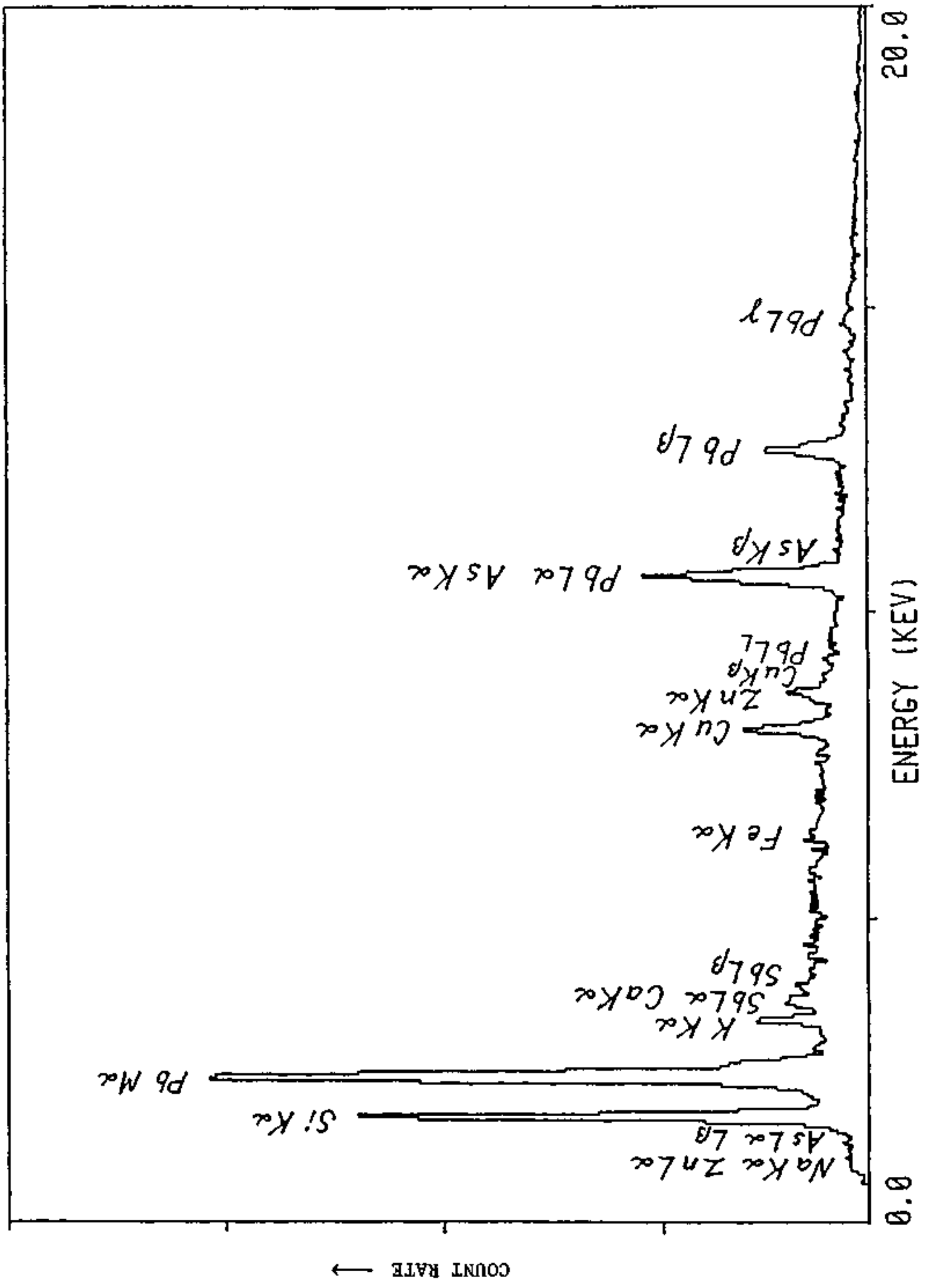

Fig. 10. Energy dispersive X-ray spectrum of glass of gold-mounted miniature egg pendant.

Fig. 11. Miniature egg pendant with swallow.

ornament. Examination with a 10× lens, microscope and spectroscope showed the glass to be similar to that of object 3, and the energy dispersive X-ray spectra of the two glasses are also similar.

The physical constants, texture and results from the analyses indicate that the glasses of objects 1 and 2 are of the same type, and differ from the glasses of objects 3 and 4. The presence of Zn in the glasses of objects 3 and 4 suggests that their chemical composition is close to that of the glass in the hand seal given in Table 1, column 1.

The four glasses described above are thus of two types. One has lower constants (RI 1.65, SG 3.81, and RI 1.658, SG 3.79) and is of a sodium-potassium-lead-silica type with negligible zinc content. The other has higher constants (RI 1.70, SG about 4.26) and is of a sodium-lead-silica type with a relatively high zinc content.

Objects 1, 2 and 3 can be attributed to Fabergé on grounds of the marks and engraving. Consequently at least two types of an opaque red glass have been used by that House and at least one of these has been used by Fabergé's competitors.

The purpurine tazza in the British Museum, alluded to in the Historical background section, has recently been examined in the Research Laboratory by Mavis Bimson and Drs I. Freestone and M. S. Tite and we are grateful for the following information: 'The glass consists of large dendritic red crystals in a clear glass matrix; X-ray diffraction examination confirms that the crystals are of cuprous oxide (cuprite). X-ray fluorescence analysis in air of the curved surface of the tazza gave the following semi-quantitative analysis: SiO_2 36%, CaO 0.7%, K_2O 7%, Cu_2O 8%, PbO 47%, Sb_2O_3 2%, SnO_2 0.2%, As_2O_3 0.5%'. This composition is similar in most respects to those listed in Table 1, columns 1, 3, 5 and 6; the major difference is the high content of K_2O. Thus the output from the St Petersburg factory included a potassium-lead-silica glass in addition to those described above.

Discussion

Glasses of very similar colour and opacity have been described by Zulkowski (1897), and recently by Bimson (1987) and Freestone (1987) in a study of red glasses from the 1st and 2nd millennia BC. The red glasses from the middle of the 2nd millennium BC are characterized by high copper and low or negligible lead while those from the first millennium BC may have low copper and lead (dull brownish red) or high copper and lead (bright red). An example of the latter group from Nimrud in northern Iraq was analysed (Freestone, 1987, Table 1) and is shown for comparison in Table 1, column 3. Compared with the Fabergé glasses, SiO_2, MgO, CaO and Na_2O are higher, and PbO is lower. The composition of the late 19th century red glass from Venice (Zulkowski, 1897, p.25) is also shown for comparison in Table 1, column 6. Compared with the two Fabergé glasses, its composition is quite similar. However, two elements that have not been found either in the ancient glasses or in that described by Zulkowski are zinc and arsenic and their presence in the Fabergé glasses may turn out to have a diagnostic significance (I. C. Freestone, personal communication).

The copper-bearing glass most familiar to gemmologists is the bronze-coloured aventurine glass or goldstone (Figures 12 and 13). For comparative purposes, a sample was analysed under the same conditions as the red glass in Table 1, column 1, and the results are shown in columns 4 and 8. The goldstone analysis shows major alkalis and silica and a low lead content, and the composition is quite different from that of the red glass. The minor element contents of the red glass and goldstone are also significantly different (compare columns 7 and 8 of Table 1).

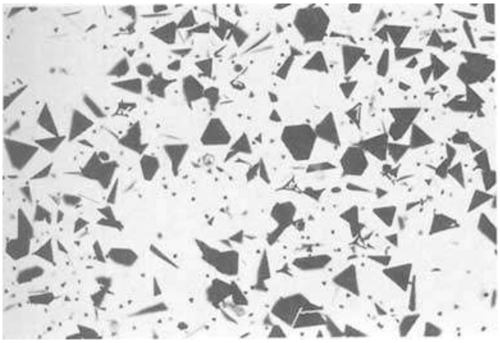

Fig. 13. Aventurine glass; thin section 30μm thick showing angular thin plates of copper metal in plane polarized light; field of view 1mm across.

Colour

The red glass used by Fabergé is so similar to some of the glasses studied by Bimson (1987) and Freestone (1987) that comments made in relation to these are probably also applicable here. In essence, they conclude that the major colourant of the opaque red glass is cuprite in the form of skeletal or dendritic crystals. Quoting extensively from the literature, they say that metallic copper can probably be discounted as a cause of the red colour, and that the grain-size of the cuprite crystals in glass shows a correlation both with colour and with the overall copper content of the glass. Thus glasses with less than 5% Cu_2O are a duller, browner red than those with 7-11% Cu_2O which give rise to the bright sealing-wax red. The low-copper glasses contain minute droplets of Cu_2O and as the copper content increases so does the proportion and size of dendritic or skeletal crystals. Despite this apparently neat correlation of colour with crystal size it may be seen in Figures 3-5 that there is not just one size of dendrite but a range from 2 mm down to submicroscopic, and how precisely this range is related to the quality of the colour is probably very complex.

The relation of grain-size to colour in gold-ruby and copper-ruby glasses is referred to by Bimson and Freestone (1985, pp.211-14) and by Nassau (1983, pp.310-11). These differ from the glasses described above in being transparent, and they owe their red colour to gold or cuprite particles only a few nanometres in size. Some glasses with a red colour in transmitted light are green in reflected light and are described as dichroic by people largely concerned with glass. In this context, gemmologists or mineralogists should be aware that the term does not refer to the kind of dichroism found in some birefringent crystals.

Fig. 12. Aventurine glass or goldstone.

When copper-ruby glass is quenched from the melt it is colourless, and the red colour is obtained by 'striking' or careful heat treatment for a certain length of time. If this heat treatment is lengthened, the cuprite particles grow and an opaque red glass develops, and with even longer treatment aventurine glass is eventually produced (Nassau, op. cit.). Webster (1962, p.335 and repeated in later editions) also refers to this connection thus 'One stage in the preparation of this aventurine glass is the formation of a dark red glass called hematinon or purpurine...'. The connection may also turn out to be significant in studies concerning the history of purpurine, for aventurine glass appears to have been known already in Venice in the 13th century (Duma, 1984, p.314). From the analyses presented in Table 1, it would appear that although purpurine, hematinon and aventurine glass may be made from a wide range of compositions, the content of copper and the nature of heat treatment are the main factors causing their distinctive appearance.

Nomenclature

Opaque glass with the colour described as sealing-wax red or sang-de-boeuf has been called purpurine by Bainbridge (1949) and Snowman (1962) and hematinon or purpurine by Webster (1962, p.335). According to Zulkowski (1897, p.134), at the end of the 19th century haematinon glass was often called il porporino (purple coloured in Italian); in Venice the glass was called la poropora (purple). As mentioned above (Röttgen, op. cit.), an opaque red glass called porporino was known in Rome at the beginning of the 18th century.

In Russia, Pylyaeva (1888, op. cit.) speaks of glass of similar type called purpur' (purple in Russian) and states that it was known in Venice in the 18th century. In the *Entsiklopedicheskij slovar'* (1892, p.296) gematinon (haematinon) or purpurino (porpurino in Italian) is defined as a type of glass of characteristic red colour found in ancient mosaics. According to the slovar' glass of this type has later been made by Pettenkoffer, Kejser* and the Imperial Glass Factory. Gematinon is similarly defined in the *Vsenauchnyj (entsiklopedicheskij) slovar'* (1878, p.420) whereas porpurino (p.506) is defined as a material of its own, viz. synthetic coloured mass made from minerals, earlier used in Italy and mainly in churches. In the *Russki entsiklopedicheskij slovar'* (1875, p.615) only gematinon is defined; the definition follows similar lines as before. Modern Russian encyclopaedias define neither purpurine nor hematinon.

In the *Oxford Dictionary*, haematinon or haematinum is defined as a red glass found in ancient mosaics and ornamental vases, and quotes the earliest reference as Phillips, 1706, with a further reference to C. W. King, 1861, who described the glass as 'entirely red, opaque sort'. The word purpurine or purpurin in the *Oxford* and *Chambers Dictionaries* is defined as 'of purple colour' (now obsolete), or as a 'red colouring matter, $C_{14}H_5O_2(OH)_3$, used in dyeing, orig. extracted from madder; also prepared artificially by the oxidation of alizarin'. There is no mention of glass. The entry in the Slade catalogue concerning the tazza in the British Museum referred to earlier contains an allusion to antique purpurine as though this were an established decorative substance. What exactly this was and whether or not it was natural or synthetic has not yet come to light and is a tantalizing indicator that more remains to be discovered.

If the opaque red glass is to have a name, then, at present, *purpurine* is provisionally recommended.

Acknowledgements

To Geoffrey Munn and A. Kenneth Snowman go our grateful thanks for the loan of material and for stimulating interest and discussion. We would like to thank Mrs Marja-Liisa Lehto at the Helsinki City Museum and Mrs Ulla Godenhielm, of the firm of Oy A. Tillander Ab in Helsinki, for allowing the examination of objects 2, 3 and 4, Raymond Slack and Prof. P. H. Plesch for useful discussions concerning the history of glass, and Frances Wall for advice concerning microprobe analysis. K. Scarratt, Director of the Gem Testing Laboratory of Great Britain, kindly supplied the spectrophotometer trace of the red glass of the hand seal, and S. Somogyi carried out the X-ray diffraction work. We have benefited greatly from discussions about red glass with Mavis Bimson and Dr Ian Freestone and thank them for permission to quote their work on the tazza at the British Museum. We thank both Dr Y. Y. Cheung who kindly supplied details of the ICP-MS method used at the British Geological Survey, and Jane Stancliffe (then at the Metalwork Department, Victoria and Albert Museum) for information concerning the Paris Universal Exhibition, 1867). Figure 7 is reproduced by kind permission of Sotheby's. Figures 9 and 11 were taken by Ms Leena Tomanterä.

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*Georg Cajetan Kaiser was professor of applied chemistry in München. Pettenkoffer worked for him some time in 1850s.

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Amber – fact and fantasy

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Foreword

Although gemmology is researched and practised as an exact science it does not come amiss – to my thinking – that its practitioners should know and understand the thoughts and beliefs of those philosophical 'gemmologists' of antiquity; 'gemmologists' such as Theophrastus (d.*c*.285 BC), Pliny (d.79 AD), and Dioscorides (d.90 AD).

For example: in the many treatises on gemstones written by Theophrastus he considered the stones to have certain attributes which dictated gender. Accordingly he classified gemstones as being either male or female. From this thinking arose the fanciful but widely accepted theory of stones breeding and begetting progeny.

Shortly after he relinquished command of the Roman Fleet which was stationed in the Bay of Naples and whose prime function was to suppress piracy, Pliny (the Elder) wrote his 37 books of *Historia Naturalis.* This massive work he dedicated to the Emperor Titus.

"No one", said Pliny, "has collected the scattered works that contribute to encyclic culture" (Enkyklios Paideia – the origins of the word encyclopedia).

Dioscorides (a founding father of pharmacy) wrote five books entitled *Materia Medica.* The fifth and last book describes the properties of over 200 stones recommended as possessing medicinal and healing properties.

For over 1600 years, *Materia Medica* was the recognized textbook of medicine; its formulae were frequently consulted by physicians and surgeons seeking an appropriate prescription for a particular malady.

Esoteric knowledge of and about gemstones has been conveyed to us over the centuries by many chroniclers and seekers of truth, such as the physician Galen – whose name is commemorated in the word 'Galenicals', a word used by the modern pharmacist in describing his bulk medicines.

Among the many philosophers whose thoughts and writings embraced gemstones are the Bishops Epiphanius, St Isadore and Marbode: bishops, respectively of Constantia, Seville and Rennes; Albertus Magnus who penned *Secrets de Vertus des Herbes, Pierres et Bestes*; Camillo Leonardo, one time physician to Caesare Borgia to whom his work *Speculum Lapidum* was dedicated.

All have their writings – either in prose or rhyme – gracing bookshelves in the world's premier universities.

True! They gather dust in their resting places, but who has not the imagination to recognize and regard them as rungs in the ladder of man's ascent to the stars?

Of those disseminating a knowledge of gemstones from the 16th century onward were, among many others: Reginald Scot, *Discoverie of witchcraft*; Jerome Cardan, *De Gemmis et Coloribus*; Thomas Nichols, *Faithful lapidary*; Dr John Schroder, *The complete chemical dispensatory*, and not the least or the last, Prof. Francis Barrett, *The celestial intelligencer.*

Researching the many facts, fantasies and superstitions of diamond and coloured gemstones has been, for me, quite rewarding and I trust that my essays on this subject make interesting and absorbing reading.

Amber – fact and fantasy

Pretty in amber to observe the forms
Of hairs, or straws, or dirt, or grubs, or worms!
The things, we know, are neither rich or rare,
But wonder how the devil they got there.
(Pope)

Philosophers of civilizations long since travelling the dusty paths of antiquity, have conjectured, imagined and woven delightful but fanciful theories in their attempts to explain the origins of amber. Religionists and philosophers of ancient Rome were not in the least embarrassed to borrow freely from the many gods and cults of the nations within their empire, and in doing so often modified the myths to suit their individual esoteric styles; in particular they borrowed many Grecian deities, changing their names as if to cover a lack of original thought. Roman gods became clothed with the mantles of

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their Greek counterparts and, for good measure, assumed many of their myths.

Insights into some thoughts and works of the ancients are presented to us in the many essays of Pliny, Metrodorus and Sudines; but by far the most enjoyable reading is to be discovered in some 250 Greek myths collected, translated, and bound together in an important and highly valued work entitled *Metamorphoses*; a work undertaken and put to 'paper' by the Roman, Ovid (43BC – AD17).

Listed by Dioscorides (AD40 – AD90) in his *Materia Medica* – together with some 200 other minerals and stones – amber is recommended as a useful and effective ingredient in medication. Its inherent healing properties are also gainfully employed by the physician and pharmacist in today's modern world; its effectiveness has not dissipated with time.

The name was derived from the Arabic 'Anabaron'; and for the electrostatic phenomenon displayed, the fossil resin was named 'Elektron' by the Greeks: from which is derived the modern word 'Electricity'.

Healing amber

For centuries amber has been used medicinally either as a cure or as a prophylactic: Pliny (*Historia Naturalis*) wrote: "Amber indeed is supposed to be a prophylactic against tonsilitis and other infections of the pharynx for the waters near the Alps have properties that harm the human throat in various ways".

Callistratus advised that "People of any age who are subject to attacks of wild distraction" were usually cured when powdered amber was taken in a little wine.

The Romans had a great faith and confidence in the curative properties of amber – especially for the treatment of such ailments as fever, croup, asthma, hay fever, and all infections of the throat – and to this effect was worn either as a necklace or as a pendant.

For those who suffered with ear problems, a medication of finely powdered amber mixed with honey and rose oil was introduced into the infected ear. This prescription was widely prescribed and is reported to have proved beneficial.

To improve poor sight, many Roman physicians recommended a mixture of amber powder and Attic honey to be taken internally. Only reddish ambers were considered suitably effective for medicinal purposes. (Callistratus: cited by Pliny).

To quote Camillus Leonardus MD (*Mirror of Stones* 1502*), physician to Cesare Borgia; "Succinum or Amber being taken inwardly, it provokes urine, brings down the menses and facilitates a birth. It fastens teeth that are loosen'd; and by the smoke of it poisonous insects are driven away".

Over the centuries, amber retained the faith of the medical profession in its ability to provide relief and comfort for the sick. This is well noted in the following paragraphs contained within the pages of a notable mid-17th century work (*Faithful lapidary*, Thomas Nichols, 1659).

"Amber is the best for physic use, and is thought to be of great power and force against many diseases, as against vertigo and asthmaticall paroxysmes, against catarrhes and arthreticall pains, against diseases of the stomach and to free it from putrefactions and against diseases of the heart, against plagues, venoms and contagions.

"It is used either in powder or in troches, either in men or of woman, married or unmarried or in the distempers of children."

Chapter XXIX, p.227 of Dr Rowland's translation of 'The complete chymical dispensatory' written by Dr Johann Schroeder mentions both bitumen and amber.

He says that bitumen is generally any fat mineral of which there are "divers sorts, as Ambe, Sperma-Ceti". "The special bitumens", he noted, "are Naphtha and petroleum, rock coal and jet."

"Amber", he writes, "generally signifies two sorts of bitumen; one called commonly Amber or Ambergreese to distinguish it from the other; the other is called Succinum."

