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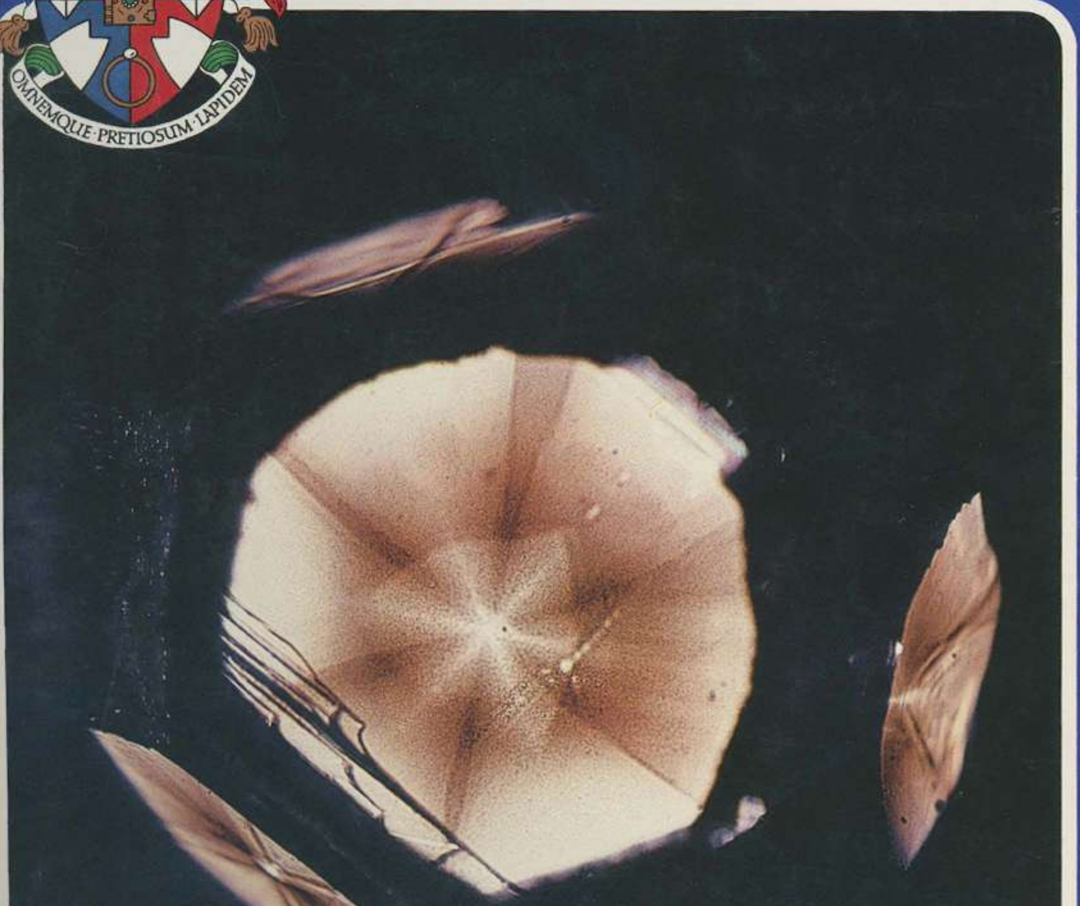

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Cover Picture

Photograph of a very unusual cubo-octahedral diamond crystal showing 'stars' through the octahedral faces – see page 52.
Photographed by S.J.A. Currie, F.G.A., New Zealand.

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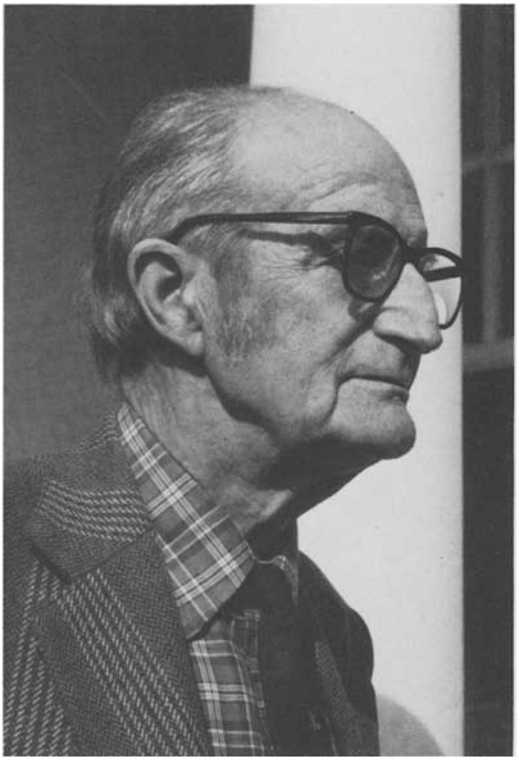
JOHN CHISHOLM,
Editor 1973–85

John Chisholm relinquished the active Editorial chair at the end of 1985. We wish him well in his retiral and thank him most sincerely for his sagacity and painstaking efforts. We are most fortunate to retain his services as Consultant Editor.



This fine verdite carving of a buffalo*, mounted on a plinth of iroko wood, was presented to John Chisholm as a mark of grateful appreciation for long and wise service to the Gemmological Association over a period of almost four decades.

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*A coloured photograph of the buffalo appeared in *J. Gemm.*, 1984, **XIX**, 2, 150.

A description of ruby from Nepal

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Abstract

A new occurrence of ruby from Nepal is described. Cut stones, crystals and the matrix minerals surrounding the rubies have been analysed by UV-visible spectrophotometer and by electron microprobe. A variety of inclusions are described and the results are compared with other occurrences of ruby in Asia.

Introduction

Early in 1984 an oval cabochon ruby and a smaller faceted ruby, which were said to come from a new occurrence in Nepal, were brought into the Geological Museum for examination. Both were identified as ruby, but irregularly curved feather inclusions (cf. Gübelin, 1983) in both stones gave rise to some doubt about whether they were natural or synthetic. A short time later the two stones (Fig. 1) were examined at the British Gem Testing Laboratory. Here it was agreed that whilst the inclusions present in these two stones were not characteristic of any particular locality, it was more likely that the rubies were of natural origin. However, it was thought best that specimens of the rough should be obtained to carry out a thorough examination. These duly arrived in late 1984 and this paper describes the nature of the new ruby and its associated minerals. Commercial quality ruby was first reported from Nepal by Toshiro Baba (1982) and he stated that it occurred with topaz in the Taplejung District, Dhankuta Zone of eastern Nepal (see Fig. 2). Cabochon quality sapphire was also reported from the same district by A. Chikayama at the 19th International Gemmological Conference held in Beruwala, Sri Lanka, in November 1983. It is possible that the source of the rubies described in this paper is also Taplejung, but the only information the authors have been given on the whereabouts of the source is that it is 'somewhere in Nepal'.

Description

Although the two polished stones are not of a particularly good gem quality (Fig. 1), the colour and clarity of the cabochon cut stone which weighs 7.90 cts is somewhat better than the faceted stone. The faceted stone, which weighs 2.17 cts, is heavily included, has a large fracture visible to the unaided eye and is a pinkish-red colour. The cabochon cut stone on the other hand, is clearer, its inclusions are not so easily visible to the unaided eye, and its colour is closer to the 'ideal' ruby red.

Apart from the deceptive curved and twisted feather inclusions two other interesting observations were made during the microscopic examination of both stones. The first was the long sometimes tapering, curved crystals inside the cabochon (Fig. 3), and the second was the presence in both stones of straight bands of blue sapphire.

Two specimens of ruby in matrix were supplied for examination. One is a fine prismatic crystal, 3.5 cm long and 2.3 cm across, in a matrix of white minerals, and the other is a friable dark mica schist (Fig. 4). A slice cut from near the top of the prismatic crystal (Fig. 5) revealed a core of ruby with a colour comparable to that of good Burmese stones. Surrounding the core are zones of paler ruby and some sharply defined bands of blue sapphire with growth lines meeting at 120° (Fig. 6). The crystal is traversed by curved cracks containing minute quantities of fluid, and in some parts these look like undulating films or veils, similar to the features seen first in the cabochon. These inclusions are very similar to those depicted by Gübelin (1983) in Figs. 2 (Chatham ruby). 3 (Kashan), 4 and 7 (Knischka).

Refractive indices and specific gravity

In the first instance refractive index measurements were attempted on the faceted stone, but as the surface was both uneven and broken in many places, the resulting measurement of 1.758–1.766 could only be regarded as approximating the actual refractive indices. Following the slicing and polishing of the crystal specimen, accurate RI measure-

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Fig. 1. Two Nepal rubies. The cabochon weighs 7.90 cts and the faceted stone 2.17 cts.

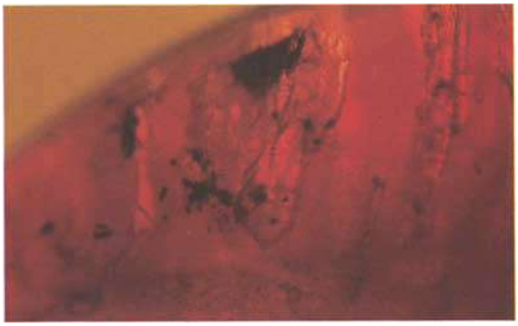


Fig. 3. Prismatic crystal inclusions in cabochon of Nepal ruby.