He continues by giving two footnotes on the black and white ambers. Note 1 tells of the black ambers about which authors differ. "Some", he says, "make a true salt of amber weaker than the rest; others say it is made of musk, civet, wood aloes,

NOTE: The forerunners of the modern pharmacy were usually ordinary trading shops; shops which stocked such items as dried animals, parts of animals, and plants: human skulls and mummy were provided by grave robbers of the period.

A list advertising wares for sale at one particular 'medicine shop' is on display in the Wellcome Foundation premises on Euston Road, London NW1. It reads as follows:

HERE ARE PREPARED:

All sorts of remedies chemical and galenical.

We sell good cordials as well as Royal English Drops – Powders of Kent, Zell and Contrajerva Cordial.

Red Powder, Gaskain Powder with or without Bezoar, English Smelling Salts, true Glauber Salt and Epsom Salt and volatile essence of Ammonia, Human Skull, Mummy, and Hartshorn.

Essence of Ambergris, Lavender, Musk and Citron.

Essences of oil of vijner, Vulnerary Balsam, Lochoch of Foxes Lungs, the Treacle of Andromachus, Dioscordium, Sparadrap, Alkermes Confection, Lavander Water, Queen of Hungary Water, Arquebusade and the Elixir of Proprietatis.

Note ii.

The Musaeum Britannicum of 1778 describes Gaskain powder as consisting of "Oriental Bezoar which is chief, White Amber, Red Coral, Crabs Eyes, Powdered Hartshorn, Pearl and Black Crabs Claws".

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*First English translation 1750.

storax, laudanum; others call jet 'black amber' or succinum." The second note mentions a white amber called Sperma-Ceti. "The amber of the shops" (see footnote), he observes, "is a sort of bitumen that breaks into the 'shoar' from Fountains and Caverns of the Sea.

"The GRYSEAN (or grey) is the best, purged sweet and smooth, pricked with a needle, it sweats out fat succinum; the black and very white is not commended; for it is adulterated. The faltitious is easily known by its scent (which discovers the ingredients) and colour (by which it is black) also if you cast it on water, it is sooner lost than the natural."

Prepared salts of amber were made into many combinations of lotions, potions and electuaries; Dr Rowland quotes Renodus who says "the pleasanter the electuaries are, the sooner their strength is gone": a thought passing through the mind of many a modern day physician.

The virtues of this medication were (and possibly still are) that it "heals, dryes, dissolves; strengthens heart and brain and revives the Animal and Vital Spirits by its sweet sulphur; and is used in perfumes to burn against bad air, and keep the Spirits from infection: These are called Pome-Ambers".

Book II, Ch.LXXV, p.122 shows Dr Rowland giving instructions on how pomeambers (modern spelling POMANDERS) were to be made.

He writes: "Pomeambers are made of sweet powders with oyls, wax, storax liquid, Indian balsam, mucilage of 'tragaganth' and turpentine to make them fasten, adding rose water and the like, and so make into balls".

He makes special note that "They have their name from amber, not that it is a necessary ingredient always, but because they are sweet and imitate 'Ambergreese'".

Modern liniments

Time has not diminished man's faith in amber; it has retained its place as a source of medication in the armouries of the physician and pharmacist and is well documented between the covers of the modern Medical Codex consulted in most countries.

A pungent oil distilled from amber is known as 'Oil of Succinate' or 'Oil of Amber'.

This oily distillate has properties somewhat similar to turpentine and it is used extensively in the preparation of liniments. (British Pharmaceutical Codex).

Fumigation and joss-sticks

Germans called the material 'Bernstein' (burning stone) and burnt it for the pleasant pine aroma which pervaded the room in much the same way that smouldering Asian joss-sticks provide a pleasant atmosphere.

The Romans also burned amber but used an inexpensive white variety to produce vast quantities of aromatic smoke with which to fumigate dwellings: a most effective way to combat Mediterranean crawlies; the residual smell, too, was not unpleasant. Their name for amber was 'succinum'.

Urine of the lynx

Theophrastus mentioned, and Pliny described, certain authorities of Rome who believed that amber and gemstones were generated from the urine of the lynx.

"They claim", writes Pliny, "that this creature bears such a grudge towards mankind that it immediately conceals its urine, which is hardened by time when it transforms to a gem."

The 1st century Roman Senator and historian – Demonstratus – records in his manuscripts a popular belief that amber (which he noted as being called Lyncurium or Lynx-urine), was formed of the urine of the lynx; tawny dark sherry colours, he writes, being a product of the male while the female lynx produced the lighter coloured ambers.

Again, according to Demonstratus, others called the material 'Langurium' and he goes on to say that the habitat of the animals is in Italy where they are known as 'Languri'.

About 240 BC, Sudines, the astrologer who lived at the court of Attalus I of Pergamum, wrote a treatise of some importance on the mystical properties peculiar to gemstones. In this he writes that amber is the product of a tree that grows in Liguria; and that tree is known as the 'Lynx'.

A similar report on the origins of amber is given by Metrodorus – a scientist at the court of Mithridates VI.

Another ancient belief describes how the rays of a brilliantly setting sun become congealed in an evening sea and are eventually cast upon the shore in the form of amber.

Biers for gladiators

A centurian by the name of Julianus, in charge of a display of gladiators ordered by Emperor Nero, had occasion to send one of his knights to the Baltic coast of Germany to procure amber.

Some time later the knight returned to Rome with such an abundance of the fossil resin that nets used for preventing beasts escaping from the scene of contest and into the amphitheatre were made up and knotted with beads of amber.

"Moreover", writes Pliny, "all the equipment used on any one day had amber fittings; including the biers used to remove the bodies of dead gladiators".

Pliny's awe at this display of affluence is understandable for he has noted that the price of a small figurine made from amber, however diminutive, exceeds that of a living, healthy slave.

"Pearls can be carried on the head and gems on the finger. In short, every other substance for which we have a weakness pleases us because it lends itself either to display or practical use, whereas amber gives us only the private satisfaction of knowing that it is a luxury."

In describing the colour of the hair of his wife Poppaea, Nero called it 'sucini' or 'amber coloured'. From that time respectable women (said Pliny) "began to aspire to this colour". (*Historia Naturalis*).

Diviner of poison

Over the centuries, both ancient and medieval, the fear of poison being administered in food or drink occupied the minds of those in envious position.

In Europe, any substance that could indicate the presence of poison by some physical change and thereby assist its owner to avoid an untimely end was very highly valued and avidly sought for.

An amber cup or chalice was believed to reveal the presence of poison by losing colour and opacity. (Chalices intricately carved from rhinoceros horn were used by the Chinese as a similar means of poison divination; in these the poisons effervesced: Wellcome display, Science Museum, Kensington).

The Sun Maidens

The Greek love of drama and tragedy is noticeable in an imaginative and original description of the origins of amber. The tragedy of Heliades (Phaethusa, Aegle and Lapetia) the Sun Maidens, is translated by Ovid in his *Metamorphoses*; a precis of which follows.

The sisters were happy for their brother and they joyfully harnessed the Steeds of the Sun to the Sun Chariot when Phaethon was allowed by Phoebus (against his better judgement) to drive the sun across the sky.

Things went well for a while when the steeds took the bit and bolted. Uncontrollable, the horses pulled the sun so close to Gaia (Heaven and Earth) that she was set on fire. Volcanoes were born, lands became parched, seas dried and forests turned to ashes.

Unable to withstand such painful devastation for much longer, she begged Zeus to save her. Taking pity on Gaia, the supreme god and ruler of Olympus threw a fatal and killing bolt of lightning at Phaethon.

The body fell into the river Eridanus (now known as the river Po) to be recovered by the Nymphs of the Stream. They carefully and reverently buried it on the river bank. His sisters eventually found the grave and knelt by it weeping copiously and perpetually. Unable to move through grief they became transfixed on the place where each knelt. There they stayed until their bodies gradually became covered with the bark which grew out from the surrounding trees; their limbs changed to branches; and they, finally, were transformed into Poplar Trees.

The sisters continued shedding a flood of tears which flowed into the river; and the tears were converted to amber.

Grease of amber

Amber was the name given to a wax-like substance found floating in tropical seas and in the intestines of the sperm-whale. Later, the name 'Ambre Jaune' or 'Succin' was given to fossil resin. 'Ambre-Gris' (grey amber) became the new name for the original 'Amber' of the whale to distinguish it from 'Ambre Jaune'; these are the names now in regular usage. Ambergris – a somewhat odoriferous substance – was at one time used extensively to provide a good base for quality perfumes until it was replaced by a secretion taken from the Civet cat.

In 1841 Pope wrote: "Praise is like ambergris; a little whiff of it, by snatches, is very agreeable; but when a man holds a whole lump of it to his nose, it is a stink and strikes you down".

Used in cookery

It seems impossible, knowing the origins of such a substance, that ambergris could ever have been used in the preparation and cooking of food.

To quote Macaulay (*History of England*, 1849.): "Something has been put into his [Chas.II] favourite dish of eggs and *ambergrease*". (*Oxford Dict.*).

This article is an excerpt taken from my larger work provisionally entitled: *Facts, Fantasies and Superstitions of Diamond and Coloured Gemstones*, which is yet to be published.

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Notes from the Laboratory – 13

Kenneth Scarratt, FGA

The Gem Testing Laboratory of Great Britain, 27 Greville Street, London EC1N 8SU.

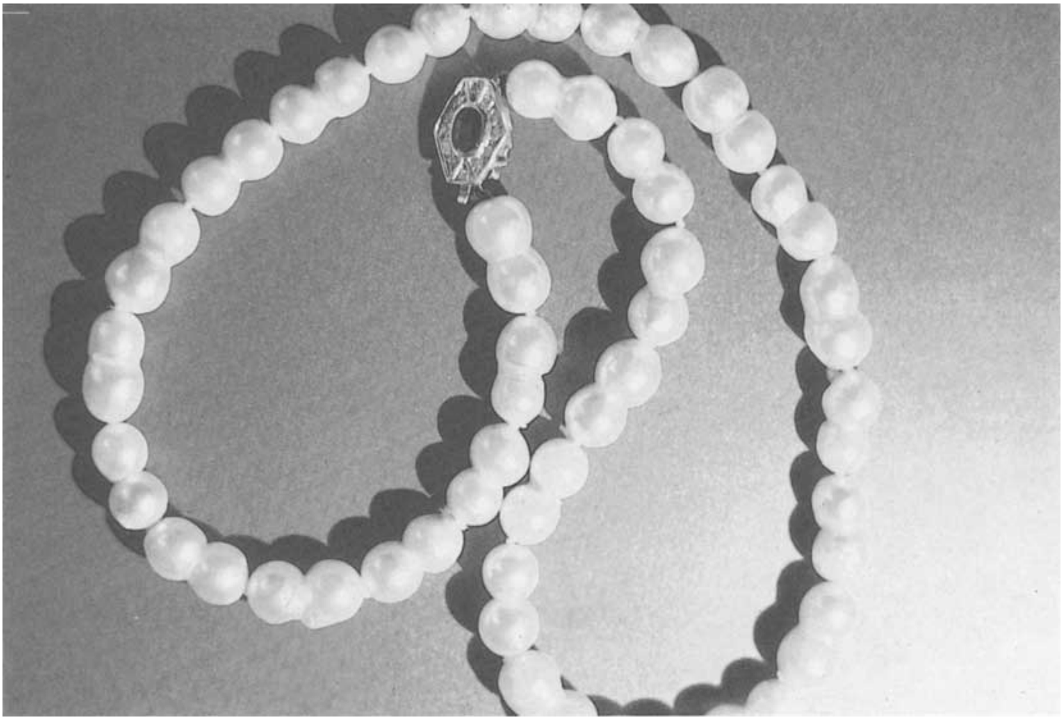

Fig. 1. A single row of double-nucleated cultured pearls.

Double-nucleated cultured pearls

We have seen many single cultured pearls which have had double nuclei in the past but we were astonished to see the necklace shown in Figure 1. There were 29 'double pearls' in the necklace, the largest being 8.35 × 13.2 mm and the smallest 6.59 × 12.8 mm. As the X-radiograph in Figure 2 shows, all of the pearls contained two mother-of-pearl beads. Under such circumstances the question that must be asked is are these merely pairs of pearls brought together by some form of adhesive or were they grown in this way. A close examination of the 'junction areas' revealed that the nacre, on which the 'overlapping platelets' could be seen quite clearly, passed smoothly from one side to the other and that there was no sign of any artificial junction. A close look at the radiograph also shows that the layers of nacre formed over both beads when they were in juxtaposition.

Repaired and filled pearl

Whilst still on the subject of pearl, yet another (Scarratt, 1986), hollow pearl that had been cunningly filled was submitted for examination. The pearl, which is shown in Figure 3, is drop-shaped and measures 26.4 – 24.9 × 29.3 mm. Its weight is

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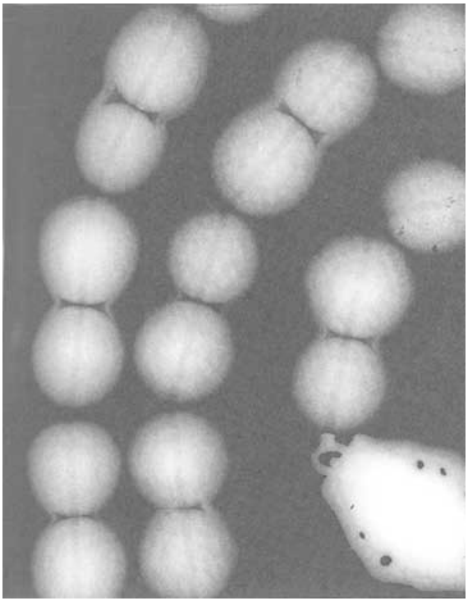

Fig. 2. Radiograph showing the two mother-of-pearl beads in each of the pearls in the necklace seen in Figure 1.

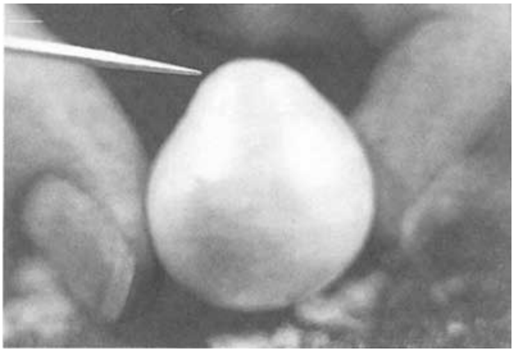

Fig. 3. 'Hollow' cultured pearl. The pointer indicates the area which has been coated with a substance similar to that which is used to coat imitation pearl.

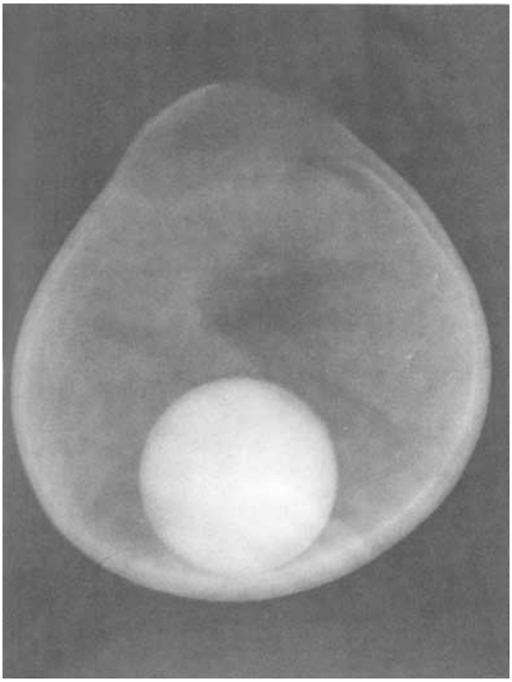

Fig. 4. Radiograph of the pearl seen in Figure 3. This shows the small mother-of-pearl bead and the fracture at the top of the pearl.

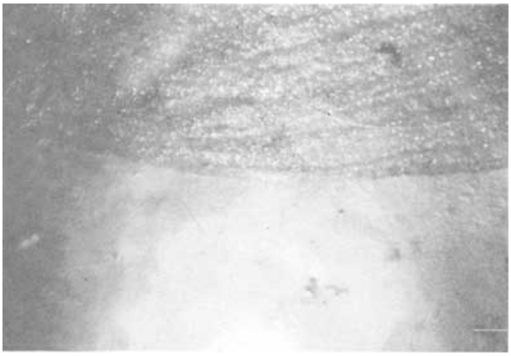

Fig. 5. A close view of the pearl in Figure 3 showing the demarcation between the artificial coating and the pearl.

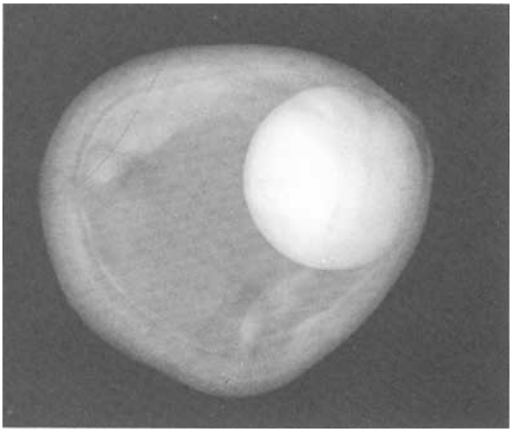

Fig. 6. Radiograph of a cultured pearl of a similar size and appearance to that in Figure 3, but in this case the surface has not been punctured.

67.49 ct. The radiograph (Figure 4) reveals it to be a cultured pearl in which the mother-of-pearl bead is both comparatively small and sits motionless at the base. From the radiograph it becomes immediately apparent that the pearl was largely hollow, but that it is now filled with an artificial substance thereby increasing the weight and adding strength to the thin shell. A closer look at the radiograph reveals a small hole in the area indicated in Figure 3 by the metal pointer, and this is obviously the place through which the pearl was filled. The hole is not visible from the exterior as the entire top of the 'pearl' has been coated with a substance usually used to coat imitation pearls (Figure 5). Another cultured pearl of similar dimensions was examined shortly after this and was found to have a similar interior (Figure 6) but in this case the entire surface was that which is usual for cultured pearls and there were no indications of it being punctured through to the 'hollow' centre.

Large aquamarine of exceptional colour

An interesting and large aquamarine was submitted for examination. The stone weighed 125.92 ct, measured in the region of 38.0 – 26.2 × 17.0 mm and had a most extraordinary colour. Figure 7 displays the deep blue colour of the stone as seen from an angle with the table. The stone was submitted with supporting documents that described the stone as being one of the largest cut from the 'Marta Rocha' crystal. The Marta Rocha crystal was named after Miss Brazil of 1954. It was discovered in July of that year, just 6 km north-east of Topazio in the State of Minas Gerais, Brazil, and its weight was 34.7 kg and it yielded 57,200 ct of faceted gems (Proctor, 1984).

Fig. 7. A 125.92 ct aquamarine said to be one of the stones cut from the 'Marta Rocha' crystal.

Amber 'imitation'

Amber is imitated by many substances and it can be treated in many different ways. It is imitated by a number of plastics including the most popular, bakelite, by glass, and by younger resins such a Kauri gum. The possible treatments include heat treatment, staining and 'pressing'.

Three barrel-shaped 'amber' beads, the largest weighing 26.05 ct, were submited for examination recently. Under magnification each was found to be manufactured, apparently, from several pieces of amber being held together by an unknown resin-like substance (Figure 8). Each of the individual pieces contained either insects or evidence of plant-life. These beads are similar to those described by Fryer *et al.* (1983).

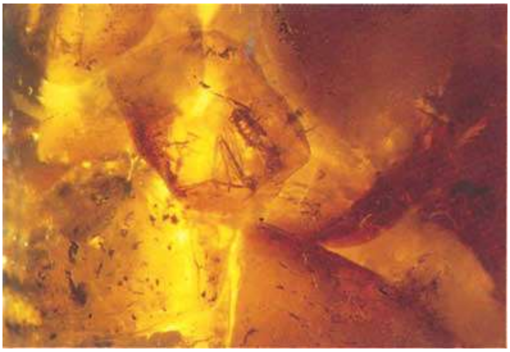

Fig. 8. The interior of an 'amber' bead revealed that it is composed of several small pieces of amber enclosed in an unknown resin-like substance. Note also the included insect in one of the pieces.