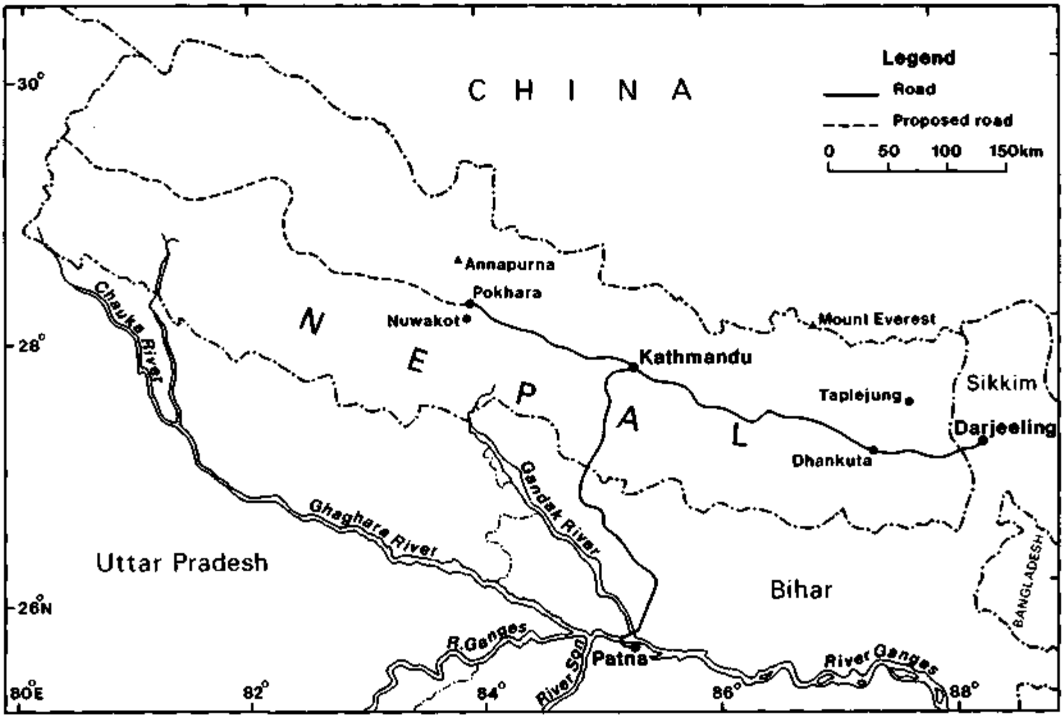


Fig. 2. Map of Nepal.

Fig. 4. Prismatic ruby in matrix of white minerals, and dark mica schist containing ruby and sapphire from Nepal.

Fig. 5. End-on view of prismatic ruby pictured in Figure 4.

Fig. 6. Slice of ruby from the prismatic crystal showing colour zones, banding and inclusions.

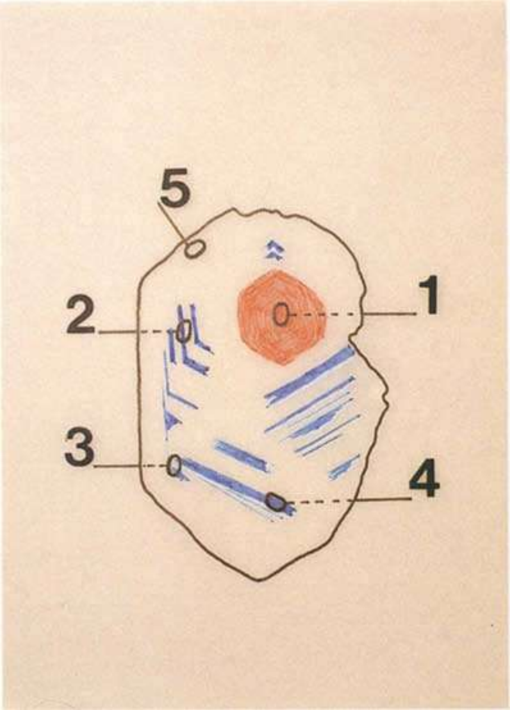


Fig. 7. Sketch of ruby slice indicating colour zones and points where spectrophotometer traces were measured (Fig. 8). See Figs. 10–14.

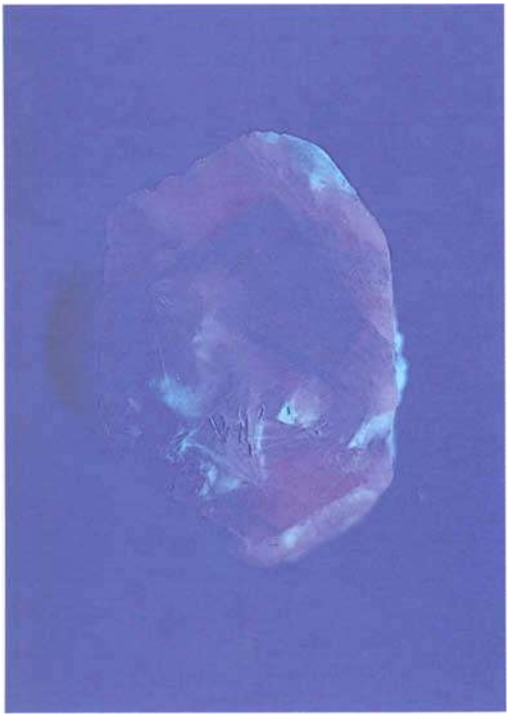


Fig. 18. View of ruby slice in UV light (365 nm). Note the contrast between the zones of ruby and sapphire and the greenish-white fluorescence of the sheaf-like margarite inclusions.

ments of 1.760–1.768 were made on the polished slice using a Rayner Dialdex refractometer and sodium light.

Using the hydrostatic weighing method and distilled water, specific gravity determinations were made on both polished stones and on the crystal slice shown in Fig. 18. The SG of the cabochon was found to be 3.99 and that of the faceted stone 3.98. The slice, however, was found to have the rather low SG of 3.79, and this is probably due to the large amount of included margarite (SG 3.0–3.1).

Absorption spectrum

During the original examination of both polished stones the absorption spectrum was noted for the visible region using a Beck prism-type hand spectroscope. Although the absorption and fluorescence lines were less easily seen in the faceted stone, both stones displayed the typical spectrum for ruby (Anderson 1980).

During the examination of the crystal a more detailed survey of the absorption spectrum was carried out, and five separate areas of the thin slice were examined (see Figs. 6 and 7). The five areas were chosen as examples of the different colours in the slice. Each area examined measured 1.1 × 1.5 mm (see Figs. 10 to 14). A Pye Unicam PU8800/03 (Basil Anderson) UV-visible spectrophotometer was used to examine each area from 190 to 850 nm at room temperature, and for all curves produced the beam passed through the slice in a direction virtually parallel to the optic axis. The span chosen for all curves was 1A (absorbance units), the bandwidth was 0.5 nm and the scan speed was 0.5 nm/s.

The recorded absoption curves for all five areas are shown in Fig. 8. The curves are numbered 1 to 5 and these correlate with the areas numbered 1 to 5 in Fig. 7, and the photographs of these areas in Figs. 10, 11, 12, 13 and 14 respectively. The levels of absorbance for each curve relate in a qualitative way to the other curves. The higher absorbance levels of some of the curves may in part arise from a higher proportion of small flaws or inclusions in the areas examined. In Fig. 8, the baseline of the diagram is 0.85A and the overall absorbance level of each curve is shown as being higher than this figure. However, because the size of the sample beam was reduced by masking to examine the small areas chosen, the absorbance level of each curve is about 0.45A higher than it should be. The path length of light through the ruby slice was small and ranged from 0.94–0.97 mm.

Although in three of the areas examined (Figs. 11, 12 and 13, and curves 2, 3 and 4 respectively) there is a strong blue component present, the curves produced for all five areas are fundamentally those which are expected of ruby (Anderson 1980). Curves 2, 3 and 4 do show, however, that for those areas of the crystal which have a blue component, there is a steeply rising absorbance level from 850 to 620 nm. Whereas, over the same wavelength range in areas which are predominantly red or pink the level of absorbance only rises slightly. Further, the level of absorbance for the band in the 410 nm region is significantly higher than that for the band in the 560 nm region in curves 1 and 5 which apply to the red and pink areas (Figs. 10 and 14), whilst the reverse is so in curves 2, 3 and 4.

Curve 1 was evaluated further according to the method published by Bosshart (1982) for the 'distinction of natural and synthetic rubies by ultraviolet spectrophotometry'. This method uses three parameters to evaluate the UV transmission area. These are the wavelength of the absolute absorption minimum in the UV and the centre position and width of the profile situated at 0.5 absorbance units above the minimum.

In this case it was only possible to measure one of the parameters as the difference between the absolute absorption minimum and the maximum of the absorption band on its long wave side was less than 0.5A (Fig. 9). The measurement of the absorption minimum at 361 nm however placed the stone well into the natural ruby range as described by Bosshart.