The 'Pool emerald'

A hydrothermally grown synthetic emerald manufactured in Australia was brought on to the market around 1981 and marketed under the trade name of 'Biron'. In common with other synthetic emeralds grown in this way, the refractive indices of some of the Biron fell into the natural emerald range at 1.571–1.576. The early production of this material contained very little in terms of inclusions and indeed some could not be termed 'emerald' because they lacked a chromium content sufficient to be detected with the hand spectroscope. However, an arrow-head or sometimes treacle-like structure was seen in most stones and, if one searched, the stone might reveal very small 'nail head' inclusions consisting of spikey growth tubes and crystals of phenakite. Later productions revealed other indicators such as feathers with screw-like turns and they also contained sufficient chromium.

In early July 1988 we received a loose 0.41 ct 'emerald' from a jeweller in Scotland who was unsure of the correct nomenclature to use for the stone under retailing conditions. He was being offered the stone under the trade name 'Pool emerald' but the advertising literature being used as a selling aid avoided stating in a clear way the origin of the stone. The literature, which was in full colour, was headed '...The Pool Emerald. From the Emerald Pool Mine Western Australia (1929). Source of natural and refined emeralds...' After showing the literature to a few members of the trade, our opinion of the wording used was very much confirmed, i.e. that people were likely to think that the stones in question were 'treated natural emeralds' whereas, as our examination of the stone in question proved, they are synthetic.

It has been stated that the 'Pool emerald' is 'refined' by recrystallizing 100% low quality natural emerald from the Emerald Pool Mine and that the method of growth used is an adaptation of the Biron hydrothermal technique. In fact the synthetic Pool emerald appears very similar to, and has the same infrared spectrum as, the Biron synthetic emerald (Figure 9).

Putting the question of nomenclature to one side, it can be said that the synthetic Pool emerald, like the Biron, is in appearance very similar to the natural material. Both the refractive indices (varying, so far, from 1.568 – 1.572 to 1.570 – 1.575) and the SG, can fall into the same range as some natural emeralds, therefore if the stone were free of internal features this would make identification by normal gemmological techniques very difficult. Fortunately the first example of the synthetic Pool emerald to be examined in the laboratory contained feather formations and growth structures typical of those reported for the synthetic Biron emerald (Kane *et al.*, 1985). However, even

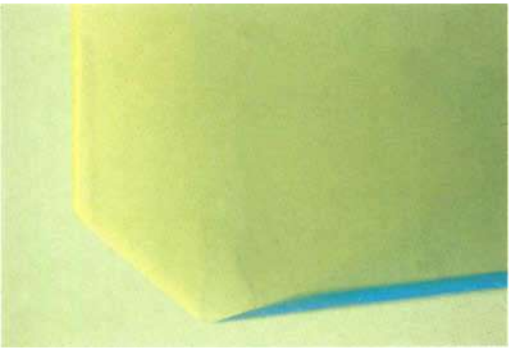

Fig. 10. A 'spiral feather' in a synthetic Pool emerald.

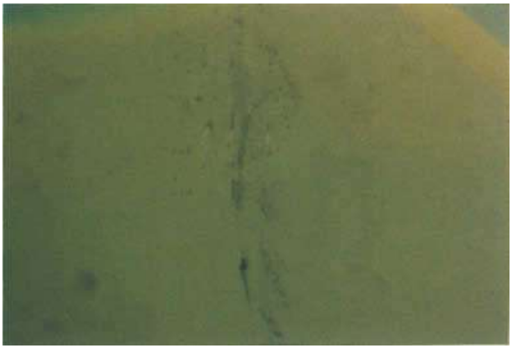

Fig. 11. A feather and three-phase inclusion in a synthetic Pool emerald.

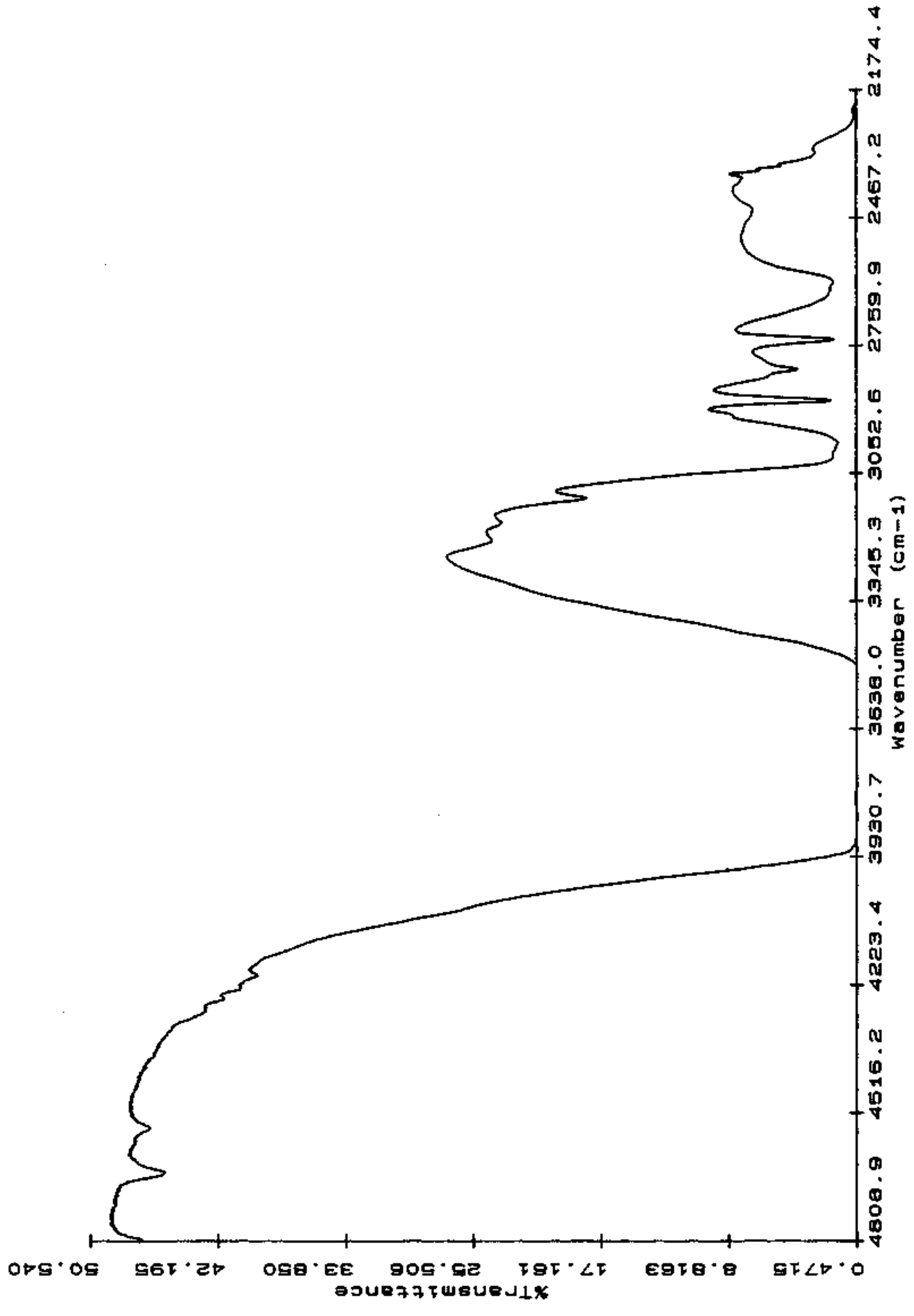

Fig. 9. Infra-red spectrum of the synthetic Pool emerald. Obtained using the Nicolet 510 FT-IR System.

with inclusions the situation could be confusing; a further example of the synthetic Pool emerald was examined in August 1988 and this stone, whilst containing the twisted feathers typical of synthetic emerald along with 'arrow-head' growth structures, also contained 'spiral feathers' (Figure 10) similar to those structures seen in some natural emerald (Fryer *et al.*, 1983) and three phase inclusions (Figure 11) similar to those typical of emeralds from Colombia.

When viewed through the Chelsea colour filter the synthetic Pool emerald appeared a dull red. Under short-wave ultraviolet light a slight reddish fluorescence was observed, but under long-wave ultraviolet light it was inert.

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Ruby/spinel teaser

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'Value my ruby necklace' was the request of a solicitor's wife, fresh from a holiday on the far side of the globe.

The two rows of faceted pink to red beads had a distinctive lack of corundum colour absorption pattern, with its modest fluorescent 686 nm line and characteristic dark door posts, along with the fainter repetition of the effect both up and over the 700 nm mark and down towards the orange. The pattern is instantly contrasted by pink sapphire/ruby with its strong chrome 693/694 doublet which pierces the red end and may show two slight support lines on the down side with the 660 more evident than the 668. Stronger coloured corundum gems would, of course, produce the diagnostic ruby trio in the blue, but these become increasingly reclusive in the paler pink sapphires, and do not appear in spinel.

Typical of a solicitor's thinking, the customer's husband had obtained a written guarantee that if the stones were not as described in identity or value, there would be a refund.

Our finding caused a strong Saxon/Gothic outburst by airmail which produced a prompt legal reply from solicitors acting for the jeweller in question. Obviously 'they' (the customers) had taken the necklet to a jeweller who knew nothing of gem identification(!), but if a bona fide gemmological laboratory report substantiated the claim all goods could be returned with costs and all moneys and expenses refunded.

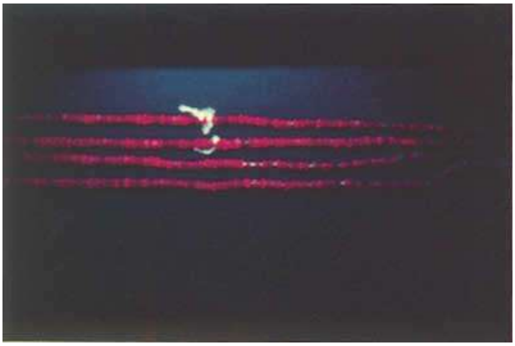

Fig 1. Chrome fluorescence in the necklace.

The trap was sprung. The photo of the necklace (Figure 1) indicates the nature of the problem – all 640 of them! – and being aware of legal niceties and not-so-niceties, I was well aware of the danger in letting our original pronouncement stand unsubstantiated. Suppose we sent the necklace all the way back, only for the other end to find two rubies in the necklace after all. Such a *faux pas* could be exploited by the articulations of the legal profession, e.g. 'Does your gemmological adviser not appreciate that the necklace does contain rubies?', which could put us in a very uncomfortable position with our own customer.

How do you test 640 red beads on two strands of red silk? I felt our case better served by leaving the stones threaded rather than loose. Where to begin? Ultraviolet light. The Long wave produced a positive response of red fluorescence without a single inert specimen (see Figure 1). The level of fluorescence varied dependent on the chrome/iron content, but typical for pink sapphire or spinel, so this did not resolve the issue.

The polariscope is a useful idea, but when you realize that the stones are as small as 1.13 mm, and there is a drill hole and thread through them, not to mention inclusions and strain birefringence in spinel, this was not going to give unequivocal proof. Also interpreting the Becke line technique was stymied by the same problems of small size, though there would have been no problem if the stones were loose. Looked at individually there were the inclusions characteristic and distinctive of spinel and corundum.

Lastly the spectroscope – but think of all those 640 stones. The conclusive answer took only seconds and has been demonstrated since on the *Retail Jeweller* Practical Gem Courses, and in darkness to boot. The students sit down one at a time confronted by the necklace lying across the

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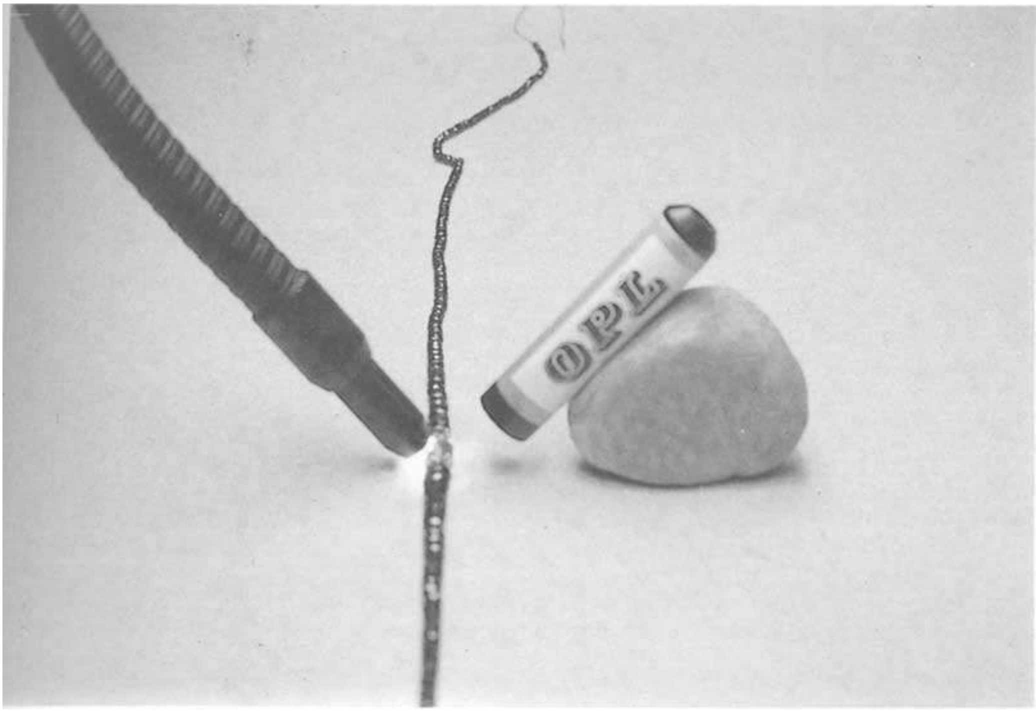

Fig 2. The spectroscope set up for the testing of the necklace.

partly 'earthed' fibre optic. (See Figure 2 for layout.) The lights are put out, and the observer sees the typical spinel pattern as described. The necklace is then drawn across the nose of the fibre optic with the spectroscope one inch distance. The necklace passes through in seconds, and amazingly the spectrum pattern stays coherently complete so long as the stones are the same. I can still hear the shouts of 'Now!', 'Now!', as on two occasions the semi-bright spinel line jumped its 686 nm to the 693/694 nm bright line position of the pink sapphire and immediately back again. The two shouts coincided with the two pink sapphire/pale rubies which lay concealed among the 640 stones – the two white cotton threads (Figure 1) indicate their position.

For all the small nanometre distance between these two key lines, 'the jump' was quite electric and an obvious gemmological treat for all who witnessed the phenomenon. The testing of the stones could be completed accurately in seconds, which goes to show the power of the spectroscope. The demonstration can easily be contrived by placing a ruby and a spinel side by side at the end of the fibre optic and panning the spectroscope from one stone to the other when the bright fluorescent line will be seen to jump back and forth as described.

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Growth patterns in Hong Kong

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Since the end of the Second World War, Hong Kong has had its growth miracles in many fields, not least in the science of gemmology.

Anne Paul, who played a leading role in the development of gemmology in Hong Kong and of the Gemmological Association of Hong Kong of which she was a founder member, left in June for a new life in Tokyo and it seemed an appropriate moment to give a background to the history of gemmology in this part of the world and to pay tribute to those who have worked there with such enthusiasm to spread the word.

First, of Anne herself, who became an FGA in 1975. This combined with her background of teaching, soon swept her into running classes to prepare students for the GAGB diploma examination. Additionally, from 1979 until her departure, she served on the executive committee of the GAHK holding the positions of Treasurer, Honorary Secretary, Vice President and President. Significantly, not in that order. Having been President, she subsequently of her own volition took upon herself the more arduous tasks on the executive committee. Anne taught students of all nationalities with great success and enthusiasm: Two Chinese students, one from Taiwan, who had unsuccessfully sat their diploma examination seven and eight times respectively, came to her for private tutorials in one determined last ditch attempt and with her help, mainly in overcoming the language problem, both passed.

Fig 1. Anne Paul

The first person to become an FGA in Hong Kong was Oleg Peresypkin (qualified 1948), a man of many parts and a true 'China hand' of the old school. He dealt in Chinese artworks, initially in Peking and later in Hong Kong and from his collection acquired in the former supplied the Mandarin Hotel, when it was first built, with beautiful gilded temple carvings and the pair of Chinese effigies, which to this day grace the entrance to the Chinese restaurant. He held the agencies for a number of well known British companies including George Lindley and later Thomson Gems.

Two years after Oleg Peresypkin, Mr Siu Man Cheuk qualified and for many years met with great resistance and struggle against the 'spurious' and uncomfortable knowledge he had assimilated from the UK. He recounts how his sanity was seriously questioned by the trade when he first pronounced a most desirable 'ruby' with curved growth bands, as a Verneuil synthetic corundum. Mr Siu is currently still well versed in the world of gemstones and has witnessed Hong Kong not only from the beginning of gemmology but from the days when many of his parents' contemporaries were victims of the opium divans.

By 1973 Hong Kong had still only claimed a total of nine successful candidates in the GAGB

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diploma examination, including one distinction: Noah Kan; the first person (there have only to date been two from Hong Kong) to continue his studies to the post diploma gem diamond examination: Mr Woo Shun-Wai; George Chan of opal and amethyst fame and Nissanka De Silva of the well established jewellers S.P.H. De Silva who in the years following his qualification gave many private words of advice and encouragement to aspiring FGAs.

At this point Hong Kong had reached a stage where it was burgeoning with businesses dealing in gemstones – far easier to acquire than an electric kettle or other domestic trifle – and although there was outstanding knowledge in some aspects of gemstones, formal gemmology was sadly lacking, misnomers abounded, and tuition in the subject difficult to obtain. In September 1972 Marcia Lanyon, an able gemmologist, had recently arrived in the Colony from London and set up classes both to prepare students for the diploma examination and general interest gemmology classes. There was no example to follow and Marcia Lanyon had the formidably task of preparing her own course notes and amassing a wide collection of stones.

This having been achieved and in a place where gemmology remained an alien subject, she turned a batch of listless European and Chinese housewives into career gemmologists and for those, mainly Chinese, already in the trade she provided the route to a new awareness and professionalism in their occupation. Amongst her successful students were Louis Lo the present GAHK president, and Anne Paul, Anne Strachan and Sandra Brauns who all went on to teach.

Apart from the gemmologists descending directly from this line; independently, a few years later, Dr T. C. Wong of the Hong Kong Chinese University qualified with distinction, Dr Healey, Dr Yu and Mrs C. M. Ou Yang from the University of Hong Kong qualified. Dr Healey became the first Chairman of the GAHK and apart from his teaching is always a willing lecturer capable of speaking on the most taxing topic, greatly respected by everyone and a guiding light in all matters gemmological. The indomitable Mrs C. M. Ou Yang has in recent years come very much to the fore with her mass production of FGAs, her thesis on Burmese jadeite jade and providing the liaison

Fig 2. Anne Paul teaching practical gemmology in Hong Kong University Laboratories.

between Wuhan University in China and gemmologists of international repute.

Mention should also be made of the Baptist College which has in recent years provided the centre for the GAGB examinations and for a number of years has offered tuition in gemmology. Initially Melinda Tilley, with her widely acknowledged flare for teaching, conducted the courses – she went on to run her own private classes – and for the past few years the centre has been co-ordinated by Kitty Wong.

Including the most recent diploma examination results, Hong Kong can now lay claim to almost two hundred FGAs, past and present, it has a thriving association of approximately 300 members comprising FGAs, GGs and DGemGs. There are many who have not been named who continue to contribute countless hours of time, much of it voluntary, and enthusiasm both in teaching and organizing. Last but not least it has been an enormous advantage to be placed on the cross roads of the Far East and in the midst of a gemstone and jewellery market for the world. As a result of these factors many gem experts and leading gemmologists find their way to this metropolis in the South China Sea and of their good nature and interest in the subject impart their knowledge by lecturing to the ever eager Hong Kong audiences.

The author would like to thank Mrs Memory Stather, FGA, who is carrying on much of Anne Paul's work, for providing information on Anne's career and for the initial thoughts on writing about gemmological education in Hong Kong.