Microprobe analyses

Analytical work has been carried out on the faceted ruby, on a slice from the prismatic crystal of ruby in matrix, on a ruby derived from crumbled mica schist, and on a polished thin section of mica schist that contained both ruby and sapphire. Analyses were made using a Cambridge Instruments Geoscan microprobe with Link Systems energy dispersive detector and computer. An accelerating voltage of 15 kV, a specimen current of 5×10^{-9} amps and an electron beam focused to approximately 5μm were used. Elements of atomic number 11 (Na) and above can be measured by this method and the limits of detection for each of the oxides are about 0.2 wt%.

Analyses of selected minerals are given in Table 1. Particular attention was paid to the compositions of the different colour zones in the corundum crystals, and in the reddest parts, the Cr_2O_3 content reached 0.32%. TiO_2 was as high as 0.30% in some zones but the TiO_2 values do not show a good correlation with the intensity of the blue coloration. Iron is below the limit of detection in all the corundum analyses, and an overall mean composition is given in Table 1 column 1. In column 3 the total for apatite is low and this is consistent with the presence of OH, F, or CO_2 which are not detectable by the microprobe. Similarly the totals for the micas margarite (column 2) and phlogopite (column 4) are low due to the probable presence of OH or F.

Table 1. Analyses of corundum and associated minerals from Nepal.

Wt%	1	2	3	4
SiO_2	0.1	31.6	<0.2	38.8
TiO_2	0.1	<0.2	<0.2	1.0
Al_2O_3	99.7	48.9	<0.2	18.2
Cr_2O_3	0.1	<0.2	<0.2	<0.2
FeO	<0.2	<0.2	<0.2	2.4
MgO	0.2	0.4	0.1	21.5
CaO	<0.2	10.9	55.7	<0.2
Na_2O	<0.2	1.4	<0.2	0.5
K_2O	<0.2	0.2	<0.2	9.9
P_2O_5	<0.2	<0.2	41.6	<0.2
Cl	<0.2	<0.2	0.4	<0.2
Total	100.2	93.4	97.7	92.3

Notes. Total Fe given as FeO.

1. Corundum, mean of 29 analyses from the ruby slice, ruby grain, and polished thin section.
2. Margarite, mean of 8 analyses from ruby slice and polished thin section. Identification checked using X-ray diffraction by R.J. Merriman (B.G.S. X-ray film number X8645).
3. Apatite, mean of 5 analyses from ruby grain and polished thin section. Total takes account of subtraction of oxygen equivalent of chlorine.
4. Phlogopite, mean of 3 analyses from polished thin section. Also contains 0.2% V_2O_3.

The matrix of white minerals surrounding the prismatic crystal of ruby consists largely of calcite, dolomite and the calcium mica, margarite. The margarite occurs as platy sheaves either intergrown with the margins of the ruby or completely included within the crystal. Other inclusions consist of muscovite and zoisite, and associated with margarite at one edge of the ruby slice, are grains of epidote which contain small quantities of rare-earth elements (REE). One black inclusion in the faceted ruby was found by microprobe analysis to be rutile, but other black inclusions, superficially similar to the rutile, present in ruby from the mica schist are apatite coloured black by graphite. The mica schist consists of 80% phlogopite mica, 5% apatite, 3% graphite, 3% corundum (ruby and blue sapphire), 2% margarite and minor quantities of rutile, muscovite, calcite, dolomite, anorthite, zoisite and epidote. Part of the mica schist is shown in Figs. 15, 16 and 17 and shows the intimate intergrowth of phlogopite mica with the corundum, apatite and other minerals. In these Figures it can be seen that the corundum is partly mantled and intersected by patches of margarite. These textures suggest that after the initial growth of corundum, temperature, pressure and chemical conditions changed such that corundum became unstable and was partially converted to margarite before temperatures became so low that alteration was inhibited. In the absence of detailed knowledge of the local geology this interpretation of the textures is only tentative and indeed Okrusch, Bunch and Bank (1976) have argued that for the Hunza Valley (Pakistan) corundum marble, the corundum and margarite formed in an environment of rising temperatures and pressures in place of diaspore, pyrophyllite and calcite.

In ultraviolet radiation the ruby generally displays a bright red to pink glow, stronger in 365 nm than in 253 nm radiation. In the zones of sapphire however the fluorescence is diminished, and where margarite is present, it fluoresces a bright greenish white and commonly shows the sheaf-like structure of the inclusion (Fig. 18).

Discussion

The association of corundum with carbonates, phlogopite, apatite, graphite and calcium aluminium silicates (margarite, zoisite, epidote and anorthite $An_{93}Ab_7$) is similar to that described by Iyer (1953) for parts of the Mogok Stone Tract (see also Keller, 1983). There the Mogok series (Iyer, 1953, p.15) consists of limestones, calciphyres, scapolite-gneisses, calc-granulites and lenticular bands of graphite. Rubies in the Hunza Valley, Pakistan come from a similar geological environment and Okrusch et al. (1976) and Gübelin (1982) describe the host rocks as series of intercalated marbles, schists and gneisses, and the latter shows rubies with calcite, phlogopite and apatite inclusions. Although the range of minerals in the two specimens from Nepal is not as extensive as that in Mogok, two specimens comprise only a very small sample of what is probably a geologically complex area, and further exploration may reveal a much bigger range of minerals and gems.

Acknowledgements

We would like to thank E.A. Jobbins for useful discussion, R.J. Merriman for his X-ray identifications, Dr M.T Styles for advice concerning the microprobe, C.W. Wheatley and R.D. Fakes for making polished thin sections and Charles Mathews Lapidaries for slicing and polishing the crystal. The paper is published by permission of the Director, British Geological Survey (N.E.R.C.).

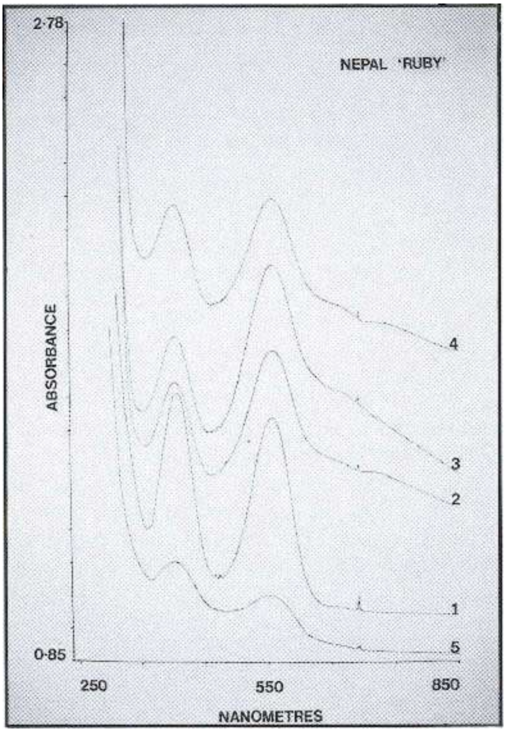


Fig. 8. Absorption curves over the range 250–850 nm measured at five points in the ruby slice (see Fig. 7).

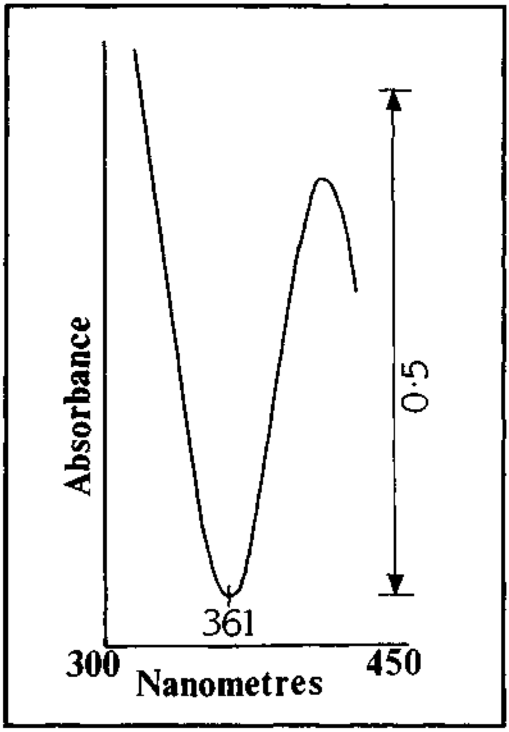


Fig. 9. Ulta-violet transmission area at point 1 (Figs. 7 and 10).

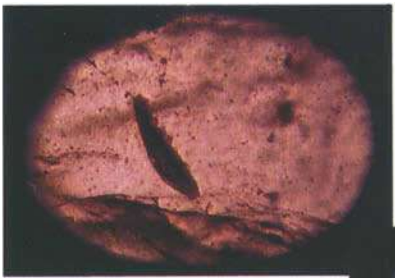


Fig. 10. Colour of corundum at point 1.

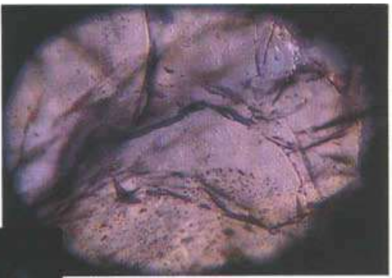


Fig. 11. Colour of corundum at point 2.

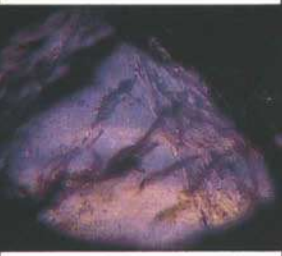
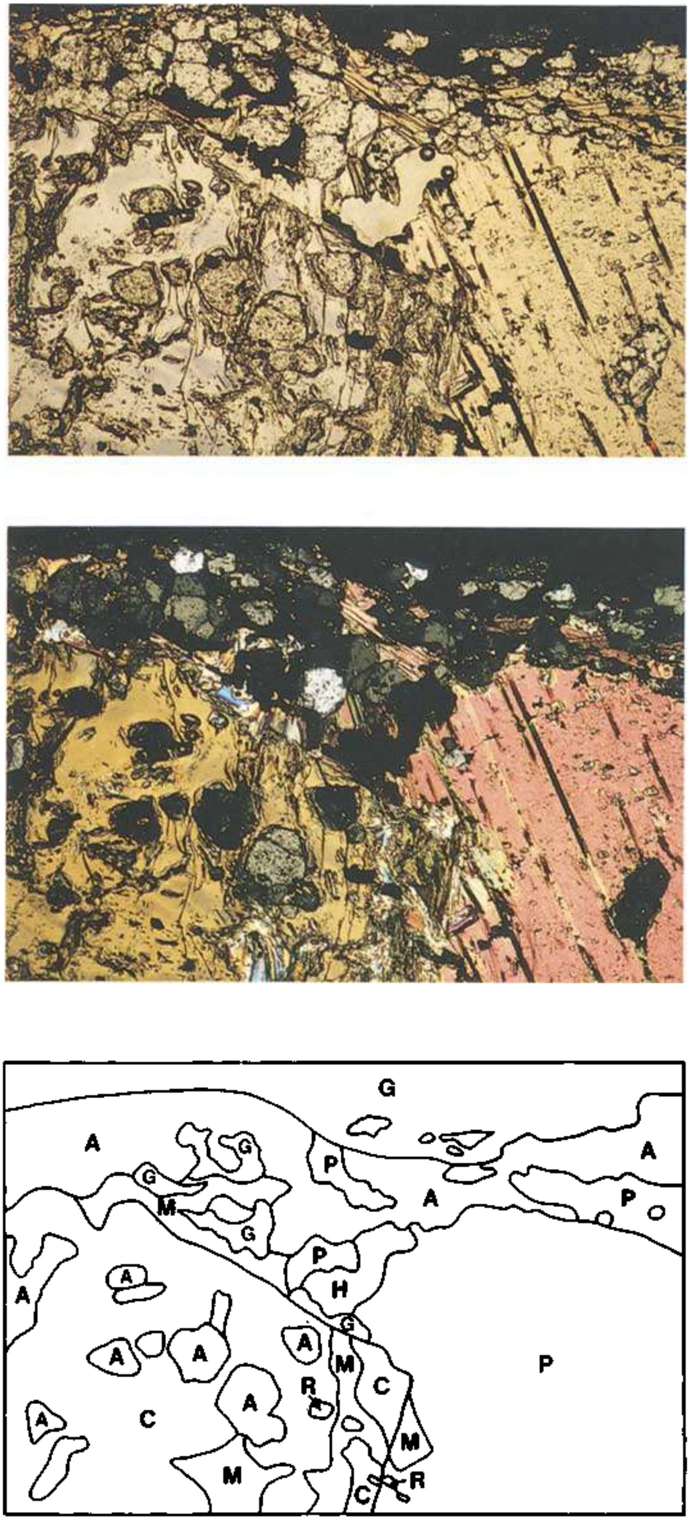


Fig. 12. Colour of corundum at point 3.

Fig. 13. Colour of corundum at point 4.

Fig. 14. Colour of corundum at point 5.



Figs. 15, 16, 17.
Photomicrographs of mica schist containing corundum. Field of view represents 4 mm across. Fig. 15 (top) plane polarised light. Fig. 16 (centre) crossed polarised light. Fig. 17 (bottom) key to minerals shown, apatite (A), corundum (C), graphite (G), margarite (M), phlogopite (P), rutile (R) and (H) is a hole in the slide.

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[*Manuscript received 31 December 1984.*]

On the identification of hollow natural pearls and non-nucleated cultured pearls

J.M. Duroc-Danner, F.G.A., G.G.

Hollow natural pearls are seen from time to time(1,2,3), and these can be troublesome to separate from the commonly produced non-nucleated cultured pearls.

A hollow natural pearl

An undrilled baroque pearl (colour plate 1, A) measuring approx. 18.80 × 12.50 × 12.20 mm and weighing 17.07 ct, on all radiographs (Fig. 1 to 4, A) showed a rather large centre of nucleation, sensibly less radiopaque than the ordinary nucleus seen in natural pearls. No circumferential conchiolin deposit could be detected.

The hydrostatic weighing of the pearl in distilled water at 4°C using a Mettler PL 300c balance (accuracy ± 0.001 carat) indicated a density of 2.20 g/cm^3, and confirmed with the X-radiographs that the centre was a large area composed of a void, or less dense material (mud ?). The pearl was identified as natural, and since it did not show any luminescence under X-rays, as a salt water pearl, which due to its large size originates most probably from Australia.

It should be noted here that in gemmological literature, genuine nucleated pearls are said to have densities lying between 2.60 and 2.85 g/cm^3 (4,5). Densities of non-nucleated or hollow natural pearls are not given due probably to perturbing factors like the irregular shape of the cavities, or of the density of the less dense material composing the nucleus.

A tissue-nucleated cultured pearl

At the same time the writer received the natural hollow pearl described above, a white undrilled baroque pearl (colour plate 1, B) measuring approx. 15.38 × 13.80 × 9.30 mm for a weight of 13.66 ct, came for identification. On the different X-radiographs (Fig. 1 to 4, B) it showed thin radiopaque layers of nacre near the surface, a large and irregular lentil-like shaped centre of nucleation which is very transparent to X-rays, with few fine circumferential lamellae of radiolucent conchiolin. All these structures are typical of non-nucleated cultured pearls. Since this pearl did not show any luminescence under X-rays, it must be a salt water non-nucleated cultured pearl, and due to its large size, originates most probably from Australia(6).

The hydrostatic weighing of this pearl in distilled water under the same conditions as for the natural hollow pearl, indicated a density of 2.718 g/cm^3 which is consistent with that quoted in gemmological literature for non-nucleated cultured pearls.

Discussion

It is interesting to compare the X-radiographs of the two pearls: For the natural hollow pearl, the centre of nucleation is more opaque to X-rays than that of the tissue-nucleated cultured pearl which is very transparent and lentil-shaped. Had the hollow natural pearl been composed of a tissue or other organic nucleus, the resultant X-radiograph would have been similar to that of the cultured tissue-nucleated pearl, and its identification a real challenge.

Density provides little help in separation since this natural hollow pearl had exactly the same as another cultured tissue-nucleated pearl density which showed 2.20 g/cm^3. Densities can overlap both for cultured and natural pearls, either nucleated or non-nucleated.

Colour and shapes in their turn cannot be taken into account to differentiate natural and tissue-nucleated cultured pearls since these vary considerably as well. For these two pearls, only direct X-radiography could make the difference since Lauegrams would in all cases invariably show an hexagonal spot pattern characteristic of natural pearls(7,8).

Acknowledgements

The writer is indebted to the British Gem Testing Laboratory of the London Chamber of Commerce and Industry for taking the X-radiographs, and for their opinion concerning these pearls.

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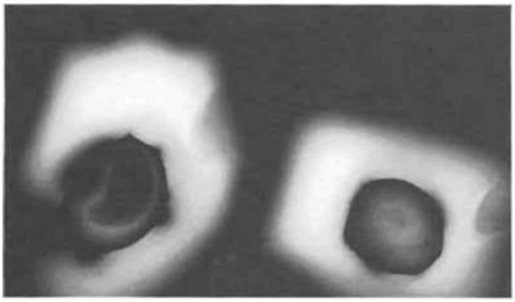
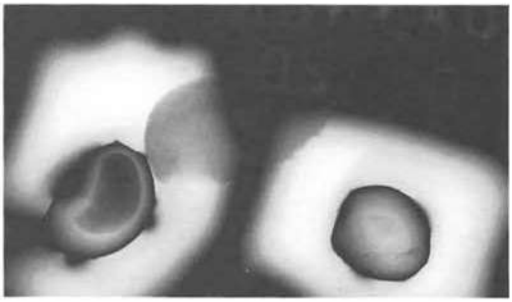
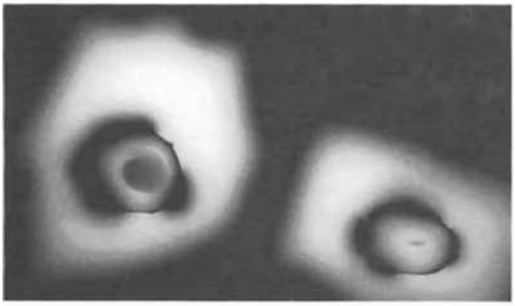
Plate 1. Pearl A and B



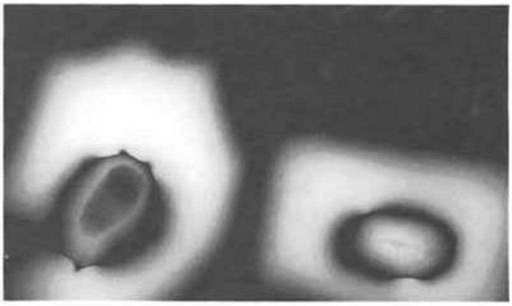
pearl A 1 pearl B



pearl A 2 pearl B



pearl A 3 pearl B



pearl A 4 pearl B

Fig. 1. X-radiographs of Pearl A and B taken from different positions. (The white areas surrounding the pearls represent the masking material.)