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Yellowish-green Gilson synthetic emerald

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Abstract

A yellowish-green faceted Gilson synthetic emerald with refractive indices of n_o 1.563, n_e 1.559 and a density of 2.65 g/cm^3 was examined. The flux-grown sample was found to contain chromium and nickel as dominant colour-causing trace elements and subordinate amounts of vanadium, iron and copper. Absorption bands and pleochroism of the sample are due to the presence of Cr^{3+}, Ni^{3+}, and Ni^{2+}, which is different from Russian chromium- and nickel-bearing hydrothermally-grown synthetic emerald.

According to gemmological literature at least three different types of Gilson synthetic emerald were commercially grown and marketed in the past. Most frequently, samples with bluish-green colour and distinct red fluorescence under long- and short-wave ultraviolet radiation were produced, the refractive indices of which were found to range from 1.562 to 1.568 for n_o and from 1.559 to 1.562 for n_e. Bluish-green Gilson synthetic emeralds with higher refractive indices between 1.577 and 1.580 for n_o and between 1.570 and 1.574 for n_e were found to contain distinct amounts of iron which is responsible for the quenching of fluorescence in long- and short-wave ultraviolet. Another type of Gilson synthetic emerald with yellowish-green colour and refractive indices ranging from 1.562 to 1.569 for n_o and from 1.558 to 1.564 for n_e is also reported in gemmological literature. Samples of this colour variety reveal a greenish-yellow, yellow or orangy-yellow fluorescence under ultraviolet radiation. The density of the bluish-green and yellowish-green fluorescent types of Gilson synthetic emerald is described as 2.65 g/cm^3, and the values measured for the bluish-green non-fluorescent iron-bearing variety were found in the range of 2.68 to 2.69 g/cm^3 (Gübelin, 1964; Liddicoat, 1964; Webster, 1964; Flanigen *et al*., 1967; Fryer, 1970; Liddicoat, 1970).

During a systematic study of absorption spectra of natural and synthetic emeralds in the visible and ultraviolet range (cf. Schmetzer, 1988, 1989), all three types of Gilson synthetic emeralds were examined. The spectra of stones of the most commonly produced bluish-green fluorescent variety reveal ordinary chromium absorption bands without any special properties. In the spectra of samples of the bluish-green non-fluorescent type of Gilson synthetic emerald, the absorption bands of Cr^{3+} are superimposed by the spectrum of Fe^{3+} replacing Al^{3+} in octahedral sites, which consists of two strong absorption bands in the bluish-violet and ultraviolet range with maxima at 23,500 cm^{-1} (426 nm) and 27,000 cm^{-1} (370 nm). In both types of Gilson synthetic emerald a pleochroism of bluish-green ∥ *c* and yellowish-green ⊥ *c* is observed, which is due to absorption minima at 20,000 cm^{-1} (500 nm) ∥ *c* and at 19,800 cm^{-1} (505 nm) ⊥ *c*. These results indicate that the high iron contents of the samples do not change colour and pleochroism of these synthetic emeralds.

Surprisingly, the absorption spectrum of one yellowish-green sample was found to reveal additional absorption bands, which could not be assigned to chromium and iron. Consequently, this Gilson synthetic emerald was examined more thoroughly in order to clarify its cause of colour as well as the spectroscopic properties of this particular type of Gilson synthetic emerald.

The sample of Gilson synthetic emerald to be described was provided by a private collector, who bought the stone in the late sixties or early seventies. The synthetic emerald, weighing 2.25 ct, was faceted with the table facet perpendicular to the *c*-axis of the beryl. The colour of the stone is described as yellowish-green, resembling high vanadium-bearing natural emeralds, e.g. from Muzo, Colombia. The pleochroism of the Gilson synthetic emerald is described as an intense green ∥ *c* and a somewhat lighter yellow-green ⊥ *c*. In long- and short-wave ultraviolet radiation a weak yellowish fluorescence was observed. Refractive

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indices were measured as 1.563 for n_o and 1.559 for n_e with Δ 0.004, the density was determined as 2.65 g/cm^3. Microscopic examination revealed the stone to contain numerous wispy or veil-like patterns (Figures 1, 2), which are typical for early Gilson synthetic emeralds. The sample showed internal growth planes and colour-zoning parallel to the basal pinacoid *c* (0001). Infrared spectroscopy revealed the absence of water and proves the synthetic emerald to be flux-grown, most probably using a seed plate which was orientated perpendicular to the *c*-axis.

Chemical investigations by electron microprobe and X-ray fluorescence analysis yielded the following trace element contents measured on the table facet of the synthetic emerald [wt.%]: V 0.05, Cr 0.29, Fe 0.20, Ni 0.24, Cu 0.01.

According to these chemical data, this particular sample of Gilson flux-grown synthetic emerald contains distinct amounts of two dominant colour-causing trace elements, i.e. chromium and nickel. Vanadium in the concentration present is assumed to increase the intensity of chromium absorption bands, whereas the concentrations of iron and copper are too low for a distinct influence on the colour of the sample.

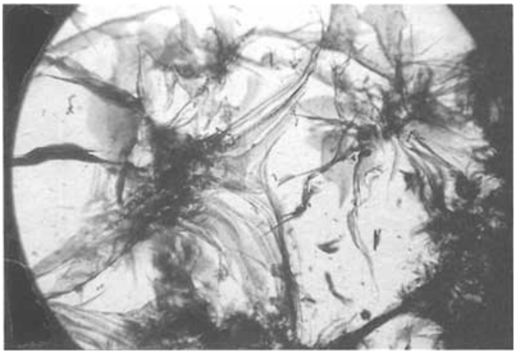

Fig. 1. Wispy or veil-like patterns of residual flux in yellowish-green Gilson synthetic emerald. 32×

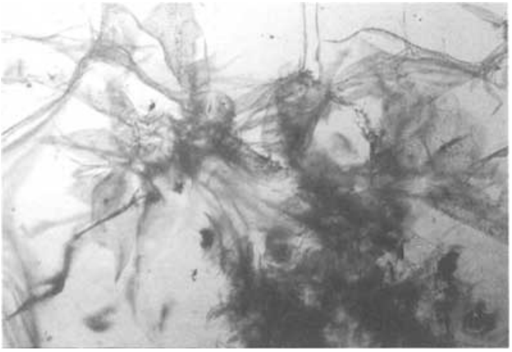

Fig. 2. Wispy or veil-like patterns of residual flux in yellowish-green Gilson synthetic emerald. 25×

Comparing chemical data and colour of the yellowish-green Gilson synthetic emerald with properties of other synthetic emeralds, which also contain chromium and nickel as dominant colour-causing trace elements, e.g. Russian hydrothermally-grown synthetic emeralds (cf. Schmetzer, 1988), the Gilson sample is expected to be bluish-green in colour, with a pleochroism of blue $\parallel c$ and yellow-green $\perp c$, and the absorption spectrum should consist of Ni^{3+} and Cr^{3+} absorption bands.

The absorption spectrum of the yellowish-green Gilson synthetic emerald described in this paper, however, consists not only of the absorption bands of Ni^{3+} and Cr^{3+} replacing Al^{3+} in octahedral sites as described recently for Russian hydrothermally-grown synthetic emeralds, but shows an additional absorption band at about 22,100 cm^{-1} (452 nm) with polarization $\parallel c$. This absorption band was assigned to divalent nickel replacing Al^{3+} in octahedral sites by Russian scientists (e.g. Solntsev, 1981a, b).

Due to the relative intensities of Cr^{3+}, Ni^{3+}, and Ni^{2+} absorption bands, the absorption minima in the Gilson spectrum are found at 19,850 cm^{-1} (504 nm) $\parallel c$ and at 19,500 cm^{-1} (513 nm) $\perp c$. In other words: due to the strong intensities of Ni^{3+} and Ni^{2+} absorption bands in the spectrum of this chromium- and nickel-bearing Gilson flux-grown synthetic emerald, the absorption minima $\parallel$ and $\perp$ *c*, which are found in chromium- and nickel-containing Russian hydrothermally-grown synthetic emeralds at about 20,300 cm^{-1} (493 nm) $\parallel c$ and at about 19,850 cm^{-1} (504 nm) $\perp c$, are shifted towards lower wavenumbers (higher wavelengths). According to these differences in the positions of absorption minima, the blue or greenish-blue colour of Russian synthetic emeralds $\parallel c$ is changed to an intense green in the Gilson sample, and the yellow component of the yellow-green in Russian stones $\perp c$ is strengthened in the Gilson sample.

Consequently, the colour of yellowish-green flux-grown Gilson synthetic emerald is caused by Ni^{2+}, Ni^{3+}, and Cr^{3+}, all of them replacing Al^{3+} in octahedral sites. The different valency states of nickel in various synthetic emeralds, e.g. in Russian hydrothermally-grown or in Gilson flux-grown synthetic emerald, are most probably due to different growth conditions.

Acknowledgement

The author is grateful to Dr H. Holländer of Eugen Blink KG, Pforzheim, FRG, who kindly supplied the specimen of yellowish-green Gilson synthetic emerald.

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[*Manuscript received 2 August 1988.*]

Gemmological Abstracts

APTER, M., 1988. L'agate et l'imaginaire. (Agate and the imagination.) *Revue de Gemmologie*, 96, 10-14, 13 figs in colour.

Agates illustrated depict shapes and forms suggesting other natural or anthropomorphic features. M.O'D.

AURISICCHIO, C., FIORAVANTI, G., GRUBESSI, O., ZANAZZI, P.F., 1988. Reappraisal of the crystal chemistry of beryl. *American Mineralogist*, **73**, 826-837, 8 figs.

The crystal chemistry of beryl is re-evaluated in accordance with modern principles and on the basis of fresh chemical analyses and X-ray structural refinements on samples from different sources and compositions. M.O'D.

BANCROFT, P., 1988. Rubies of Thailand. *Lapidary Journal*, **42**, 7, 45-57, 5 figs, 2 in colour.

Geological and marketing features of Thai ruby are described. M.O'D.

BANERJEE, A., 1988. Gilson-Opale der neuen Generation. (New Generation Gilson opal.) *Kurzmitteilungen aus dem Institut für Edelsteinforschung der Johannes Gutenberg-Universität Mainz*, **4**, 2, 12, 1 fig.

Zirconium dioxide has recently been used as matrix material by Gilson in place of silica gel. Gilson opal can be identified by IR spectroscopy, using characteristic Si-O vibrations in the region around 1250cm^{-1}. M.O'D.

BANK, H., 1988. Gemmologische Kurzinformationen. *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **36**, 3/4, 161-74. (a) Geschliffener, farbloser Mesolith von Poonah, Indien. Id., 163-4; (b) Durchsichtiger, brauner, bestrahlter Phenakit. Id.., 165-6.

(a) A cut, colourless mesolite from Poonah, India, is described. The crystals are needle-shaped, and the one discussed was found in a lot of zeolites from Poonah, RI 1.505-1.506, hardness 5, SG 2.27.

(b) A transparent, brown, irradiated phenakite measuring 9.9 x 7.9 x 5.8 mm and weighing 2.84 ct is discussed. E.S.

BANK, H., BANK, F.H., 1988. Gemmologische Kurzinformationen. Variationsbreite der Brechungsindizes von Aquamarinen. *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **36**, 3/4, 166-8. 2 tables, bibl.

An extensive note on the variation of refractive indices of aquamarines, finding the largest variation in those from Nigeria. E.S.

BANK, H., HENN, U., 1988. Gemmologische Kurzinformationen. Changierende, chromhaltige Turmaline von Ostafrika. *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **36**, 3/4, 161-3.

Colour-changing, chrome containing tourmalines from East Africa are described. They change from green in daylight to brownish-red to red in artificial light. Probably from Lelatema in Tanzania. The tourmalines are chrome containing crystals of the dravite-uvite series, the uvite content being about 55-65%. E.S.

BECKER, G., 1988. Gemmologische Kurzinformationen. Farbveränderungen von Apatit durch Erhitzen. *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **36**, 3/4, 172.

Colour changes in apatite by heat treatment are described. The apatite came from five different sources (Mexico, Madagascar, India and two Brazilian sources). The various apatites were heated to 300°C to 850°C and showed varying results, the most interesting being the Madagascan stones which changed from light green to tourmaline green, then blue and lastly to an aquamarine blue. E.S.

BROWN, G., 1988. Precious versus man-made opal. *Gemological Digest*, **2**, 3, 24-8, 6 figs.

The structure of natural and imitation opal is compared and nomenclature suggestions made. M.O'D.

BROWN, G., 1988. Paua Shell: New Zealand's distinctive organic gems. *Australian Gemmologist*, **16**, 10, 367-70, 13 figs most in colour.

'Paua' is Maori for the large abalone, the shell of which is discussed. Most shell is dye enhanced, some is cemented to black epoxy resin or other materials, including the cabochon glass front and possibly an opaque back to make the so-called 'sea opal', doublet or triplet forms. Buttons are made by encasing a circular paua fragment in clear plastic. R.K.M.

Brown, G., 1988. Sapphirine. *Wahroongai News*, **22**, 7, 22-4, 2 figs.

A detailed account of an extremely rare gem which seems to exist as uncuttable grains or as a few small cut stones. It is apparently a layer structured monoclinic magnesium aluminium silicate which is usually blue, but can be purplish or even brown. RI 1.710-1.717, SG 3.5, H 7. A very obscure collector's gem [possibly made more so by naming it so similarly to sapphire, to which it is related only by colour. In 55 years I cannot recall seeing a cut specimen of sapphirine. The same name has been used for a blue chalcedony]. R.K.M.

Brown, G., Kelly, S.M.B., Snow, J., 1988. A coconut pearl? *Australian Gemmologist*, **16**, 10, 361-2, 3 figs.

An Indonesian spherical 'gem' claimed to be a specimen of the equivocal and possibly mythical 'coconut pearl' was shown to have been fashioned from thick sea-shell. R.K.M.

Brown, G., Kelly, S.M.B., 1988. A Verneuil sapphire with induced fractures. *Australian Gemmologist*, **16**, 11, 419-21, 5 figs.

A sapphire with natural looking partially healed fractures was found to have curved colour bands, partly diffused by heat treatment, which confirmed it as synthetic. R.K.M.

Brown, G., McCabe, A.J., 1988. The New Zealand Aurora Shell, a unique organic gem material. *Australian Gemmologist*, **16**, 11, 401-7, 11 figs.

An account of the search by the McCabe family for green-lipped New Zealand mussel shell (Perna canaliculus) with iridescence suitable for jewellery use. Grahame Brown examined the finished products some of which were plastic coated, or backed with pink polyester resin to strengthen the shell and increase its colour effect. All shells processed are dyed. R.K.M.

Brown, G., Snow, J., 1988. The EW-120SG electron densimeter. *Australian Gemmologist*, **16**, 11, 422-3, 2 figs.

A report on a simple to use densimeter intended for assessment of gold qualities by specific gravity. Works well within limits of 2-120 grams, which restricts its use with gems to 10 ct or larger sizes. R.K.M.

Brown, G., Snow, J., 1988. An interesting hematite imitation. *Australian Gemmologist*, **16**, 10, 371-3, 5 figs.

A Study Club investigation which arose from a black cabochon set in a practical examination, correctly identified by an examinee but marked wrong by the examiner. [These things can happen] The error was discovered and the glass confirmed by its SG 2.57, RI 1.52, white streak and conchoidal fracture. Hematite (gem) SG about 5.00, RI as above refractometer range (3.22-2.95), red streak, splintery fracture. R.K.M.

Brown, G., Snow, J., 1988. Gemmology Study Club laboratory reports. *Australian Gemmologist*, **16**, 11, 424-9, 18 figs.

Deals with plastic imitations of lapis lazuli and malachite; with dumortierite in quartz and with a native necklace of elephant ivory. A diamond in a ring was badly damaged by a cleavage when dropped in a kitchen sink. Plastic imitation pearls tested by X-ray found to have radio-opaque outer coating. A greenish synthetic triplet spinel was thought to have a centre coloured section of water soluble silica 'glue', rather than glass, since it dissolved in dilute acetic acid. Sue Kelly identified a bronze coloured cabochon gem, with broad cats-eye, as the elaeolite variety of nepheline (SG 2.53, RI (spot) 1.55.) R.K.M.

Brown, G., Snow J., 1988. Is it amber? *Australian Gemmologist*, **16**, 11, 409-16, 21 figs.

An interesting attempt to provide procedures for identifying amber, modified amber, copal resin, various plastic simulants and glass which authors suggest should make amber identifiable from its imitations and treated forms. R.K.M.

Cassedanne, J., 1988. Les hélidores du Sapucaia. (Heliodor from Sapucaia.) *Revue de Gemmologie*, 96, 5-6, 6 figs, 1 in colour.

Heliodor is reported from the area of Sapucaia, Minas Gerais, Brazil. The crystals are quite large and a greenish-yellow. RI is given as 1.571-1.576 with a birefringence of 0.005 and SG of 2.69.

M.O'D.

De Goutière, A., 1988. Photomicrography of gemstones. *Gemological Digest* **2**, 3, 35-6, 3 figs in colour.

A brief description of the techniques used to photograph inclusions in gemstones. M.O'D.

Delbasteh-Miandoab, R., 1988. Spodumene afghanischer und brasilianischer Herkunft. (The origin of Afghan and Brazilian spodumene.) *Kurzmitteilungen aus dem Institut für Edelsteinforschung der Johannes-Gutenberg Universität Mainz*, **4**, 2, 9-10, 2 figs.

Pink, green and colourless spodumene crystals from Afghanistan and Brazil show a variety of inclusions. Idiomorphic beryl, quartz, Caamphiboles, Ca-pyroxenes, muscovite, lepidolite and zircon are among the minerals found. Also observed were two, and three-phase inclusions, negative crystals and fragments of opaque or minerals. Bent fissures and small etched tubes were noticed. Mn-content was found to be approximately proportional to the intensity of the colours. In the green crystals chemical analysis indicated that the colour was caused by Fe rather than Cr. M.O'D.

Frazier, S., Frazier, A., 1988. The Steinkaulenberg in Idar-Oberstein. *Lapidary Journal*, **42**, 7, 23-35, 4 figs (2 in colour.)

Agates have long been known from the prominent mountain overlooking Idar-Oberstein. Commercial mining there ceased in 1870/71 but the article reviews the mining history before that time. M.O'D.

Hänni, H.A., 1988. Les grenats. (Garnets.) *Revue de Gemmologie*, 96, 15-19, 11 figs (10 in colour).

The garnet group is reviewed with reference to the composition of the gem varieties which are described. M.O'D.

Hänni, H.A., Weibel, M., 1988. Origin of the cat's-eye effect in heat treated zircons from Sri Lanka. *Australian Gemmologist*, **16**, 10, 363-6, 5 figs.

Heat treatment is shown to produce minute disc-like fractures in some zircons, parallel to the *c* axis of the crystals, thought to be due to the decomposition of included apatite crystals which cause prismatic cleavages to develop. Another type exhibits needle-like inclusions. R.K.M.

Hicks, T., 1988. An American beauty. *Lapidary Journal* **42**, 6, 44-8, 4 figs (1 in colour).

A description of the rubies found in Cowee Valley, North Carolina, USA. M.O'D.

Hrabanek, J., 1988. Moldavite aus Süd-Böhmen und Süd-Mähren. (Moldavite from southern Bohemia and southern Moravia.) *Kurzmitteilungen aus dem Institut für Edelsteinforschung der Johannes Gutenberg-Universität Mainz*, **4**, 2, 10-11, 1 fig.

Characteristic inclusions of lechatelierite help to distinguish natural from artificial glass as well as distinctive Al/Na0$_2$ + K ratios. M.O'D.

Hutton, D.R., Troup, G.J., 1988. The identification of a natural ruby by electron spin resonance (ESR). *Australian Gemmologist*, **16**, 11, 399-400, 2 figs.

A brief account of procedure and identifying ESR absorption features in a ruby variously identified previously as synthetic or natural. Writers speculate on whether other large rubies have been identified incorrectly as synthetic. R.K.M.

Hughes, R.W., 1988. Pleochroism and colored stone grading. *Gemological Digest*, **2**, 3, 16-24, 9 figs.

Grading of coloured stones has to take pleochroism into account and various ways in which this can be done are discussed. M.O'D.

Hughes, R.W., Sersen, W.J., 1988. The Kanchanaburi sapphire secret. *Gemological Digest*, **2**, 3, 37-9, 3 figs in colour.