For pearl B, note on radiographs 3 and 4 in particular, the small elongated patch near the centre produced by the conchiolin, and the large lentil-shaped nucleus. This is very characteristic of a non-nucleated cultured pearl.

For pearl A, the absence of conchiolin deposits, and the aspect of the nucleus as seen from different positions on the radiographs is characteristic of a natural pearl.

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[*Manuscript received 7 March 1985.*]

Seiko synthetic emerald

Stephen J. Kennedy, B.Sc., F.G.A.

The British Gem Testing Laboratory of the London Chamber of Commerce and Industry

Abstract

A new synthetic emerald developed by the Seiko group of companies is described. The features highlighted include the refractive indices (1.560–1.564), the specific gravity (2.655), and the distinctive crystalline inclusions, which are all relevant in differentiating the stone from a natural emerald.

Introduction

The Suwa Seikosha group of companies, renowned in the jewellery trade for its Seiko watches, has moved into the synthetic gem market. The synthetic counterparts of ruby, sapphire (blue, pink, and pink/orange), alexandrite, and emerald are being produced by Matsushima Kogyo Co. Ltd., an affiliated company of Suwa Seikosha.

In November 1983 the Creative Jewel Group of Suwa Seikosha started marketing these stones set in their own line of jewellery, which they have named Bijoreve. Their policy for the present is that the synthetic stones will only be marketed set in their own jewellery. So familiarization with the range of jewellery would be an advantage to anyone concerned with identifying the stones. It would be far better of course to be in a position to recognise the stones themselves without reference to their settings.

Examples from most of the species have already been reported upon(1) but a synthetic emerald subsequently received at the laboratory proved worthy of a further article. The stone was kindly sent to the laboratory at the end of 1984 by Suwa Seikosha, who also confirmed that the stone had been made by a flux-melt method, in contrast to the floating zone technique(2) being used for other Seiko synthetic stones.

Investigation

The synthetic emerald examined is a faceted, marquise-shaped stone, measuring approx. 4.94 × 2.98 × 2.40 mm, and weighing 0.19 ct. The SG of the stone is approximately 2.65 determined by the hydrostatic method. The accuracy of the latter method was limited by the small size of the stone. So this was followed by observing the behaviour of the stone in a heavy liquid in which quartz (SG of quartz 2.651) suspended freely. The stone sank slightly quicker than quartz as the temperature of the liquid increased and hence the SG of the stone was estimated to be approximately 2.665.

The RI of the stone is 1.560–1.564, which was measured on a spinel refractometer using sodium light. The optic axis is parallel to the table along the length of the stone. This was assessed by noting the orientation of the stone on the refractometer prism when a single shadow edge was seen on the scale of the refractometer(3).

The absorption spectra of the Seiko synthetic emerald (Fig. 1) were recorded at room temperature on a Pye Unicam PU 8800/03 UV/visible spectrophotometer (Basil Anderson model). The spectra for the ordinary and extraordinary rays were obtained using a polarizing filter. The relevant operating conditions were a bandwidth of 1 nm, a scan speed of 0.5 nm/sec, and the light path through the girdle of the stone approximates to the width of the stone at 2.98 mm. The salient peaks occur at 476 nm, 637 nm, 680 nm, and 683 nm, for the ordinary ray, and 642 nm, 660 nm, 680 nm, and 683 nm for the extraordinary ray. The areas of general absorption occur below 350 nm, and also are centred at approximately 430 nm and 600 nm. There is nothing exceptional in the visible region but on comparing the spectra (Fig, 1) with the spectrum of a Chatham synthetic emerald recorded under similar conditions (Fig. 2) one notices a difference in the ultraviolet. The Seiko synthetic emerald absorbs radiation below 350 nm, whereas the Chatham synthetic emerald transmits radiation down to 250 nm. This feature of the Seiko synthetic emerald is not definitive as many other synthetic and natural emeralds behave in a similar fashion by absorbing radiation in the same region of the ultra violet(4).

In common with most synthetic emeralds and many natural emeralds the stone appears a strong pinkish-red when viewed through a Chelsea colour

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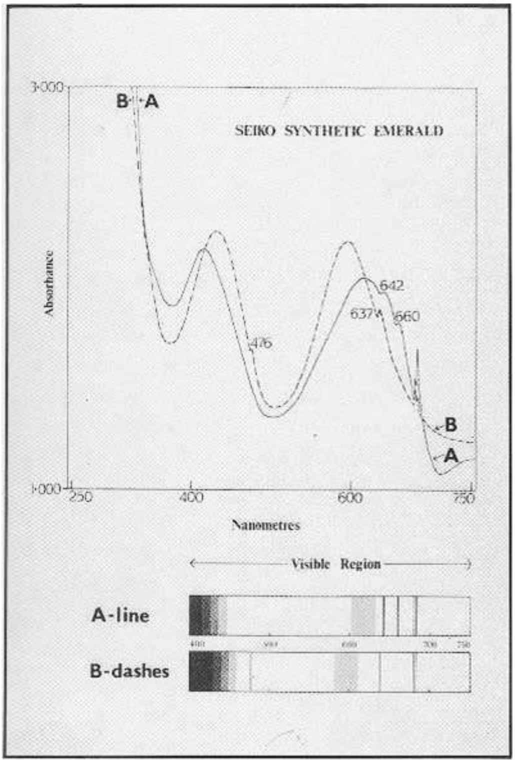

Fig. 1. The absorption spectra of the Seiko synthetic emerald recorded at room temperature on a Pye Unicam PU 8800/03 UV/visible spectrophotometer (operating conditions – bandwidth 1 nm, scan speed 0.5 nm/sec, and light path approximately 2.98 mm) using a polarizing filter to obtain the ordinary ray (dotted curve) and extraordinary ray (solid curve). A comparable representation of what would be seen in a hand spectroscope is illustrated directly below the curves.

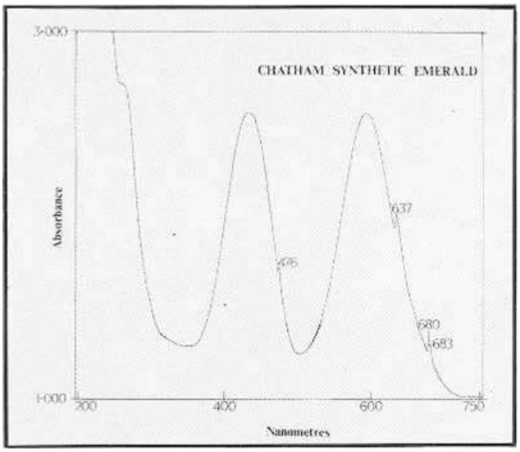

Fig. 2. The absorption spectrum of a Chatham synthetic emerald crystal slice recorded at room temperature on a Pye Unicam PU 8800/03 UV/visible spectrophotometer. (Operating conditions – bandwidth 1 nm, scan speed 0.5 nm/sec, and light path approx. 3.5 mm). The crystal was cut perpendicular to the optic axis and this is the direction through which the recorded ordinary ray was obtained.

filter. This is an inconclusive test for differentiating a natural emerald from a synthetic emerald.

Inclusions

1) Colour zoning of green and colourless growth bands running parallel to the table (Fig. 3). This explains why the observed colour of the stone is better through the table than it is through the girdle.
2) Roughly rectangular inclusions of flux which are oriented in one general direction (Fig. 4) and contained within a plane between the colour zones. There tends to be a concentration of inclusions between these colour zones.
3) Included crystals are situated just above a plane between the colour zones (Fig. 5). The crystals seen in side view in Fig. 5 are the same as those seen in plan view in Fig. 6. A 'star-burst' of three crystals and a rod-shaped crystal make up the complement of included crystals. The 'star-burst' inclusion in Fig 6 appears to be a set of crystals radiating in many directions from a common point. However, the side view reveals that the crystals only radiate above the plane between the colour zones. The positions and general orientations of the crystals in the stone indicate that the crystal occurrences were connected with the local growth conditions. The identities of the crystal inclusions remain unknown since it was not possible to analyse them.
4) Fine dust-like flux, which consists of some 'dot-dot-dot' formations, tends to be oriented perpendicular to the coloured growth zones. This gives the effect of a general orientation of the dust-like flux throughout the stone (Fig. 7).

Conclusions

The refractive indices, the double refraction, and the specific gravity for this synthetic emerald accord to the values for other synthetic emeralds grown by flux-melt methods, as well as being similar to the values recorded for another Seiko synthetic emerald(1). In common with many flux grown synthetic emeralds the approximate determination of the density of a loose stone using heavy liquids proves a useful means of checking whether a suspect emerald might be a Seiko synthetic, especially if it is impossible to obtain the refractive indices.

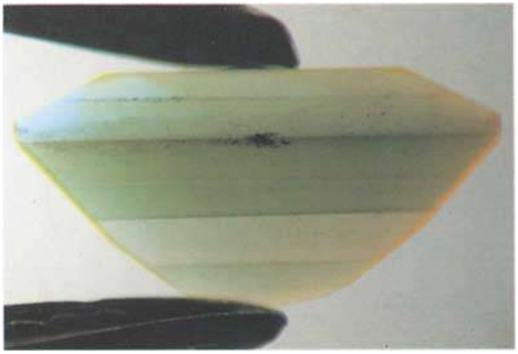

Fig. 3. Coloured growth bands in Seiko synthetic emerald, immersed in benzyl benzoate (length of stone, 4.94 mm).

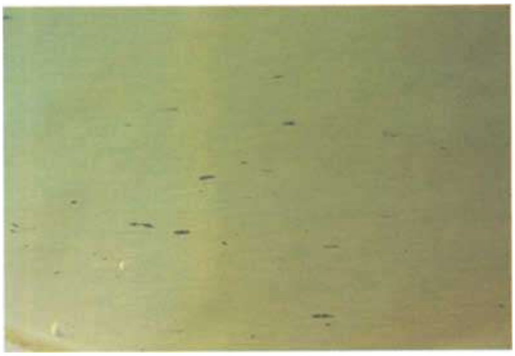

Fig. 4. Roughly rectangular inclusions of flux oriented in one direction within a Seiko synthetic emerald (approx. 60x magnification).

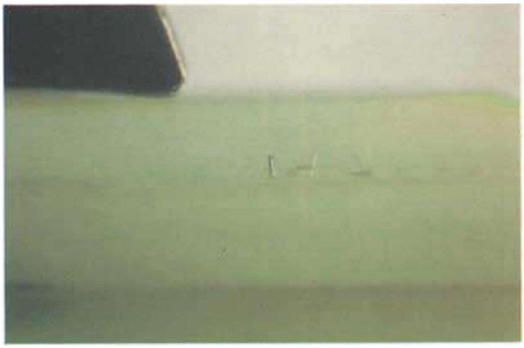

Fig. 5. Crystals in a Seiko synthetic emerald immersed in benzyl benzoate (approx. 60x magnification). This side view shows the association of the crystals with a plane between the coloured growth zones.

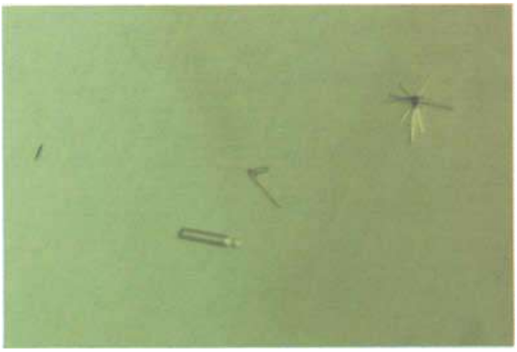

Fig. 6. 'Star-burst' cluster of crystals, a conjunction of two crystals, and a 'two-phase like' crystal in a Seiko synthetic emerald immersed in benzyl benzoate (approx. 100x magnification).

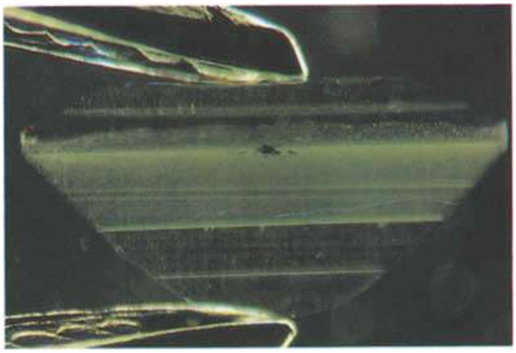

Fig. 7. Fine dot-like flux oriented perpendicular to the coloured growth zones in a Seiko synthetic emerald immersed in benzyl benzoate (length of stone 4.94 mm).

The careful measurement of the refractive indices or a specific gravity determination should differentiate this synthetic emerald from any natural emerald(5). The identification would be completed by observing the emerald absorption spectrum and examining the stone for the presence of any of the recognizable synthetic-type inclusions already described.

Acknowledgements

On behalf of the laboratory the author acknowledges the gift of the synthetic emerald from Mr K. Yamashita on behalf of the Suwa Seikosha group of companies. The author also acknowledges the help of Mr K. Scarratt and Mr E.A. Jobbins in the composition of this article.

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An andalusite anomaly

R. Keith Mitchell, F.G.A.

Every mineralogical textbook I have consulted describes the crystal habit of andalusite unequivocally, and it would seem to be one of most invariable of minerals in this respect. A visit to one of the great museum collections will underline this seemingly inflexible characteristic, for every crystal of this mineral will be found to be in the habit of an almost square orthorhombic prism, usually with broken ends, but when terminated, with the basal pinacoid prominently developed, or perhaps a well-developed simple dome form with the pinacoid as almost a knife-edge. The actual angle between the prism faces is 89° 12′, so close to 90° that only the keenest of eyes would detect the difference in even the best developed crystal.

Well-developed gem-quality crystals of this mineral seem to be quite rare and a water-worn specimen received some twenty years ago from a friend in Ceylon was greeted with some delight. This stone was confirmed beyond all doubt by SG and other tests to be andalusite, and had come from Ceylon gem gravels. But it lacked the requisite 'square prism' habit. This stone is illustrated on the right in Fig. 1.

Fig. 1 Andalusite crystal, Brazil, 8.19 ct (left); water-worn crystal, Sri Lanka, 9.75 ct (right); crystal showing common 'square prism' habit (bottom).

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Fig. 2 Detail of Brazilian andalusite crystal with mm scale.

Then earlier this year Mr C.R. Cavey showed me a euhedral crystal of this mineral which had come from Minas Gerais in Brazil, and which has most of its faces intact apart from minor etching. This is the left-hand crystal in Fig. 1. It will be seen that these two crystals are closely similar in habit. The third specimen in this picture is andalusite in the conventional 'square prism' habit, lying on its side.

Fig. 2 gives an enlarged picture of the Brazilian crystal, which emphasizes the unorthodox habit. Indeed it looks almost monoclinic and it does not take much imagination to see that the Ceylon stone seems to be similarly restricted in symmetry. I am assured that both crystals do, in fact conform to the accepted crystal structure of andalusite, so the discrepancy is apparent rather than real. But I am left wondering at this unusual habit being found in two widely different parts of the world and yet going unrecorded in the highly authoritative mineralogies.

Acknowledgements

I wish to acknowledge the kind help of Dr Roger Harding of The Geological Museum, who arranged for the morphology of these stones to be investigated and for the two photographs which were the skilful work of Mr Frank Greenaway of the British Museum (Natural History).

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An improved sample holder and its use in the distinction of natural and synthetic ruby as well as natural and synthetic amethyst

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Abstract

An improved sample holder for the gem microscope and its application to problems of the distinction of natural and synthetic rubies and amethysts are described. The basic principle of the sample holder is a combination of a vertical and a horizontal rotation axis. Furthermore, the vertical axis is supplied with a dial having a 360° subdivision. Using this new sample holder the optic axis of a cut gemstone is placed parallel to the microscope axis without having problems, and the determination of angles between structural elements, e.g. between crystal faces, is possible.

Diagnostic criteria useful for a distinction between natural and synthetic rubies are derived from the determination of families of straight parallel growth planes and angular growth banding formed by two families of growth planes. Under crossed polarizers, natural and synthetic amethysts show characteristic interference figures which are also useful for determinative purposes.

Introduction

For the microscopic investigation of gemstones using the horizontal microscope in order to facilitate the application of an immersion cell and immersion liquids, in general, a sample holder is used which has only one vertical rotation axis. The sample under investigation is rotated about this vertical axis through the full angle of 360°. The possibility of the investigation of inclusions is limited in those directions in which the field of view is hidden by the sample holder, e.g. by the crocodile clips, normally used. This disadvantage of the horizontal microscope is partly compensated for by a special sample holder described by Yu (1983), which allows the investigation of inclusions in a cut gemstone during almost the full angle of 360° using the conventional vertical rotation axis.

In order to investigate the inclusions in a cut gemstone in different directions of view, it is necessary to remove the sample from the holder and to place the object under investigation after its rotation back into the sample holder again. According to the geometrical properties of the cut gemstone distinct directions of view in connexion with a 360° rotation about the vertical axis are easily accomplished. In other words, a cut gemstone is easily placed in distinct orientations into the conventional sample holder, e.g. the gem is held by the crocodile clips between its table and culet or at the girdle. However, additional and different orientations of a cut gemstone are very difficult to obtain. Due to this fact, it is very time consuming or sometimes even impossible to adjust the optic axis of a normally faceted gemstone parallel to the microscope axis. The recognition of structural properties, e.g. the exact determination of growth planes, and the verification of the applicability of growth features to a distinction between natural and synthetic gemstones is practically impossible with the conventionally used gem holders.