This piece gives a description, from the grading standpoint, of the Thai blue sapphires. M.O'D.

Koivula, J.I., 1988. Nasute: the soldier. *Australian Gemmologist*, **16**, 10, 388-9, 1 fig. in colour.

An amusing description, not of amber as such, but of a soldier termite entombed in amber some 35 million years ago. One strange fact emerges; many termites were trapped in this way, but an entrapped 'soldier' is quite rare. (Perhaps specialized 'military' were fed by the worker termites and did not often need to venture onto the resin bearing trees?)

The repellent fluid of the Nasute species is trinervitane, highly offensive, and lethal to ants etc, unknown elsewhere in nature. It would even divert anteaters from an attack. R.K.M.

Koivula, J.I., Fryer, C.W., 1988. Gemmologische Kurzinformationen. Native bismuth in quartz. *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **36**, 3/4, 168-70, 2 figs.

This note deals with native bismuth in quartz, from Teofilo Otoni, Minas Gerais, Brazil. The colourless host weighed 4.1 ct and measured 9.1 x 8.3 x 6.68 mm, and was purchased as a faceted emerald. The bismuth inclusions were accompanied by numerous, highly refractive tension fractures. E.S.

Landais, E., 1988. Un réfractomètre universel automatique le 'Dialsan'. *Revue de Gemmologie*, 96, 7-8, 5 figs.

A refractometer developed by the Swiss firm of Djévahirdjan measures refractive indices in the range 1.44 to 3.00. It makes use of the Brewster angle and indicates readings digitally. An accuracy of ± 0.02 is claimed. M.O'D.

Landmesser, M., 1988. Uber den sogennanten 'Streifenchalcedon'. (About the so-called banded chalcedony.) *Kurzmitteilungen aus dem Institut für Edelsteinforschung der Johannes Gutenberg-Universität Mainz*, **4**, 2, 5-8, 7 figs (1 in colour).

Using polarized light banded bluish quartz aggregates have been distinguished from agates. Length-fast chalcedony is rare in the aggregates which consist mainly of length-slow chalcedony and larger quartz crystals. The detail of the banding differs from that seen in most agates and from the Uruguay-type banding. Aspects of formation are discussed. Specimens are from Namibia. M.O'D.

Landmesser, M., 1988. Bau und Bildung der Achate. (Structure and formation of agate.) *Lapis*, **13**, 9, 11-28, 47 figs (22 in colour).

The nature of the structure and formation of agate is reviewed with the aid of some high quality photographs, some taken with the electron microscope. M.O'D.

Larsen, I., 1988. Das Sammeln von schleifbaren Mineralien und losen Einzelkristallen in Raum Mendig, Bell und Volkesfeld. (The occurrence of cuttable minerals and loose single crystals in the area of Mendig, Bell and Volkesfeld.) *Emser Hefte*, **9**, 4, 2-18, 14 figs (11 in colour).

Hauyne, olivine and sanidine, are found in the areas of Mendig, Bell and Volkesfeld, south of the Laacher See in the Eifel volcanic area of West Germany. These and other minerals are described. M.O'D.

Liu, G., Kang, X., Zhang, L., 1988. On the genesis of demantoid from Xinjiang, China. *Chinese Journal of Geochemistry*, **5**, 4, 381-90.

Demantoid occurs in asbestos veins cutting ultramafic rocks in the W of the Zuenggel basin, Xinjiang. The garnets contain ±90% of the andradite molecule and range from emerald-green, to yellow-green, light green and apple green. The gem-quality, transparent, emerald-green variety forms 2 mm rhombic dodecahedra. Chemical analysis gave $Si0_2$ 35.14, Al_20_3 0.71, Cr_20_3 0.531, Fe_20_3 29.13, FeO 0.75, CaO 32.17, MgO 0.34, $Ti0_2$ 0.018, = 98.79; *n* 1.888, SG 3.835, *a* 12.06Å, VHN 1195=1200 kg/mm^2 (H.7.1=7.2). Mössbauer spectroscopy showed that Fe^{3+} occupies the octahedral site; IR absorption spectra are reported. The necessary trace Cr was derived from chromite and Cr-spinel in the ultramafic bodies. R.A.H.

Mertens, R., 1988. Gemmologische Kurzinformationen. Schleifwürdiger Variscit aus dem Hunsrück. *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **36**, 3/4, 170-1.

Some cuttable variscite from the Hunsrueck, the mountain range between the Nahe and the Moselle, is described. The variscite is green. E.S.

Muntyan, B.L., 1988. Amazonite: The magic of microcline. *Coloured Stone*, /*21*, 6, 15-29, 2 figs in colour.

The main American locations for amazonite as briefly described. M.O'D.

Nassau, K., Miller, A.E., 1988. Strontium titanate. An index to the literature on properties and the growth of single crystals. *Journal of Crystal Growth*, 91, 373-81, 1 fig.

Single crystals of $SrTi0_3$ have been found to be useful substrates for the epitaxial growth of high temperature superconducting films. Over 100 papers are listed in this index. Many have gemmological interest. M.O'D.

Pienaar, H.S., 1988. A numerical approach to gemstone identification. *Australian Gemmologist*, **16**, 10, 374-8, 4 lists.

A rather way-out method of arriving at a reference number derived basically from the SG and RI of a species which, it is suggested, should make identification simpler. It is derived from on a formula devised by Gladstone and Gale in 1964, who were working on liquids, apparently to obtain constants which would be unaffected by temperature. [Constants of solids vary only very slightly in the normal ambient range so this advantage is lost.] RI 1.81 is used for all gems above the range of refractometer. Some ranges definitely overlap. [There are easier ways to identify gems today]

R.K.M.

Ramsey, J.L., 1988. Brazil, the ultimate field trip. *Lapidary Journal*, **42**, 5, 32-40, 7 figs (6 in colour).

The gemstones of Brazil are reviewed with details of their main occurrences. M.O'D.

Reinitz, I.M., Rossman, G.R., 1988. Role of natural radiation in tourmaline coloration. *American Mineralogist*, 73, 822-5, 4 figs.

Optical spectra of elbaite subjected to large controlled doses of gamma radiation were found to show the same spectroscopic features as natural stones. Pink elbaite was examined for the purpose of this study. Absorption feature of Mn^{2+} in nearly colourless elbaites are lost during artificial irradiation, presumably due to $Mn^{2+} \rightarrow Mn^{3+}$ transformation. The radiation that some Californian pegmatite tourmalines have undergone has been computed with reference to artifically irradiated samples. The amounts usually correspond to the amounts needed to restore the colour to elbaites that have lost colour during laboratory heat treatment and this shows that colour in natural pink elbaite is the result of natural radiation. The radiation process in nature could only have been effective if the pegmatite cooled below the decolourizing temperature of tourmaline. It is probable that most pink elbaite grew as near-colourless crystals in the pegmatites, only becoming pink from oxidation of Mn through ionizing radiation. M.O'D.

ROBERT, D., 1988. Padparadschas traités par irradiation. *Revue de Gemmologie*, 96, 4, 2 figs in colour.

Examples of corundum irradiated to give a padparadshah colour are given. A dosage of 309 Mrad is used. M.O'D.

SCHIER, J., 1988. Romancing the iris. *Lapidary Journal*, **42**, 7, 66-7, 4 figs in colour.

Iris agate is briefly described with particular reference to specimens found in Montana, USA. M.O'D.

SCHRADER, H.-W., 1988. Gemmologische Kurzinformationen. Synthetische Smaragde nach dem Hydrothermalverfahren aus der USSR – eine Ergänzung. *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **36**, 3/4, 173-4, 1 table.

Chemical data of nickel-bearing hydrothermally grown synthetic emeralds from the USSR are presented. E.S.

SERSEN, W.J., 1988. Colored stone grading and the question of nomenclature. *Gemological Digest*, *2*, 3, 29-34.

Nomenclature use and misuse in the coloured stone grading context, is discussed and a set of standardized terms suggested. M.O'D.

STRIPP, D.M., 1988. The soft touch. *Lapidary Journal*, **42**, 6, 20-36, 7 figs (4 in colour).

An account of the faceting techniques practised by Art Grant who specilizes in difficult materials. Pleochroism is attributed to fluorite. M.O'D.

THOMAS, A.E., 1988. Emeralds of the N.E. Transvaal. *South African Gemmologist*, **3**, **1**, 5-13, 7 figs (6 in colour).

An account of the emerald deposits in the north-eastern Transvaal, South Africa with a partial bibliography of published papers. M.O'D.

TRET'YAKOVA, L.I., VOKHMENSTEV, A. YA., OSTROUMOV, M.N., 1987. (Diagonostic reflectance spectra for jewellery grade and industrial stones.) (Russian with English abstract.) *Zapiski Vses Min. Obshch*, **116**, 4, 486-97.

The IR reflectance spectra are presented over the range 400=1600 and 700=1600 cm-^{1} for gem and commercial grade stones. The location of the reflectance bands and of diffuse reflections in the visible range (400=800 nm) is tabulated for diamond, ruby, sapphire, chrysoberyl, alexandrite, spinel, citrine, amethyst, rose quartz, chrysoprase, chrysolite, zircon (hyacinth), pyrope, almandine, uvarovite, topaz, emerald, etc. Spectra of diffuse reflections are given for 51 gemstones. R.A.H.

WEERTH, A., 1988. Edelsteinvorkommen im Schatten der Achttausender. (Gem locations in the shadow of eight thousand [metres].) *Lapis*, **13**, 10, 11-28, 39 figs (22 in colour).

Gem minerals from the northern areas of Pakistan are described. They include topaz, tourmaline, spessartine, epidote, beryl, apatite and fluorite. M.O'D.

WILSON, M.M., 1988. Montana moss agate. *Lapidary Journal*, **42**, 7, 58-60, 4 figs (2 in colour).

Fine quality agates are found in a number of places in the state of Montana, USA. The mining and fashioning of the agates are described. M.O'D.

ZEITNER, J.C., 1988. American classics. *Lapidary Journal*, **42**, 7, 36-44, 3 figs in colour.

Agate deposits of North America are reviewed. M.O'D.

Book Reviews

BECKER, V., 1988. *Fabulous Fakes*. Grafton Books, London. pp.viii, 232. Illus. in colour. £19.95.

This is an exellent survey of imitation jewellery and the book is subtitled 'The history of fantasy and fashion jewellery'. It deals with glass, plastic, steel, Berlin iron and a wide variety of superficially unlikely materials used for ornament. The impetus toward the use of these materials began in the eighteenth century with a great increase in the use of paste accompanying the fashion for artifice and display which was so much a feature of that period. The next period to have a chapter to itself is described as Neo-classic to Romantic and covers the new regime in France, which, succeeding the Revolution, developed its own distinctive style characterized by a classical elegance and which later turned into a less severe and delicate fashion. Cameos were characteristic of this period and the use of Berlin iron and jet began at this time.

By the beginning of the twentieth century the somewhat heavy style of the late Victorian years had been succeeded by a more natural appearance in fashion generally. This period saw the rise of designers like Chanel; there was a great exuberance of design and many of the pieces illustrated show an amazing panache in the use of materials. The Art Deco years have a chapter of their own which is called 'Sophisticated barbarism' – the turning point in the use of decoration is said to be the 1910 performance in Paris of Diaghilev's Schéhérazade. The 'Cocktail style' covers the years 1930 – 1940 and with a break for the war, jewellery was overtaken by the rebellious styles of the 1960s, which to some extant still obtain today. This is a jolly good book; there is a useful list of references and plenty of first-class pictures, some reproducing sales catalogues which must be collectors' pieces by now.

M.O'D.

BURCHARD, U., 1986. *Mineral museums of Europe*. Walnut Hill Publishing Company with the Mineralogical Record, Carson City, Nevada, USA. pp. 269. Illus. in colour. £40.00.

Western European museums only are covered in this beautifully illustrated guide. Museums are arranged by country and in general only those with a full public access are included. Most entries give a historical account of the collections and all have listings of specimens of world or slightly lesser importance; this is in order to help the reader track down items that he particularly wants to see. This is not only a useful book but is pleasing to read through for interest.

M.O'D.

CHERMETTE, A., 1986. *La fluorite*. (Fluorite.) Gaston Lachurie, Paris. pp. 171. Illus. in black and white and in colour. FF180.

This is a useful introduction to fluorite and is, so far as I can see, one of the very few monographs to be devoted to this mineral. Though emphasis is placed on French deposits introductory chapters describe the main features, including crystallography, physical and optical properties and provide brief notes on the cause of colour and luminescence. Important world deposits are described and those in France marked on a map. The economic importance of fluorite is explained and production statistics given. There is a short though useful bibliography.

M.O'D.

GHASWALA, S., 1987. *Diamond, king of gems*. Bombay. pp. 302. Illus. in black and white. RS 175/-.

This is a useful survey of the diamond in all its aspects and although there is not much to say that is new, there are many interesting sidelights of Indian practice. Furthermore, the information is up-to-date so that the book will form a quick reference guide to the commercial handling of rough, the details of which vary from time to time. The illustrations, which are of fair quality, show a number of Indian scenes as well as portraits of celebrated diamantaires. The only serious lack is a bibliography but none the less the text is accurate and lucid; the book represents good value for students and will undoubtedly be used in this context.

M.O'D.

NRIAGU, J.O., MOORE, P.B., 1984. *Phosphate minerals*. Springer, Berlin. pp. vi, 442. Illus. in black and white. Price on application.

For years so much work has been carried out on the phosphates that all comprehensive texts are long out of date. This book attempts to improve on this position by listing all the known phosphates and at the same time giving a set of accompanying chapters dealing with current work and problems. The preliminary descriptive section of 137 pages provides the best extent general survey in which details of each mineral are given, together with up-to-date references and constants. M.O'D.

O'DONOGHUE, M. 1988. *Gemstones*. Chapman and Hall, London and New York. pp xiv, 372. 18 colour plates. Line figures. £37.50

A few years ago the author mentioned his intent to rewrite and update *Gemstones*, the classic standard work by Dr G. F. Herbert Smith, which ran to some fourteen editions in half a century. The present book is shorter and is more a work of reference than a teaching text, but in other respects Mr O'Donoghue is to be congratulated on producing a modern book which, although written to a rather different format, takes over in place of the now regrettably unobtainable 'Herbert Smith'.

The short preface claims that this is the first attempt in English to bring together developments of the past thirty years. But the later editions of Webster's *Gems* were such attempts, as were works by other authors, and this new *Gemstones* scores in this respect mainly from having been written after the latest developments rather than before them.

Some of the colour plates supplied by the British Geological Survey are familiar friends from other works. Line drawings are also recognized. Much of the information has been abstracted from well-known authoritative works and may have suffered a little by drastic condensation from several large volumes into one comparatively slim one.

Misprints and errors are few and minor but some are mistakes in the source material which have been carried forward apparently without checking.

Dolomite, a lapidary challenge rather than a useful gem, has perfect rhombohedral cleavage, i.e. three directions, not one. Second order prisms are attributed to topaz, but the biaxial systems do not have first and second order forms. Amber is described as having a 'sticky feel'. In more than fifty years I have not noticed this. A test for Plato twinning is mentioned under synthetic corundum, but is not explained. The index refers to the brief glossary at the beginning of the book, but the Plato effect is not there. But these are small matters and should not detract from the general usefulness of the book.

The large descriptive section is split into Inorganic and Organic chapters, each dealing with most of its contents in alphabetical order, an arrangement which I found very convenient, even though it meant that the vastly more important commercial gems are also included strictly in their turn, but recognizable in most cases by the greater length of their entries. Rarer and collectors' gems are for the most part dealt with briefly, if sufficiently. The origins of gem names are given in all cases. Further chapters deal with Synthetics and Methods of Synthesis. Early sections cover the Formation of Gems with particular emphasis on their inclusions; the Nature of Gemstones; Gem Testing and Recent Developments in this; Colour with particular reference to the theory of its causes; Fashioning; Grading and Marketing.

Constants (SG, RI, DR, etc) are presented as ranges of possible values. Some of these differ from those published in most textbooks. Many minerals do vary quite widely and odd specimens are occasionally found which have testing constants outside the normally accepted range. Such occurrences should certainly be noted but to include them as end members of a range extends it possibly on the strength of a single non-typical specimen. Biaxial gems have values for the beta index quoted, but one spondumene which lacks this less useful constant gets accidentally relegated to uniaxial status.

Appendices include reference lists of SG and RI, mostly reduced to two places of decimals, but which do not always agree with those in the main text. Lists of Birefringence and Disperson would be more useful if they were complete. It is not really sufficient to say that those missing will be found in the text. They are all in the text so, on that basis, why print the lists at all? The highest disperson of glass is quoted as 'about 0.016'. This must mean natural glasses, for flint glass, much used in pastes, can go up to 0.040 or more.

The exhaustive bibliography runs to eleven pages but rather strangely does not include Herbert Smith's *Gemstones* which must have been the origin of Mr O'Donoghue's inspiration. Nor is that book mentioned elsewhere.

I am told that the author has said "It's all in there!". I am inclined to think that, at the very least, most of it certainly is.

R.K.M.

Raulet, S., 1986. *Van Cleef and Arpels.* Rizzoli, New York. pp. 328. Illus. in black and white and in colour. £58.00.

The celebrated jewellery firm of Van Cleef and Arpels was founded in Paris towards the end of the nineteenth century. Coinciding with the development of Art Nouveau the firm also attracted from the first the rich emigrés from Russia and American visitors to Paris. Later the business was expanded to towns outside Paris and up to the outbreak of war in 1939 it attracted an international and sometimes royal clientèle by virtue of its designs and the high quality materials used. After the war the firm continued to thrive and to attract wealthy customers and perhaps the high point reached in this context was the order for the jewellery used at the coronation of the late Shah of Iran in 1967.

The early chapters on the book tell the story of the birth and development of Van Cleef and Arpels. Succeeding chapters describe some of the famous diamonds which have passed through their hands and some of the most individual designs. Later in the book many pieces are illustrated in colour.

M.O'D.

Smith, J.V., Brown, W.L., 1988. *Feldspar minerals.* Second revised and extended edition. Vol. 1. Springer, Berlin. pp. xviii, 828. Illus. in black and white. DM360.

The history of this major work needs some explanation. The first edition was published in 1974 in two volumes with a third projected but never completed. By 1977 the incomplete draft for the projected third volume had become out-of-date, largely because of the advances made in the knowledge of feldspars – this in turn was fuelled by lunar mineral studies. The second edition is to be in two volumes; this first one is to be the new version of the original volumes 1 and 2 and the second volume will be an update of the unpublished volume 3.

The first volume deals with the origins, crystal structures, physical properties and experimental techniques employed in the study of feldspars, cell parameters and macroscopic thermal expansion and compression, light optics, nomenclature and determinative diagrams, electron-optical techniques, spectroscopy, miscellaneous physical properties, chemical properties, formation and intergrowths. References are extensive and divided into pre-and post-1973 and there are name, geographical and subject indexes. The second volume will cover phases relations and geological occurrence.

Feldspars are the most widespread of any mineral group and constitute about 60% of the earth's crust. Gemmologists will be familiar with the two main groupings of the feldspars but the relationship between individual minerals in the two groups and between the groups themselves are complex and not always easy to resolve. The various attempts and the techniques used in this task are well documented here and although the price is perhaps too high for the private library, serious students of feldspars should at least be aware of the book and know where it may be consulted. M.O'D.

Tomalin, S., 1988. *Beads.* David & Charles, Newton Abbot. pp. 128. Illus. in colour. £10.95.

A book on beads is welcome since there are very few others in English. Not only does the author describe a great number of bead materials but she goes on to illustrate the stages of using beads for the manufacture of jewellery. As far as I can see the details she gives on the threading of beads have not been published (or not so conveniently) before and this is very interesting to read about. After the introductory chapters the book, very sensibly, deals with seven separate projects for making jewellery so that the reader can see exactly how it is done.

At the price I can recommend this book and the standard of illustration is high. Some of the details on gemstones, particularly the names, are incorrect and others are confusing, but this is not a gemmology text. M.O'D.

Wagner, U., 1988. *Schatzkammer Hohe Tauern.* (Treasure house Hohe Tauern.) Doris Bode Verag, Haltern. Illus. in colour. DM39.

The Hohe Tauern area in the south of Austria includes the emerald locality of the Habachtal as well as the Ober-and Untersulzbachtal. Fine epidote crystals are found here, as well as phenakite and some tourmaline. The photographs seem to have reached a new level of excellence and there is a short bibliography. M.O'D.

Proceedings of the Gemmological Association of Great Britain and Association Notices

GIFTS TO THE ASSOCIATION

The Council of the Association are indebted to the following for their gifts:

Mr E. Fontana and Mr W.L. Kunsch of Sao Bernardo do Campo, Brazil, for a copy of the book *Gems of Brazil*.

Dr Dietmar Schwarz of Ouro Preto, Brazil, for a copy of his book *Esmeraldas – Inclusoes em Gemas*.

NEWS OF FELLOWS

The first International Amber Symposium took place in Poland from 20 to 23 October 1988. Helen Fraquet, FGA, attended as the only gemmologist at the event, which attracted 52 registrations from as far afield as Russia, Tanzania and the USA. The cross-interests of participants from differing backgrounds of geology, mineralogy, archaeology and paleoentomology, led to a vibrant series of discussions over two days of presentations in Warsaw. There was also a two-day field trip to Malbork and Golansk to view the rich archaeological and modern collections, as well as the current methods of amber extraction in the Baltic area and processing techniques. Full details will be published in a future issue of the ***Journal***.

In October 1988 at Dulwich College, Michael O'Donoghue organized and assembled an exhibition of gemstones, crystals and rare books.

MEMBERS' MEETINGS

Midlands Branch

On 21 October 1988 at Dr Johnson House, Colmore Circus, Birmingham, the guest speaker was Mr Alan Hodgkinson, FGA, who brought along a selection of the gems in his collection. These included a 49 ct sapphire crystal, a black opal, a variety of colour-change gems, and a large red beryl.

On 18 November 1988 at Dr Johnson House, Mr R.V. Huddlestone gave an illustrated presentation on Siberian diamonds.

North West Branch

On 18 November 1988 at Church House, Hanover Street, Liverpool, the Annual General Meeting was held at which Mr R. Perrett, FGA, and Mrs I. Knight, FGA, were re-elected Chairman and Secretary respectively.

ANNUAL REUNION OF MEMBERS AND PRESENTATION OF AWARDS

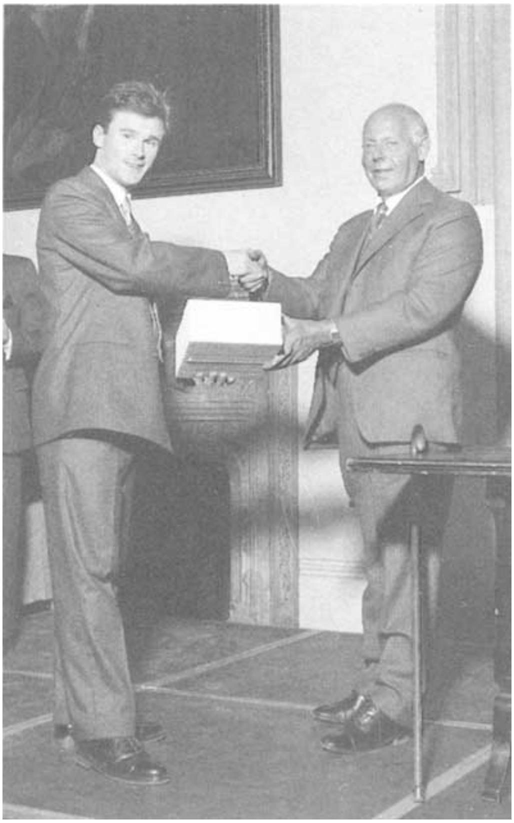
The Annual Reunion of Members and Presentation of Awards was held on 25 November 1988 at the Guildhall, Gresham Street, London EC2. The Chairman of the Association, Mr David J. Callaghan, presided at the Presentation and welcomed those present to the new venue. He explained that the Goldsmiths' Hall, where the Presentation is usually held, was being refurbished, and he gave a brief history of the Guildhall, parts of which were almost a thousand years old.

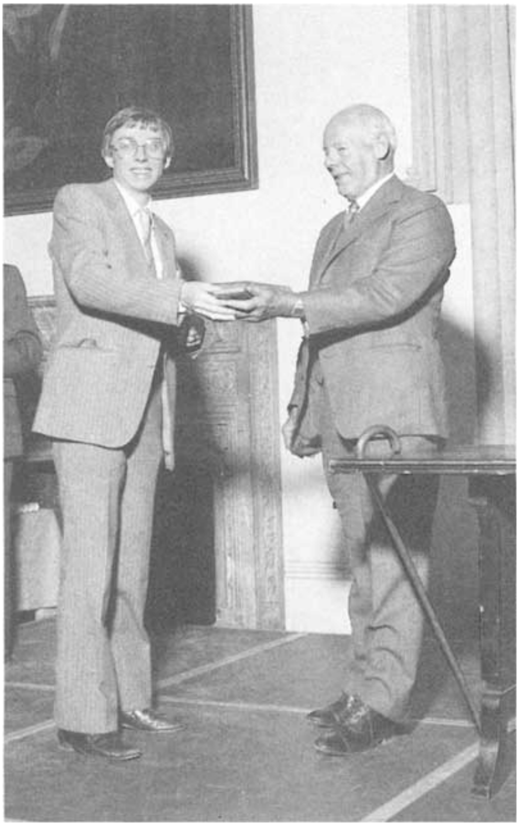
This year award winners from many countries outside the UK including Brazil, Belgium, Canada, Italy, Japan, Kenya, The Netherlands, Spain, Sweden, USA and Venezuela, were present to receive their Diplomas.

Mr Callaghan then called upon Professor R.A. Howie, past-President of the Mineralogical Society and for many years Professor of Mineralogy at King's College, London, to present the awards.

After the presentation Professor Howie delivered his address. He began by quoting the words of his driving test examiner: 'OK, you have passed – now the real learning begins'. The same could surely apply to those who had just received their Diplomas. The best mineralogist is the one who has examined the most minerals and Professor Howie felt sure that the same principle applied to gemmologists; they should take every opportunity to examine as many gems as possible. Like mineralogists, gemmologists have to possess a unique blend of aesthetic and scientific judgement. At one checkout in a supermarket in Cambridge, Massachusetts, there was a sign which read 'One basket only'. A

Figs 1 and 2. The Anderson/Bank Prize winner, Birgitte Muste, and the Rayner Diploma Prize winner, David Webster, receiving their awards from Professor R.A. Howie.





Figs 3 and 4. The Anderson Medal winner, Robert Maxwell Torrens, and the Rayner Preliminary Prize winner, Catherine Rieger, receiving their awards from Professor Howie.

young man approached with two baskets and proceeded to unload them. The lady at the checkout said to him: 'You are either from Harvard and can't count, or you are from MIT and can't read'!

He recommended that gems should be examined with one's eye or hand-lens rather than going straight to instrumental techniques. He stressed that mineralogy is the fundamental science which is the base of our own knowledge of gemmology.

Professor Howie went on to talk about his twenty-five years at King's College, London, although he had moved to Royal Holloway and Bedford New College, also part of the University of London, in 1985. Many eminent gemmologists had come from King's, including Basil Anderson, Alan Jobbins (the Editor of *the Journal*),and C.J.Payne. Professor Howie was at one time Admissions Tutor in Geology and a young student came to him and said that he had devised a new scheme for identifying minerals. Before he demonstrated this new method, Professor Howie said that he had a test for him and asked him to identify a colourless octahedral crystal of diamond. 'Fluorite', said the student. He was then given a hardness set to verify this, and when he passed the hardness of fluorite (4) and went steadily on to hardness 8, he was asked if he had any comment. 'Hard fluorite' said the student! By all means make a tentative identification from a stone's appearance, but always be prepared to alter your identification on the basis of further tests.

Professor Howie then spoke about the importance of the nomenclature of mineralogy. In 1950 the International Mineralogical Association set up a Commission for New Minerals and Mineral Names, and any new mineral should be approved by them before publication. There is a tendancy to give new names to known minerals and gems and one must be wary of this. Not all scientists, however, are happy to abide by the decision of the Commission. It comes down particularly heavily on editors using unapproved names. Professor Howie said that the only one he personally had a sympathy with was tanzanite, a lovely stone, though officially blue zoisite.

He then went on to stress the growing importance of computers in gemmology, and the necessity to learn how to use one. But, of course, the information you obtain from them is only as good as the data put in.

Professor Howie concluded with an exhortation modified from the inaugural address of President J.F. Kennedy: 'Think not of what the Gemmological Association can do for you, but what you can do for the Gemmological Association' In other words, attend the Association's meetings, and bombard the Editor with papers for the Journal!

The Vice-Chairman, Mr Noel Deeks, gave the vote of thanks. He said how fortunate we were that Professor Howie was able to present the awards, as he is a man of great standing in his field as well as being a humorist. He has dedicated most of his working life to mineralogy and is recognized throughout the world as a leading authority in his field. Mr Deeks went on: 'It may well be that you will not be able to aspire to these great heights, but possibly, as Professor Howie said, many of you will be able to make a contribution to the Gemmological Association by becoming members of the Council or by serving on a committee. If you are able to offer your services we will welcome you with open arms'. He went on to emphasize Professor Howie's point that you never stop learning, and hoped that many of those who had just qualified would go on to take the new Diamond Course which will be introduced very shortly.

Mr Callaghan then paid tribute to Mr Leslie Fitzgerald and his team for all their work in organizing the examinations and also thanked the Examiners and Instructors, congratulating them on the work done.

In conclusion Mr Callaghan then made a special presentation to Mr John Green who is retiring from the Rayner Optical Company, with the Association's grateful thanks for long service.

GEM DIAMOND EXAMINATION 1988

In the 1988 Gem Diamond Examination 48 candidates sat and 46 qualified, one with Distinction. Their names are as follows:

Qualified with Distinction

Burques Montserrat, Ma Jesús, Barcelona, Spain.

Qualified

Allen, Elizabeth A., London.
Aresti, Tony, Enfield.
Arthur, Lynne, Denny.
Asiainde Los Angeles, Jorge J., Barcelona, Spain.
Bernad Serra, Marcos, Barcelona, Spain.
Bernal Garcia, José, Barcelona, Spain.
Billingham, Carole J., Richmond.
Chan, Richard Ki-Mun, London.
Cros, Jean-Marc, London.
Dallas, James A., London.
Dalmau Bafulluy, Ma Nieves, Barcelona, Spain.
Dunn, Wendy S., London.
Dunstall, Robert, Northampton.
Glover, Graham D.B., London.
Guarino Alemany, Maite, Barcelona, Spain.
Hilton, Holly A., London.
Humpage, Susan A., Edgbaston.
Huppach, Friedrich H., Earby.
King, Barry J., Bury St Edmunds.
Latre Gonzalez, José, Barcelona, Spain.
Levy, Laurence, London.
Manders, Andrew P., Guildford.
Metaxas, George C., Nicosia, Cyprus.
Millar, Ewan, Paisley.
Molina Torreblanca, Amparo, Barcelona, Spain.
Morena Garcia, Rosa, Barcelona, Spain.
Navarro Garcia, Rodolfo, Barcelona, Spain.
Ortol-Lockwood, Dominique, London.
Padley, Stanley J., Bredenbury.
Pick, Velma M., London.
Pridham, Michelle A., Colchester.
Raymond, Robert S., London.
Riley, Mark J., Gloucester.
Romero Caminero, Luz, Barcelona, Spain.
Rosier, Jane L., Walton-on-Naze.
Sanhueza A., J. Antonio, London.
Sierra Martiñez, Dolores, Barcelona, Spain.
Straitouri, Sophia M., London.
Tait, Alistir W., Edinburgh.
Tapia Canadell, Laura, Barcelona, Spain.
Taylor, Alec E., Glasgow.
Turnbull, Daniel A., Glasgow.
Watson, Margery E., Edinburgh.
Watson, Thomas N., Edinburgh.
Wren, Rebecca J., Ware.

EXAMINATIONS IN GEMMOLOGY 1988

In the 1988 Examinations in Gemmology, 569 candidates sat the Preliminary Examination and 355 (62%) passed, and 398 candidates sat the Diploma Examination and 170 (43%) passed, 15 with Distinction.

In the opinion of the Examiners, no candidate achieved the high standard needed to warrant the award of the Tully Medal.

The Anderson/Bank Prize for the best non-trade candidate of the year in the Diploma Examination has been awarded to Birgitte Margarethe Muste of Dordrecht, The Netherlands.

The Rayner Diploma Prize for the best candidate of the year who derives his main income from activities essentially connected with the jewellery trade has been awarded to David Webster of Glasgow.

The Anderson Metal for the best candidate of the year in the Preliminary Examination has been awarded to Robert Maxwell Torrens of Crieff, Perthshire.

The Rayner Preliminary Prize for the best candidate under the age of 21 years on 1 June of the year of the examination, who derives her main income from activities essentially connected with the jewellery trade has been awarded to Catherine Jane Rieger of Maidstone.

The names of successful candidates are as follows:

DIPLOMA

Anderson/Bank Prize

Muste, Birgitte M., Dordrecht, The Netherlands.

Rayner Diploma Prize

Webster, David, Glasgow.

Qualified with Distinction

Baumann, Yvonne, Dungarvan, Co Waterford, Ireland.
Boozer, Joan B., Hong Kong.
Castro, Ana Isabel, London.
Feenie, Helen L., Hong Kong.
Grieder, Judith Y., Hong Kong.
Hergel, James E., Toronto, Ont., Canada.
Jassinger, Alexandre P.O.L., London.
Kim, Won-Sa, Daejon, Rep. of Korea.
Larsson, Thomas, Jarfalla, Stockholm, Sweden.
Muff, Walter C., Muri, Switzerland.
Muste, Birgitte M., Schoonhoven, The Netherlands.
Nangia, Rani, North Harrow.
Rosoff, Martin, Toronto, Ont., Canada.
Webster, David E., Glasgow.
Winterbottom, Martin, Watford.

Qualified

Alliance, Alma B., Cheadle.
Amiel Fresneda, Josefa, Figueres, Spain.
Atkins, Tristan A., Banstead.
Attar, Simon, London.
Axell, Anita C., Stockholm, Sweden.
Bagnall, Maria, London.
Barber, Susan A., Billingshurst.
Becker, Kim A., Francistown, Botswana.
Belenguer Blat, Ma del Carmen, Valencia, Spain.
Bignotti, Fabrizio, Novara, Italy.
Bode, William E.G., Harrogate.
Bramham, Kathleen, London.
Bramsden, Manny, Maidenhead.
Brandligt-van den Hoed, Maria A.G., Bussum, The Netherlands.
Bridgewood, Alan, Bramhope.
Bron, Harm, Heerenveen, The Netherlands.
Cadavid Tortosa, Manuel, Montgat, Spain.
Carracedo Oliva, Robert, Tarragona, Spain.
Carry, Peter D., Aberdeen.
Chan, Albert H.S., Hong Kong.
Chan, Yuk Ching, Hong Kong.
Cheng, Rosalia, Hong Kong.
Chiu, Sin Y., Hong Kong.
Cijvat, Els, Bussum, The Netherlands.
Climent Coscolluela, Nuria, Barcelona, Spain.
Collins, Steven J.C., Letchworth.
Corée, Henk, Borne, The Netherlands.
Cowdrey, John W.F., Harrow.
Dabell, Louise C., Nottingham.
Deacon, Richard H., Swindon.
De Bevere, Dirk, London.
Dechef, Eveline E.J., Ottawa, Canada.
De Waal, Irina, Delft, The Netherlands.
Easterbrook, Steven, Bridgend.
Escalona Larroy, Josep A., Barcelona, Spain.
Evans, Elma H., Spring Valley, Calif., USA.
Farinos Folgado, Ramon, Ribarroja Del Turia, Spain.
Findlay, Caroline E., London.
Fisher, Barbara E., Kahuku, Hawaii, USA.
Fowler, Jennifer A., Burnley.
Franco da Fonseca, Ana L., Sao Paulo.
Fung, Annie C.Y., Hong Kong.
Gay, Bernice M., Romsey.
Girod, Daniel F.G., Amsterdam, The Netherlands.
Glaysher, Andrew J., Horsham.
Glover, Andrew M., Horsham.
Gohel, Dilhar M., London.
Gomez da Silveira, Luiz A., Sao Paulo, Brazil.
Gordon, Scott M., Okhlahoma City, Okla., USA.
Gouverneur, Keith, Caracas, Venezuela.
Hammett, David W., Glasgow.
Harrison, Roger F.J., King's Langley.
Haufe, Wilfred, Toronto, Ont., Canada.
Hideyuki, Nakata, Tokyo, Japan.
Hiramatsu, Ikuo, Tokyo, Japan.
Hitcham, Peter J., Kingston-upon-Thames.
Hobbs, Fiona G., Winchester.
Holbech, William H., London.
Holloway, Sarah D., London.
Howat, Denise, Hong Kong.
Ivanoff Landovski, Tatiana, Barcelona, Spain.
Janssens, Nadia E., Brussels, Belgium.
Kaiyoorawongs, Julie B., Bangkok, Thailand.
Kathe, Madeline S., Hong Kong.
Kawamoto, Keiko, Hong Kong.
Kothari, Hema, Bombay, India.
Kuwahara, Chizu, Kanagawa Pref., Japan.
Kwan, Suet M., Hong Kong.
Kyriakidou, Katerina A., London.
Lam, Sau W., Hong Kong.
Laurie, John J.W., Monte Carlo, Monaco.
Lewis, Rachel, Stockport.
Lloyd, Florence M., Harpenden.
Lo Wong Chi Ping, Stella, Hong Kong.
Longden, Sharon D., Eckington.
Lopezzo, Lorraine V., Long Valley, NJ, USA.
Maharaj, Rajendra K., Toronto, Ont., Canada.
Mairal Nebot, Susana Ma, Zaragoza, Spain.
Mak Sin Leung, Gary, Kowloon, Hong Kong.
Malarek, Anna, Toronto, Ont., Canada.
Marriott, Janet, Amsterdam, The Netherlands.
Marti Gomez, Emilio A., Valencia, Spain.
Martinez Masip, Amelia Ma, Barcelona, Spain.
Matzener-Levy, Lydia, Zurich, Switzerland.
Mele Ardiaca, Ma Teresa, Barcelona, Spain.
Michalkow, Christina L., Manchester.
Mistry, Mukesh, London.
Moghadam, Paravanah, London.
Ng, Lai Yee, Hong Kong.
Nishizaki, Mikio, Tokyo, Japan.
Norton, Robert, Oak Wood.
Nunes, Michél, George, S. Africa.
Oshima, Takako, Osaka, Japan.
Parr, Rosalind, Wilmslow.
Planelles Fenollosa, Enrique V., Burriana, Spain.
Potts, James D., Telford.
Premnath, K.P., Salem, India.
Pye, James A., Leven.
Renieblas Salo, Sara, Barcelona, Spain.
Revol Macdonald, Brigitte M., Bangkok, Thailand.
Rice, Michael, Hull.
Richner, Sally J., Grosse Pointe, Mich., USA.
Roig Miguel, David, Barcelona, Spain.
Rufli, Jeanette, Stockholm, Sweden.
Rydeng, Rig, Finnsnes, Norway.
Rysenbry-Beens, Jantine C., Haarlem, The Netherlands.
Sayers, Angela C., London.
Schreier, Larry, Skokie, Ill., USA.