The development of an improved sample holder was initiated during the investigation of cut flux-grown synthetic rubies of different producers using the gem microscope with a conventional sample holder, in connexion with the determination of crystal faces of rough flux-grown samples of the same producers using a two-circle reflecting goniometer. At present, the recognition of cut flux-grown rubies and the distinction of flux-grown samples from natural rubies is thought to be one of the greatest problems in gemmology. During the investigation of the above mentioned rough crystals of flux-grown ruby it was realized that depending on the producer and the flux material used during crystal growth a characteristic morphology was developed for the crystals investigated. In addition,

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it was realized that distinct crystal faces, which are common in natural ruby (and corundum) were never found in the commercially available flux-grown samples investigated. Furthermore, some distinct crystal faces, which were seldom found in natural crystals, are frequently observed in synthetic rubies of the trade. From these experimental results the question arose, whether these observations were also verifiable in cut rubies and, in addition, if some criteria useful for a distinction between natural and synthetic rubies were derivable from these experimental results.

In the present paper the new improved sample holder is first described. Furthermore, the data of flux-grown and natural rubies, which are easily available by use of the newly developed equipment, are discussed in order to verify a possible application for the distinction of natural and synthetic rubies. Another field of application for the new sample holder is the distinction of natural and synthetic amethyst which is also discussed in this paper.

It is worth mentioning that the criteria for the distinction of natural and synthetic gem materials which are discussed in this paper should be taken as additional possibilities for determinative purposes and supplementary to the conventional methods of microscopy and spectroscopy and *not* as a substitutional method. By the application of the new sample holder for determinative purposes characteristic data useful for a distinction between natural gemstones and their synthetic counterparts are available for a great percentage of samples. However, the data available for distinct samples of the red corundum variety ruby and the violet quartz variety amethyst (as well as for heat-treated amethyst, the so-called citrine) may not be diagnostic for every single sample of these important gem varieties. In other words, the data of some samples may be typical for both natural and synthetic samples and, therefore, are sometimes not useful for determinative purposes. These data, which are typical for both natural and synthetic gem materials, are also discussed in detail.

Description of the improved sample holder for microscopic investigations of gemstones

The most important supplementary alteration of the improved sample holder* (Fig. 1) is the introduction of a second horizontal rotation axis (a) in addition to the normally used vertical rotation axis (b). By use of this new axis which is connected with a set screw, a rotation of the sample about the horizontal axis, through an angle up to about ±40° is practicable. It is self-evident, that the object under investigation may have to be focused again in the microscope and that, in addition, a small displacement of the immersion cell could be necessary at rotation angles above 30°. In general, by this additional possibility of rotation the optic axis of a cut gemstone is found in the gem microscope without problems (Figs. 2–5), starting with different orientations of the cut gemstone held in the gem holder by use of the crocodile clips. These orientations are normally determined by the cut of the gemstone, i.e. the gemstone is held between the table and the culet or in various positions at the girdle. Further additional equipment of the new sample holder is a dial having a 360° subdivision (c) which is attached to the conventional vertical axis. In addition, it is possible to attach a small indicator with set screw (d) to the 360° dial. By use of this equipment the angle between two structural properties of a gemstone, e.g. the angle between the optic axis and a distinct growth plane is measured.

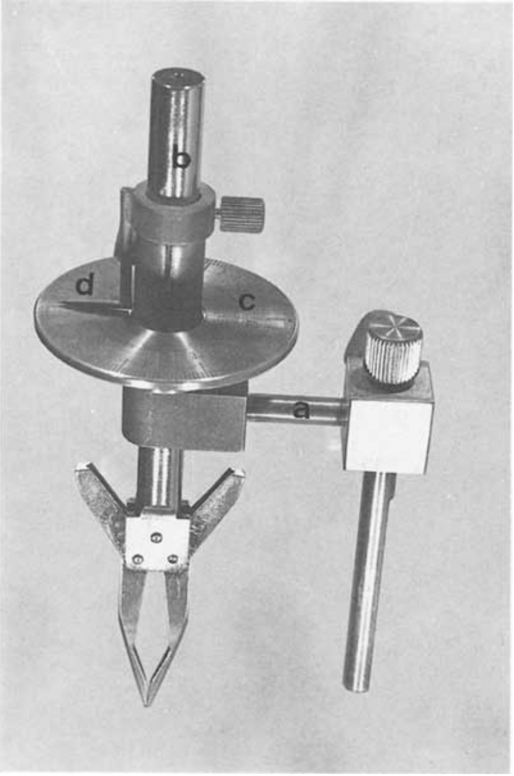
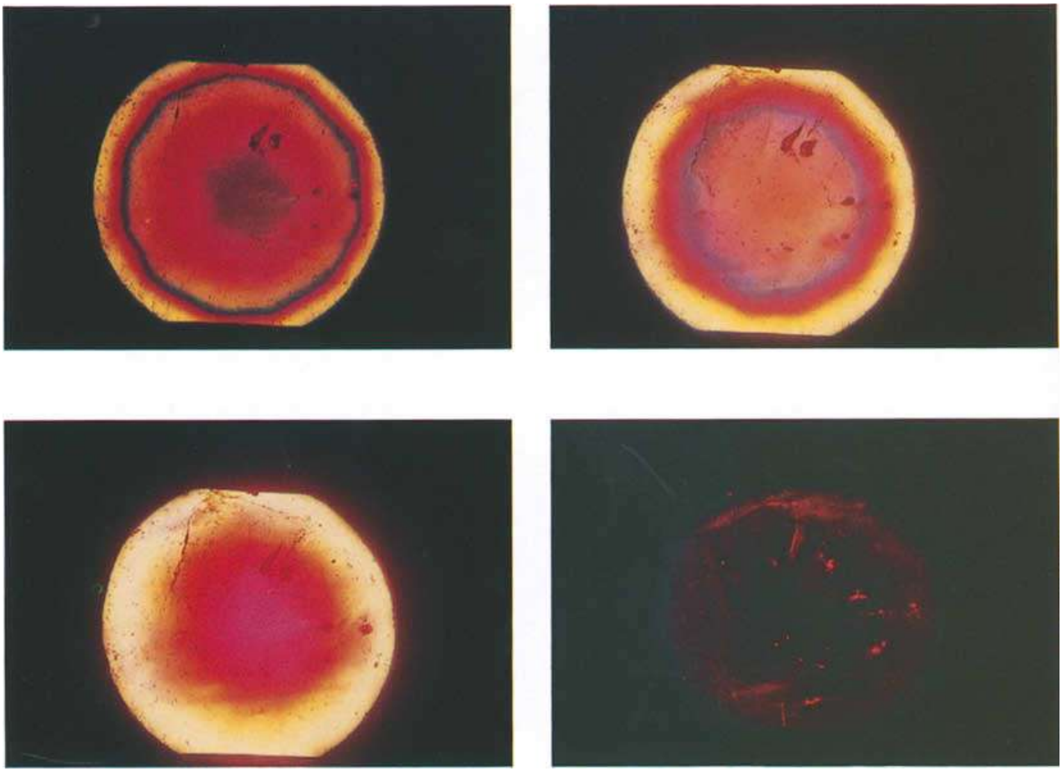


Fig. 1. Improved sample holder for the horizontal microscope (gem microscope with immersion cell); (a) horizontal rotation axis with set screw, (b) vertical rotation axis, (c) dial with 360° subdivision, (d) indicator with set screw.

*The new sample holder described in this paper is commercially available from Hans-Günter Schneider, Dietzenstr. 41, D-6580 Idar-Oberstein.



Figs. 2–5. This series describes the variation of interference figures of corundum (Burmese ruby) during a slight rotation of the stone; in Fig. 2 the angle between the optic axis and the microscope axis is about 30°; tilting of the corundum crystal slowly towards positions, in which the angles between optic axis and microscope axis is diminished moves the interference rings towards the centre (Figs. 3 and 4); in Fig. 5 the optic axis is exactly parallel to the microscope axis; further tilting of the corundum crystal slowly towards positions in which the angles between optic axis and microscope axis is enlarged moves the interference rings towards the rim of the interference figure – x pol., 60x.

Applications of the new sample holder

In this paper the applications of the new sample holder to the distinction of natural and synthetic flux-grown ruby as well as natural and synthetic amethyst are described in detail. However, the use of the improved sample holder for routine gemmological investigations is also recommended because of the general enlargement of the field of view by the additional rotation axis. With this additional degree of freedom routine microscopic investigations, i.e. the determination of structural properties and inclusions in gemstones, become much easier.