Schuch, Yvonne D.J., Capella, Aan den Yssel, The Netherlands.
Scott, Jean V., New York, NY, USA.
Sekiguchi, Kazuyoshi, Tokyo, Japan.
Serra Badia, Lluisa, Barcelona, Spain.
Serras, Helen, Athens, Greece.
Seung, Yuet Fan Pinky, Hong Kong.
Shimizu, Terukazu, Tokyo, Japan.
Sinclair, Anne L.K., London.
Sinclair, Lyall W., Cambridge.
Smith, Kevin M., Bangkok, Thailand.
Sneeringer, Margaret R., Worthington, Ohio, USA.
Socias Barenys, Ma Angels, Barcelona, Spain.
Stead, Heather E., York.
Stone, Emma E., Derby.
Sugihara, Kaori, Tokyo, Japan.
Sumar, Nizar P., Nairobi, Kenya.
Ten Berge, Robert B.H., Zuidlaren, The Netherlands.
Theriault, Peter J., Camden, Me., USA.
Tirat, Pierre, Poitiers, France.
Titina, Meher R., Bombay, India.
Triossi, Amanda C., London.
Tyler, Elizabeth V., London.
Underdown, Derek W., Horsham.
Urvik, Hilde, Oslo, Norway.
Ushio, Tsutae, Fukuoka City, Japan.
Van Camp, Coralie A., Auckland, New Zealand.
Van Deijl, Jacobus H., Parow, South Africa.
Vila Torrejon, Ma Enrique, Valencia, Spain.
Viladrich Ros, Ma Teresa, Barcelona, Spain.
Voordewind, Derk J., Delfzijl, The Netherlands.
Walker, Jeremy R.P., Workington.
Wallin, My, Stockholm, Sweden.
Warshow, Nancy, Nairobi, Kenya.
Weiss, Anthony S., Bushey.
Weston, Jonathan, Stourbridge.
White, Helen Leung Yuk-Ching, Hong Kong.
Wilson, Sandra McKinnon, Cumbernauld.
Wong, Che K., Hong Kong.
Wong, Helen, Toronto, Ont., Canada.
Wood, Teddy, Hong Kong.
Woolley, Shirl L., San Diego, Calif., USA.
Woszczyna, Paul D., Toronto, Ont., Canada.
Yi, Yu Hsiao-Wen, Taipei, Taiwan.
Yokoyama, Haruaki, Kurume City, Japan.
Yoshimoto, Misako, Munakata-gun, Japan.
Zabitsky, Shelley, Toronto, Ont., Canada.
Ziemelis, Ojars, Stockholm, Sweden.

PRELIMINARY

Anderson Medal
Torrens, Robert M., Crieff.

Rayner Preliminary Prize
Rieger, Catherine J., Maidstone.

Qualified
Abul Huda, Samar, Athens, Greece.
Achakane, Abdelaaziz, Birmingham.
Almenar Zamora, José A., Valencia, Spain.
Andrews, Suzanne M., Cheadle Hulme.
Arnau I,Graus, Concepció, Lleida, Spain.
Arranz Garcia, Félix, Cozuelos de Fuentidueña, Spain.
Arrufat I.Cervera, Silvia, Barcelona, Spain.
Asanis, Nikolaos, Athens, Greece.
Asfour, Hana, Athens, Greece.
Aston, Mandy, Birmingham.
Au, Kwok Ming, Hong Kong.
Aulosalo, Liisa H., Turku, Finland.
Azon Vilas, Félix, Almunia de San Juan, Spain.
Badenoch-Jones, Harwood G., Goring-by-Sea.
Barbara Solé, Ma Rosa, Reus, Spain.
Barrabes Lacarda, Silvia, Lleida, Spain.
Basham, Leslie J., Stowmarket.
Bengston, Anne-Marie, Täby, Sweden.
Bercik, R. Mary, Pickering, Ont., Canada.
Bieri, Josiane, Athens, Greece.
Blasco Jimenez, Josep Ma, Barcelona, Spain.
Bofill Montoro, Anna Ma, Barcelona, Spain.
Bohra, Sushil, Jaipur, India.
Boira Roges, Berta, Barcelona, Spain.
Bourdillon, Catriona C.C., London.
Brantly, Rhona M., Rio de Janeiro, Brazil.
Brinkhuis, Petrus J., Langewijk, The Netherlands.
Brotons Llopis, Rafael, Alicante, Spain.
Bubshait, Ahmed I., London.
Buxton, Diana M., Slough.
Canty, Gavin, Auckland, New Zealand.
Carroll, Patricia E., Hong Kong.
Cartwright, Freda H., King's Langley.
Castro, Ana I., London.
Chan, Angela Yin Nae, Hong Kong.
Chan, Chun Kit Michael, Hong Kong.
Chan, Kar Ming, Hong Kong.
Chan, Linda Ann Yong, Hong Kong.
Chan, Mazie Josephine Man-Wah, Hong Kong.
Chan, Mei Kuen, Hong Kong.
Chan, Suk Fun Betty, Hong Kong.
Chan, Wai Wah, Hong Kong.
Chan, Yoke Leng, Hong Kong.
Chen, Qian Yun, Hong Kong.
Cheney, Marguerite D., Rio de Janeiro, Brazil.
Cheung, Kam Ko, Hong Kong.
Chiu, Sau King, Hong Kong.
Chiu, Yuk Lan Rafia, Hong Kong.
Chow, Chi Leung Cristo, Hong Kong.
Chow, Kam King, Hong Kong.
Chow, Kar Wai Kevin, Hong Kong.
Chow, Yuen Ching Rita, Hong Kong.
Cloke, Deborah J., Sevenoaks.
Clover, Wai Ying, Hong Kong.
Cocke, David D., London.

Colley, Gordon, Denny.
Collingwood, Mark A., Pudsey.
Collins, Jessica M., London.
Cope, Andrew R.W., West Bridgford.
Corée, Henk, Borne, The Netherlands.
Corne-Halstenbach, Michele, Geneva, Switzerland.
Corta Alonso, Ma Lina, Barcelona, Spain.
Crosby, Neal J., Menston.
Cross, Margaret J., Leeds.
Davidson, June A., Toronto, Ont., Canada.
De Bevere, Dirk, Brussels, Belgium.
de Crecenzio Ferreira Ramos, Alejandro, Amsterdam, The Netherlands.
De Jonge, Martin L., Utrecht, The Netherlands.
de Kam, Anneke, Schoonhoven, The Netherlands.
Delaini, Giuglia, London.
Deller, Antony M., Mansfield.
Deraniyagala, Isanth R., Selsdon.
Dhir, Parikshat P., Nairobi, Kenya.
Dorab, Brian I., Hong Kong.
Douglas Marshall, Anna T., Cambridge.
Downes, Lisa E., Birmingham.
Dryden, Kenneth E., Spalding.
Eames, Simon F., Hemel Hempstead.
Eccles, Robert B., Bray, Co. Wicklow, Eire.
Edwards, Jennifer L., Hong Kong.
El-Saadi, Siham, Athens, Greece.
Elankainesan, Arulneshan, Colombo, Sri Lanka.
Emden, Lee, High Wycombe.
Ennis, Frances M., Dublin, Eire.
Espinosa Romera, Pedro, La Puerta de Segura, Spain.
Fabregat Miedes, Fernando, Teruel, Spain.
Fan, Siu Kam, Hong Kong.
Feld, Simon, Huddinge, Sweden.
Ferguson, Neil F., Balloch.
Fiducia, Suzanne J., Hong Kong.
Fisher, Barbara E., Hawaii, USA.
Foster, W. James, Pismo Beach, Calif., USA.
Fuertes Arruti, José A., Zaragoza, Spain.
Fuller, Mark R., London.
Fung, Eleanor So-Wan Au, Hong Kong.
Fung, Kam Man, Hong Kong.
Fung, Mun Yung Juliana, Hong Kong.
Galeote Torralbo, Albert X, Barcelona, Spain.
Gallagher, Marie, Middlesbrough.
Ganella Garcia, Ma del Pilar, Moncada i Reixac, Spain.
Garcia Ferrandiz, Javier, Alicante, Spain.
Gardner, Stewart J., Halifax.
George, Wanda M., Nairobi, Kenya.
Ghaffar, Gulnefer, Hong Kong.
Ghysels, Patrick G.B., Brussels, Belgium.
Gill, David C., Wellington, New Zealand.
Girardi, Josephine C., Hong Kong.
Glynn, Peter J., Bangkok, Thailand.
Gonzalez, Marie C.Y., Hong Kong.
Gonzalez Galvan, Francisco A., Jerez de los Caballeros, Spain.
Gower, Sarah-Jane, Yiewsley.
Guerra Vidiella, Laura, Barcelona, Spain.
Gunaratne, Madanasinghage D.R., Manori, Sri Lanka.
Gunther, Kenneth G., Nairobi, Kenya.
Hammett, David W., Glasgow.
Hara, Yoshiko, Osaka, Japan.
Harding, Ian, Nottingham.
Hasan, Zia-Ul, Toronto, Ont., Canada.
Hassink, Karin, Polsbroek, The Netherlands.
Hernandez Marin, Ma Teresa, Elx, Spain.
Higuchi, Miyuki, London.
Hirst, Jenny E., London.
Ho, Kar Fai Patrick, Hong Kong.
Ho, Kiam Fong, Singapore.
Ho, Siu Yeung, Hong Kong.
Hoffman, Cindy W., Herndon, Va., USA.
Holmberg, Petri I., Turku, Finland.
Hughes, David J., Cardiff.
Hui, Wah Kam, Hong Kong.
Hui, Wai Kwong, Hong Kong.
Huppach, Stefan A., Colne.
Hyde, Elizabeth E., Reading.
Imakubo, Kouhei, Nara, Japan.
Ingman, Ulf Nils Goran, Karis, Finland.
Irie, Michiko, Hyogo, Japan.
Isern Truy, Enric, Vic, Tarragona, Spain.
Jackson, Alexander V.M., Birmingham.
Jackson, Dan N., Watford.
Jacome Bolton, Maria José Peres, Luton.
Jain, Sanjay, London.
Jarvis, Hilary A., London.
Jassinger, Alexandre P.O.L., London.
Johnston, Paul W., Belfast.
Jones, Paul D., Isle of Man.
Kaiyoorawongs, Julie B., Bangkok, Thailand.
Kamman, Maria A., Schoonhoven, The Netherlands.
Kangasniemi, Arto J., Inari, Finland.
Kanodia, Jai P., London.
Kara, Shams A., Markham, Ont., Canada.
Karkkulainen, Kari J., Oulu, Finland.
Kehe, Alan, Nairobi, Kenya.
Keusch, Schohreh, Hong Kong.
Knott, Teresa, Leicester.
Ko, Olivia, Hong Kong.
Ko, Siu-Wah Johnny, Hong Kong.
Kochx, Johanna M.C., Amsterdam, The Netherlands.
Kothari, Hema, Bombay, India.
Ku, Herching, Hong Kong.
Laborda Ferrer, Ma Angeles, Zaragoza, Spain.
Lamb, Lois N., London.
Langridge, John P., Sompting.

Lau, Yuet Yung Ellen, Hong Kong.
Laurie, John J.W., Monte Carlo, Monaco.
Law, Patricia M., London.
Lawrence, Craig, Brampton, Ont., Canada.
Lazaro Anglada, Ma José, Zaragoza, Spain.
Leddicoat, Andrew, Guiseley.
Lederman, Victor, Koge, Denmark.
Lee, Ophelia, Hong Kong.
Lehtinen, Kirsi K., Helsinki, Finland.
Leon Martin, Josefa, El Tiemblo, Spain.
Leung, Chi Hon, Hong Kong.
Leung Lam, Anne, Kowloon, Hong Kong.
Lewis, Karen J., Hong Kong.
Li, Chi Man, Hong Kong.
Lilley, Elaine, Hull.
Lilly, Gregory R., Taranaki, New Zealand.
Ling, Lai Ching Apollonia, Hong Kong.
Link, Constance A., Nairobi, Kenya.
Liu, Charles Kwok-Hung, Hong Kong.
Liu, Mei Fong, Hong Kong.
Liyanage, Don C.S., Ashford Common.
Lockie, Debra L., Hong Kong.
Lodhia, Harish, Leicester.
Lopez Berbel, Ricardo, Guadix, Spain.
Lui, Man Lee, Hong Kong.
Luis I. Pavia, Rosa Ma, Castello, Spain.
Luzondo Olea, Blancanieves, Tolosa, Spain.
McCosh, Samuel M., Birkenhead.
McKenna, Joseph T., London.
MacGregor, Rory, Rio de Janeiro, Brazil.
MacMillan, Fenella J., Borstal.
Magina Arachchige, Wimalaséna, Maharigama, Sri Lanka.
Mak, Kai Wing, Hong Kong.
Makinen, Heidi C., Hong Kong.
Manjavacas Cañego, Carina, Barcelona, Spain.
Mann, Alexandrina E., Nottingham.
Mannequin, Gilles E., Antananarivo, Madagascar.
Mariona De Urquijo, Victoria E., Zaragoza, Spain.
Martinez Del Campo, Leopoldo, Zaragoza, Spain.
Mas Lillo, Javier F., San Vicente de Raspeig, Spain.
Masters, Gary W., Alton.
Maung, Thet Oo, Bangkok, Thailand.
Maycock, Richard C., Wilton.
Merchant, Arti R., Bombay, India.
Minami, Kazumasa, Osaka, Japan.
Moghadam, Parvaneh, London.
More, Deepak K., Hong Kong.
Morris, David C., Dover.
Mossberg, Karsti M.C., Uddevalla, Sweden.
Mustchin, Vivienne, Auckland, New Zealand.
Nakajima, Miki, Osaka, Japan.
Nakamura, Chiyo, Hokkaido, Japan.
Nakano, Noriko, Tokyo, Japan.
Nakao, Kimitoshi, Tokyo, Japan.
Nandha, Manoj, Nottingham.
Negrin, Ilan, Amsterdam, The Netherlands.
Nenonen, Reijo O., Taivalkoski, Finland.
Nevalainen, Tuula M.-L., Helsinki, Finland.
Ng, Lai Yee, Hong Kong.
Nishida, Hiroko, Hyogo, Japan.
Nishizaki, Mikio, Bangkok, Thailand.
Nomura, Takayo, Tokyo, Japan.
Norberg, Carl S., Koping, Sweden.
Oakley, Maureen P., Hong Kong.
Ohmura, Keiko, Tokyo, Japan.
Okamoto, Koichi, Osaka, Japan.
Ooi, Kazunari, Osaka, Japan.
Osborne, Sean J., London.
Paakkari, Petri W., Lahti, Finland.
Paez Martinez, Ma Lluisa, Barcelona, Spain.
Page, Christopher D., Carlton.
Pak, Ching-Yuen Bernard, Hong Kong.
Pakarinen, Tea Maria, Espoo, Finland.
Papadopoulou, Stefania, Athens, Greece.
Parikka, Pekka J., Helsinki, Finland.
Parr, Rosalind, Styal.
Parsons, Ann S., Kemsing.
Parsons, Stephen, Middlewich.
Pedersen, Gunhild R., Nattland, Norway.
Peers, Sharon M., Chatham.
Peramaki, Kaarlo M., Koria, Finland.
Perquin, Manon C.A., Schoonhoven, The Netherlands.
Petersen, Rikke, Hong Kong.
Petersheim, Axel, Oslo, Norway.
Pfister, Hans, Zurich, Switzerland.
Pointon, Jean F., Tanggu, PR of China.
Preddy, Ma Del Pilar H., Hong Kong.
Pun, Yuk Ling, Hong Kong.
Quintana Martin, Margarita, Las Palmas, Gran Canaria.
Recaj Recaj, Eduardo, Ejea de los Caballeros, Spain.
Reitz, Catherine A., Pittsburgh, Pa., USA.
Revol MacDonald, Brigitte M., Bangkok, Thailand.
Rieger, Catherine J., Maidstone.
Riera Lopez-Feliu, Sara, Granollers, Spain.
Roberts, Anne M., Crawley.
Roberts, Katherine H., South Harrow.
Robres Garcia, Milagros, Zaragoza, Spain.
Rohloff, Michele A., Johannesburg, South Africa.
Roman Llopis, Juan F., Alicante, Spain.
Rosoff, Martin, Toronto, Ont., Canada.
Ruff, Agnes, Hong Kong.
Rufli, Michel, Stockholm, Sweden.
Ruiz Belver, Antonio J., Almería, Spain.
Ruusunen, Petri S., Kiukainen, Finland.
Sa'D, Ghia, Athens, Greece.
Saito, Reiko, Tokyo, Japan.
Sanchez Martinez, Antonio J., Valéncia, Spain.
Sancho Gracia, Ma Elena, Zaragoza, Spain.

Santacreu Rull, Montserrat, Lleida, Spain.
Sayed, Ahad, Brentford.
Schaetzle-Parisod, Arlette, Kaiseraugst, Switzerland.
Scott, Andrew M., Richmond, Yorks.
Scott, Kenneth MacDonald, Carluke.
Seaton, Johanna L., Hong Kong.
Sekiya, Mayumi, Hyogo-Ken, Japan.
Sempere Leal, Esther, Castalla, Spain.
Sergoulopoulos, Alexandros, Athens, Greece.
Seung, Yuet Fan Pinky, Hong Kong.
Shaw, Gillian A., Nairobi, Kenya.
Shinjo, Yasushi, Osaka, Japan.
Sinclair, Ann, L.K., Fernhurst.
Sjovold, Inger E., Oslo, Norway.
Smith, Kevin M., Bangkok, Thailand.
Smyth, Adrian J., Mold, Clwyd.
Soung, Min Hee, Bangkok, Thailand.
Sparks, Deborah A., Watford.
Spink, Michael C., London.
Stanley, Sylvia, Hong Kong.
Stanton, Jeremy, Edgware.
Sutton, Susan A., Elmswell.
Swarnasinghe, Wijendra G.A., Gunnepana, Sri Lanka.
Takahashi, Makoto, Hyogo, Japan.
Takashima, Kazuko, Tokyo, Japan.
Tam, Tat Kuen, Hong Kong.
Tam, Ying Che Lucilla, Hong Kong.
Tamblin, Carol S., Liskeard.
Tayara, Mona, Athens, Greece.
Taylor, David J., Isle of Wight.
Taylor, Sarah J.W., Solihull.
Teoh, Kiang-Hong, Singapore.
Thornton, Shirley E., Bangor.
Tipping, Maria De Carvalho, London.
Tirat, Pierre, Chorlton Cum Hardy.
Tock, Graham B., Hull.
Tompkins, Julian E., Tokai, South Africa.
Topley, Karen, Kirkby-in-Ashfield.
Torgerson, Norman, Bridgewater, New Jersey, USA.
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Tse, Kwok-Fung, Hong Kong.
Tse, Mei Lai Daisy, Hong Kong.
Tsuda, Minako, Hyogo, Japan.
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Turunen, Kirsi A., Helsinki, Finland.
Udaya Saman, Halwatura G., Kandy, Sri Lanka.
Uriarte Terol, Ma Victoria, Alacante, Spain.
Usechi Espinosa De Los Monteros, Ma Amparo, Pamplona, Spain.
Van Den Haak, Hester, Krimpen ad Yssel, The Netherlands.
Van Den Top, Thea, Schoonhoven, The Netherlands.
Van Der Klauw, Angela V., Utrecht, The Netherlands.
Van Rijckevorsel-de Bruijn, Bernadette T.F.M., Amsterdam, The Netherlands.
Vataru, Monica, London.
Veecumsee, Dipal D., Bombay, India.
Velaz Azpilicueta, Mercedes, Pamplona, Spain.
Vermunt, Richard A.J., Tilburg, The Netherlands.
Vidal Ramia, Enriqueta, Tarragona, Spain.
Vildiridis, Athanassios, Thessaloniki, Greece.
Visker, Charlotte M.J.R., Beuningen, The Netherlands.
Volpe, Albert J., Toronto, Ont., Canada.
Waldron, Melanie J., Broadway.
Webster, Richard C., Chevy Chase, Md., USA.
Weiss, Daniel P., Vancouver, BC, Canada.
White, Nigel B., Cotgrove.
Whitney, Amanda, London.
Wielenga, Mark, Schoonhoven, The Netherlands.
Wijnands, Monique A.N., Heerlen, The Netherlands.
Wiles, Susan J., Hull.
Wissink, Marion E.J., Schoonhoven, The Netherlands.
Wong, Lai Ming, Hong Kong.
Wong, Lap Kwan, Hong Kong.
Wong, Wai-Yin, Hong Kong.
Wootton, Angela B., Sheffield.
Worthington, Sally L., Sowerby Bridge.
Woszczyna, Paul D., Downsview, Ont., Canada.
Xanthopoulos, Paraskevi, Athens, Greece.
Yamana, Katsunori, Wakayama-City, Japan.
Yamanaka, Kazuko, Osaka, Japan.
Yeung, Chan Siu Ling, Hong Kong.
Yeung, Siu-Kei, Hong Kong.
Yi, Yu Hsiao-Wen, Bangkok, Thailand.
Yount, Henrietta S., Hong Kong.
Yu, Kam-Hon Steven, Hong Kong.
Yuill, John M., Lanark.
Zanardi Landi, Sabina, London.
Zijlstra, Neeltje, Schoonhoven, The Netherlands.

MEETING OF OFFICERS

At a meeting of the Officers of the Association held on 30 November 1988 at Saint Dunstan's House, the business transacted included the election to membership of the following:

Fellowship
Alliance, Alma, Cheadle. 1988
Bagnall, Maria, London. 1988
Baumann, Yvonne, Dungarvan, Co. Waterford. 1988
Bloodworth, Roy N., Doncaster. 1985
Bode, William E.G., Harrogate. 1988
Boozer, Joan B., Sha Tin, Hong Kong. 1988
Brandligt-van den Hoed, Maria A.G., Bussum, The Netherlands. 1988

Bridgewood, Alan, Leeds. 1988
Castro, Ana I.J., London. 1988
Chan, Albert H.S., Hong Kong. 1988
Corée, Henk, Borne, The Netherlands. 1988
Cowdrey, John W.F., Harrow. 1988
Deacon, Richard H., Shrivenham. 1988
De Waal, Irina, Delft, The Netherlands. 1988
Easterbrook, Steven, Bridgend. 1988
Evans, Elma H., Spring Valley, Calif., USA. 1988
Fisher, Barbara E., Kahuku, Hawaii, USA. 1988
Fowler, Jennifer A., Perth. 1988
Fung, Annie C.Y., Yuen Long, Hong Kong. 1988
Glaysher, Andrew J., Horsham. 1988
Glover, Andrew M., Horsham. 1988
Gomez da Silva, Luiz A., Sao Paulo, Brazil. 1988
Grieder, Judith Y., Hong Kong. 1988
Hanslip, Malcolm J., Exeter. 1950
Hideyuki, Nakata, Tokyo, Japan. 1988
Hitcham, Peter J., Kingston-upon-Thames. 1988
Holloway, Sarah D., London. 1988
Janssens, Nadia E.L., Brussels, Belgium. 1988
Kaiyoorawongs, Julie B., Hollywood, Calif., USA. 1988
Kawamoto, Keiko, Kowloon, Hong Kong. 1988
Kothari, Hema P., Bombay, India. 1988
Kwan, Daisy S.M., North Point, Hong Kong. 1988
Laurie, John J.W., Monte Carlo, Monaco. 1988
Lo Wong Chi Ping, Stella, Kowloon, Hong Kong. 1988
Mak Sin Leung, Gary, Kowloon, Hong Kong. 1988
Malarek, Anna, Toronto, Ont., Canada. 1988
Marriott, Janet A., Amersham, The Netherlands. 1988
Mistry, Mukesh, London. 1988
Moghadam, Paravanah, London. 1988
Muste, Birgitte M., Schoonhaven, The Netherlands. 1988
Naylor, Tina, Ashton in Makerfield. 1987
Ng, Lai Y., Chai Wan, Hong Kong. 1988
Nishizaki, Mikio, Tokyo, Japan. 1988
Norton, Robert, Warrington. 1988
Parr, Rosalind, Styal, Wilmslow. 1988
Premnath, K.P., Salem, India. 1988
Revol Macdonald, Brigitte, Bangkok, Thailand. 1988
Rice, Michael, Humbleton. 1988
Rosoff, Martin, Toronto, Ont., Canada. 1988
Rydeng, Rig, Finnsnes, Norway. 1988
Rysenbry-Beens, Jantine C., Haarlem, The Netherlands. 1988
Schuch, Yvonne D.J., Ijssel, The Netherlands. 1988
Scott, Jean V., Bayside, NY, USA. 1988
Serras, Helen, Washington DC, USA. 1988
Seung, Yuet F.P., Wah Fu, Hong Kong. 1988
Smith, Kevin M., Calgary, Alta., Canada. 1988
Storm (née Rufli), Jeanette, Stockholm, Sweden. 1988
Ten Berge, Robert B.H., Zuidlaren, The Netherlands. 1988
Titina, Meher R., Bombay, India. 1988
Tyler, Elizabeth V., London. 1988
Voordewind, Derk J., Delfzijl, The Netherlands. 1988
Walker, Jeremy R.P., Allonby. 1988
Warshow, Nancy, Nairobi, Kenya. 1988
White, Helen Y.C., Shiu Fai, Hong Kong. 1988
Wong, Che K.J., Kowloon, Hong Kong. 1988
Wood, Teddy, Kowloon, Hong Kong. 1988
Woszczyna, Paul D., Toronto, Ont., Canada. 1988
Ziemelis, Ojars, Solna, Sweden. 1988

Transfers from Ordinary Membership to Fellowship

Atkins, Tristan A., Banstead. 1988
Axell, Anita C., Stockholm, Sweden. 1988
Barber, Susan A., Billingshurst. 1988
Bignotti, Fabrizio, London. 1988
Bramsden, Manny, Maidenhead. 1988
Carry, Peter D., Aberdeen. 1988
De Bevere, Dirk, Brussels, Belgium. 1988
Findlay, Caroline E., London. 1988
Gay, Bernice M., Romsey. 1988
Gordon, Scott M., Oklahoma City, Okla., USA. 1988
Gouverneur, Keith, Caracas, Venezuela. 1988
Harrison, Roger F.J., King's Langley. 1988
Hiramatsu, Ikuo, Tokyo, Japan. 1988
Hobbs, Fiona G., Winchester. 1988
Jassinger, Alexandre P.O.L., Epsom. 1988
Kim, Won-Sa, Daejon, Korea. 1988
Kyriakidou, Katerina A., London. 1988
Larsson, Thomas, Jarfalla, Sweden. 1988
Lloyd, Florence M., Harpenden. 1988
Longden, Sharon D., Eckington. 1988
Lopezzo, Lorraine V., Long Valley, NJ, USA. 1988
Nunes, Michél, George, South Africa. 1988
Richner, Sally J., Grosse Pointe, Mich., USA. 1988
Sayers, Angela C., London. 1988
Schreier, Larry, Skokie, Ill., USA. 1988
Sekiguchi, Kazuyoshi, Tokyo, Japan. 1988
Shimizu, Terukazu, Tokyo, Japan. 1988
Sinclair, Anne L.K., Fernhurst. 1988
Sinclair, Lyall W., Cambridge. 1988
Sneeringer, Margaret R., Worthington, Ohio, USA. 1988
Stead, Heather E., York. 1988
Stone, Emma E., Derby. 1988
Sugihara, Kaori, Tokyo, Japan. 1988
Theriault, Peter J., Camden, Me., USA. 1988
Tirat, Pierre, Poitiers, France. 1988
Underdown, Derek W., Partridge Green. 1988

Urvik, Hilde, Oslo, Norway. 1988
Ushio, Tsutae, Fukuoka City, Japan. 1988
Van Camp, Coralie A., Auckland, New Zealand. 1988
Van Deijl, Jacobus H., Parlow, South Africa. 1988
Weiss, Anthony S., Bushey. 1988
Winterbottom, Martin, Watford. 1988
Woolley, Shirl L., San Diego, Calif., USA. 1988
Yokoyama, Haruaki, Kurume City, Japan. 1988
Yoshimoto, Misako, Munakata-Gun, Japan. 1988

Ordinary Membership
Ahmed, Mohammed A., Jos, Nigeria.
Alabaster, Andrew G., Ashton Gate.
Arbisman, A.R., Selsdon.
Baldock, Janine, London.
Ballester, Emilio, Madrid, Spain.
Blanchard, Clive P., Leeds.
Bruyns, Jacques P., Rhode Saint Geneve, Belgium.
Cartwright, Freda H., King's Langley.
Chiu, Roy S.H., Central, Hong Kong.
Clarkson, Adam A., Baldock.
Conrad, Lucinda H., Tauranga, New Zealand.
Corne-Halstenbach, Michele, Geneva, Switzerland.
Cox, Edward M., Great Yarmouth.
Daines, Deirdre, Haywards Heath.
Dalfen, Daniel J., Harrow.
Davis, Danny A., London.
Deen, Mohamed A., Colombia, Sri Lanka.
Dobson, Michael, Sheffield.
Fong, Chan N., East Molesey.
George, Wanda M., Nairobi, Kenya.
Ghahramani, Nasser, Oxhey.
Gorden, Joachim M.B., London.
Hartnup, Stephen J., St Albans.
Heatherwick, Stefany R., London.
Jarmyn, Shirley J., Enfield.
Jones, Phyllis M., Sheffield.
Lancaster, Wendy, London.
Lewis, Karen J., Hong Kong.
Lewis, Richard D.F., Epsom.
Mairlot-Peterbroeck, Veronique, Brussels, Belgium.
Michallat, Mark L., Shipley.
Milne, Herta, London.
Moncrieffe, Christopher, Gillingham.
Muchmore, Leslie R., Liskeard.
Murray, Robert A., London.
Nattagh, Shahla A., Harrow.
Oldershaw, Caroline J.E., London.
Oura, Mamiko, London.
Parry, Michael F., Winchester.
Pickering, Joanne, Ossett.
Plumb, Helen L., London.
Pointon, Laurence, Edgware.
Scott, Ian, Wimborne.
Shaw, Gillian A., Nairobi, Kenya.
Skilton, Margaret, Auckland, New Zealand.
Spentza, Alexandra, Nutley.
Stalnaker, Karen J., London.
Stone, Peter M.B., Seeb, Sultanate of Oman.
Stulting, Wendy R., London.
Syn, Lucy, London.
Takahashi, Yasushi, Kofu, Japan.
Van Heesewijk, Jacqueline, London.
White, Felicity, London.
Whiting, Kevin, Buckingham.
Whittle, John E., Sutton Coldfield.

EXAMINATIONS 1989

The examination dates for 1989 are as follows:

Gem Diamond Examination:
Theory – Monday 5 June
Practical – Monday 5 June and Monday 12 June

Examinations in Gemmology:
Preliminary – Tuesday 27 June
Diploma Theory – Wednesday 28 June
Diploma Practical – Tuesday 27 June, Thursday 29 June and Friday 30 June.

The final date for receiving examination entry forms is 31 March.

The Buckingham Award

Mr W.C. Buckingham, FGA, has very generously donated his fine collection of zircon rough to the Gemmological Association of Great Britain to mark his retiral after fifty years from the firm of George Lindley & Co. Ltd. He is also offering an award to newly-qualified Fellows of the Association who carry out research on samples from the collection.

The criteria for the research are:

1. The rough specimens originate from various localities, mostly Indo-China, and the research might be directed towards determining any variation in properties from the different localities. However, other research topics would be considered.
2. Having carried out the research programme, the Fellow must present the results in the form of a paper which would, in the opinion of the Editor, be worthy of publication in *The Journal of Gemmology*.
3. A Fellow whose research and paper satisfy these criteria will be awarded the sum of £100 or books and/or instruments to that value.
4. The Fellow must first apply in writing to the Secretary of the Association, setting out his proposed research and methodology and the

instruments he proposes to use. The time to be taken must also be specified.

Research materials provided by the Association must be returned within the time stipulated.

The Association reserves the right to authorize or reject research projects at its sole discretion and will not enter into the reasons for any decision made.

Those interested in the Award are invited to write to the Secretary of the Gemmological Association, Saint Dunstan's House, Carey Lane, London EC2V 8AB, giving the information set out in item 4 above.

Letter to the Editor

From Dr Karl Schmetzer

Dear Sir,

In an article dealing with colour-changing chromiferous tourmalines from East Africa by H. Bank and U. Henn, 1988, (*Journal of Gemmology*, **21**, 102-3), two alexandrite-like tourmalines containing 0.36 and 0.64 wt.% Cr_2O_3 are described. According to the chemical data published, these two samples were magnesium tourmalines, i.e. intermediate members of the solid solution series dravite-uvite.

Colour-changing magnesium tourmaline from the Ural Mountains, USSR, containing exceptionally high amounts of chromium (10.86 wt.% Cr_2O_3) was analysed by Cossa and Arzruni (*Z. Kryst. Mineral.*, 1883, 7, 1-16) which actually implies that alexandrite-like tourmaline is the second mineral, after chromium-bearing chrysoberyl (alexandrite *sensu stricto*), for which a distinct colour change between daylight and artificial light was observed long before alexandrite-like garnets, sapphires, spinels, etc., were described (cf. Schmetzer, Bank and Gübelin, 1980, *N. Jb. Miner. Abh.*, **138**, 147-64). However, it is worth while pointing out that not every chromium-bearing member of the dravite-uvite series reveals a distinct alexandrite effect. For example, one sample originating from Tsavo, Kenya, which contained 0.53 wt.% Cr_2O_3 (Schmetzer, Nuber and Abraham, 1979, *N. Jb. Miner. Abh.*, **136**, 93-112) did not show a remarkable colour change between daylight and artificial light.

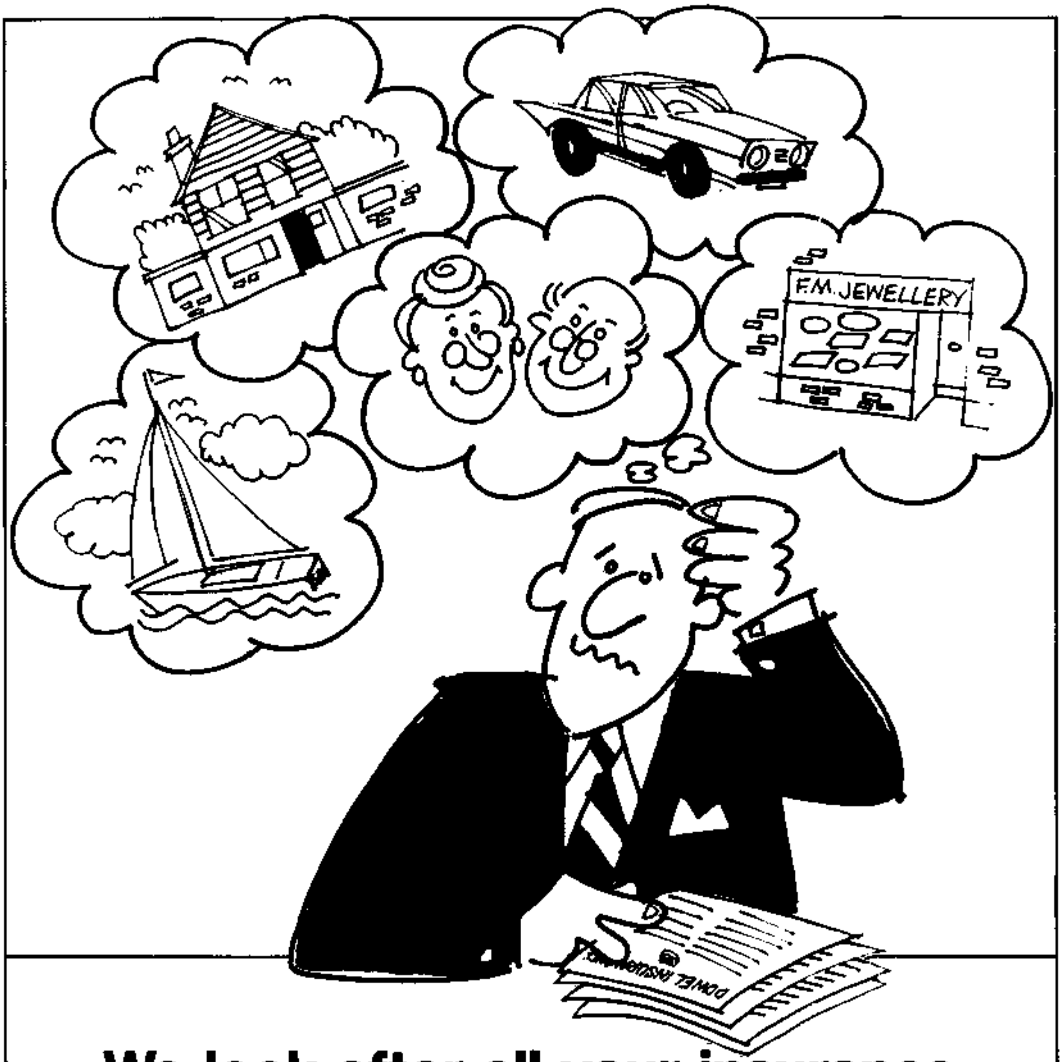
In general, absorption spectra of chromium-bearing tourmalines from various localities are similar or almost identical, but small differences are found in the positions and intensities of absorption maxima and minima. This result of spectroscopic investigations is supposed to be due to a variable distribution of chromium between both octahedrally coordinated lattice positions of tourmaline, i.e. between magnesium and aluminium sites in tourmaline crystals which were grown in different environments (cf. Nuber and Schmetzer, 1979, *N. Jb. Miner. Abh.*, **137**, 184-97). A similar correlation of the intensity of colour change with variable site occupancies of chromium between two octahedrally coordinated polyhedra is already established for chrysoberyl, the structure of which contains two different aluminium positions (cf. Bukin *et al.*, 1980, *Inhomogenity of minerals and crystal growth*, Moskva, 317-28).

At present, no exact correlation between site occupancies of chromium in tourmaline and the presence or absence of a pronounced colour change is worked out and the influence of iron and titanium absorption bands is unknown. Consequently these problems need further experimental study and research.

Yours etc.,
K. Schmetzer

25 July 1988
Institute of Mineralogy and Petrography, University of Heidelberg, West Germany.

ISSN: 0022-1252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The Editors of the *Journal* invite advertisements from gemstone and mineral dealers, scientific instrument makers, publishers and others with interests in the gemmological, mineralogical, lapidary and jewellery fields.

Rates per insertion, excluding VAT, are as follows:

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The GEMDATA Package by Peter Read (see p. 274 for full details) is available through the Gemmological Association at £75.00 plus postage, packing and VAT* (*UK only at £11.25). Postal rates are as follows: £3.50, UK and Eire; £4.00, Europe; £6.00 rest of the world.

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GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

The Arms and Crest of the Association, conferred by a grant of Arms made by the Kings of Arms under royal authority. The cross is a variation of that in the Arms of the National Association of Goldsmiths of Great Britain and Ireland. In the middle is a gold jewelled book representing the study of gemmology and the examination work of the Association. Above it is a top plan of a rose-cut diamond inside a ring, suggesting the scrutiny of gems by magnification under a lens. The lozenges represent uncut octahedra and the gem-set ring indicates the use of gems in ornamentation. The lynx of the crest at the top was credited, in ancient times, with being able to see through opaque substances. He represents the lapidary and the student scrutinizing every aspect of gemmology. In the paws is one of the oldest heraldic emblems, an escarbuncle, to represent a very brilliant jewel, usually a ruby. The radiating arms suggest light diffused by the escarbuncle and their tips are shown as jewels representing the colours of the spectrum.

OMNEMQUE PRETIOSUM LAPIDEM

Historical Note

The Gemmological Association of Great Britain was originally founded in 1908 as the Education Committee of the National Association of Goldsmiths and reconstituted in 1931 as the Gemmological Association. Its name was extended to Gemmological Association of Great Britain in 1938, and finally in 1944 it was incorporated in that name under the Companies Acts as a company limited by guarantee (registered in England, no. 433063).

Affiliated Associations are the Gemmological Association of Australia, the Canadian Gemmological Association, the Gem and Mineral Society of Zimbabwe, the Gemmological Association of Hong Kong, the Gemmological Association of South Africa and the Singapore Gemologist Society.

The *Journal of Gemmology* was first published by the Association in 1947. It is a quarterly, published in January, April, July, and October each year, and is issued free to Fellows and Members of the Association. Opinions expressed by authors are not necessarily endorsed by the Association.

Notes for Contributors

The Editors are glad to consider original articles shedding new light on subjects of gemmological interest for publication in the *Journal*. Articles are not normally accepted which have already been published elsewhere in English, and an article is accepted only on the understanding that (1) full information as to any previous publication (whether in English or another language) has been given, (2) it is not under consideration for publication elsewhere and (3) it will not be published elsewhere without the consent of the Editors.

Papers should be submitted in duplicate on A4 paper. They should be typed with double line spacing with ample margins of at least 25mm all round. The title should be as brief as is consistent with clear indication of the content of the paper. It should be followed by the names (with initials) of the authors and by their addresses. A short abstract of 50–100 words should be provided. Papers may be of any length, but long papers of more than 10,000 words (unless capable of division into parts or of exceptional importance) are unlikely to be acceptable, whereas a short paper of 400–500 words may achieve early publication.

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