Distinction of natural rubies and flux-grown synthetic rubies

At present, the recognition of the commercially available types of flux-grown rubies produced by Chatham (Chatham synthetic ruby), Ardon Associates (Kashan synthetic ruby), Knischka (Knischka synthetic ruby), and J.O. Crystals (Ramaura synthetic ruby) is one of the greatest problems of determinative gemmology. The synthetic rubies mentioned above, in general, may have inclusions consisting of feathers with residues of the flux material used in crystal growth (cf. Table 2). In some cases, these feathers are not distinguishable from healing feathers of natural rubies due to their almost identical visual appearance in the gem microscope. In addition, the flux-grown types of commercially produced rubies may show growth features consisting of straight parallel growth bands and even sets of straight growth bands that form an angle. Some years ago, these types of structural properties were taken as indications of undoubted natural origin for unknown samples which were submitted for determinative purposes to gemmological laboratories.

The habit of natural corundum crystals including its red gem variety ruby, in general, is dominated by a number of different crystal forms which are shown in Table 1. These are combinations of the basal pinacoid c (0001) with the second-order hexagonal prism a (11$\bar{2}$0), the positive rhombohedron r (10$\bar{1}$1) as well as different second-order hexagonal dipyramids (cf. Goldschmidt, 1918; Niggli, 1927; Palache *et al.*, 1944). The negative rhombohedron d (01$\bar{1}$2), on the other hand, is developed in natural corundum crystals quite rarely and, if developed, this subordinate crystal form is found in very small faces only and, therefore, the negative rhombohedron is of no importance for the habit of natural crystals. In contrast, the habit of the commercially available gem rubies of the above-mentioned producers is dominated by a more limited number of different crystal forms. A characteristic combination of crystal forms which are typical for every producer (Table 2) was found during the determination of the crystal faces of more than 50 rough crystals with an optical two-circle reflecting goniometer. The predominant crystal faces of synthetic flux-grown ruby are represented in the idealized drawing of Fig. 6. It is important to mention that the second-order hexagonal prism a (11$\bar{2}$0) was never found in rough crystals of the four most important producers. The negative rhombohedron d (01$\bar{1}$2), which is a subordinate crystal form in natural corundum (if present at all), was found to be a predominant form in samples of Chatham synthetic ruby, Knischka synthetic ruby and Ramaura synthetic ruby. Three crystal forms, which are predominant in natural ruby, were also determined by the two-circle goniometer as predominant forms in synthetic rubies, the basal pinacoid c (0001), the positive rhombohedron r (10$\bar{1}$1) and the second-order dipyramid n (22$\bar{4}$3).

The morphological properties of natural and synthetic rubies are reflected by the internal structure of the crystals, i.e. by straight parallel growth bands visible in natural and synthetic gem rubies by the horizontal microscope in immersion liquid. An exact determination of the angular position of parallel growth planes in ruby vs. the optical axis of the crystal is achievable by use of the new improved sample holder with simple practical training. Please refer to Fig. 7. As a first step, the optic axis of the ruby under investigation is orientated to be coincident with the direction of view (microscope axis) using both the horizontal and vertical axes of the sample holder. By using crossed polarizers in the gem microscope, interference figures consisting of coloured interference rings are observed. Tilting the corundum crystal towards a position in which the angle between the optic axis of the sample and the microscope axis is diminished, the interference rings move towards the centre of the interference figure. If the angle between the optic axis of the ruby and the microscope axis is enlarged, the interference rings move towards the rim of the interference figure (Figs. 2–5). After having placed the optic axis in the best achievable position, the indicator attached to the dial of the vertical axis is fixed to 0° by use of the set screw. In a second step of the procedure, the sample is rotated about the vertical axis towards a position, in which sharp parallel growth planes are observed in the microscope, i.e. towards a position in which sharp traces of the growth planes become visible in the gem microscope. By use of the rotation angle δ, which is now readable on the graduated dial, the growth plane under investigation is exactly determined (Table 1). The schematic drawing of the situation is given in Fig. 7., the rotation angle δ is defined as the angle formed by the optic axis of the corundum crystal and the trace of any single growth plane of the crystal.

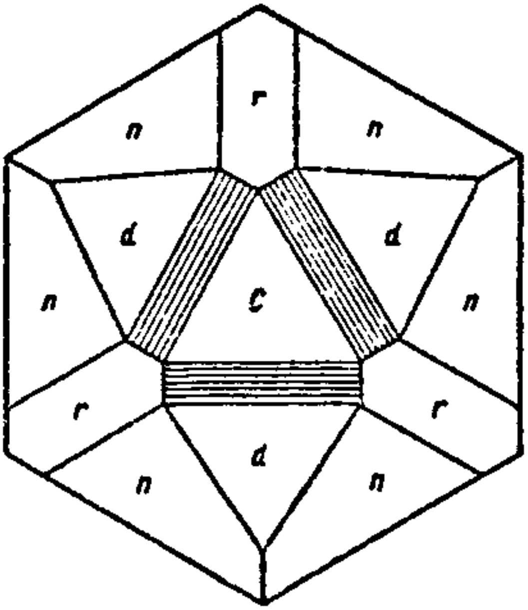


Fig. 6. The most important faces of synthetic corundum: basal pinacoid c (0001), positive rhombohedron r (10$\bar{1}$1), negative rhombohedron d (01$\bar{1}$2) and second-order hexagonal dipyramid n (22$\bar{4}$3); the crystal is viewed in a direction down the c-axis (optic axis); from Timofeeva & Luk'yanova, 1967.

The recognition of families of straight parallel growth planes which are parallel to crystal faces, and growth planes which do not appear in synthetic rubies of commercial productions, e.g. straight parallel growth planes of the second-order

Table 1. Crystal faces and angles of corundum

Name	Designation	hkl*	angle between c-axis and crystal face (rotation angle δ)**
basal pinacoid	c	(0001)	90°
second-order hexagonal prism	a	$(11\bar{2}0)$	0°
positive rhombohedron	r	$(10\bar{1}1)$	32.4°
negative rhombohedron	d	$(01\bar{1}2)$	51.8°
negative rhombohedron	γ	$(01\bar{1}5)$	72.5°
important second-order hexagonal dipyramids	n	$(22\bar{4}3)$	28.8°
	w	$(11\bar{2}1)$	20.1°
	v	$(44\bar{8}3)$	15.4°
	z	$(22\bar{4}1)$	10.4°
	ν	$(44\bar{8}1)$	5.2°
	ω	$(14\ 14\ \overline{28}\ 3)$	4.5°

*based on the morphological cell with a:c = 1:1.365
**cf. Fig. 7

angles between crystal faces (cf. Figs. 7 and 8)

faces	interfacial angle φ	angle made by the two faces φ'
r∧r'	93.9°	86.1°
n∧n'	52.0°	128.0°
a∧a'	60.0°	120.0°
r∧n	26.0°	154.0°
d∧n	32.0°	148.0°
r∧d	47.0°	133.0°

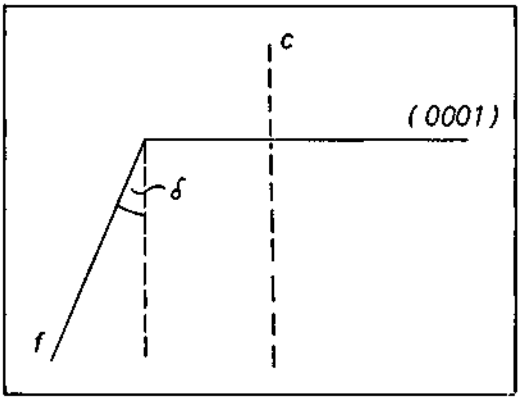


Fig. 7. The determination of growth planes in corundum using the angle between optic axis of the crystal and growth plane; (0001) basal pinacoid, c optic axis, f crystal face or growth plane, δ rotation angle.

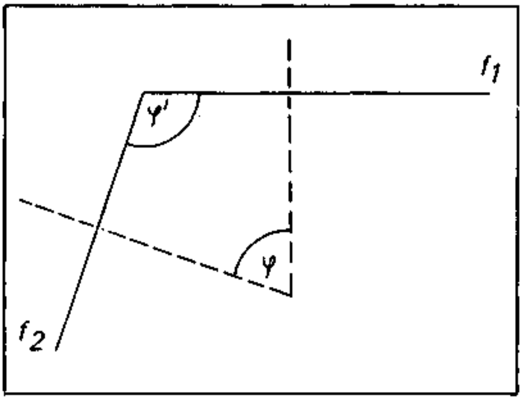


Fig. 8. Straight growth planes that form an angle; f_1 and f_2 growth planes, φ interfacial angle, φ' angle made by the two faces.

Table 2. Crystal forms of synthetic corundum

Producer/trade name	flux*	predominant forms	subordinate forms	frequently observed angular growth bands	twinning* c = common r = rare
Chatham Created Gems of San Francisco, USA (Chatham synthetic rubies)	Li_2O-MoO_3-PbF_2 and/or PbO_2	c, r, d, n		(r, n) (n, n') (d, n)	$(10\bar{1}1)$ r $(10\bar{1}0)$ c
Ardon Associates of Dallas, USA (Kashan synthetic rubies)	Na_3AlF_6	c, r, n		(r, n) (n, n')	$(10\bar{1}1)$ c
P.O. Knischka of Steyr, Austria (Knischka synthetic rubies)	Li_2O-WO_3-PbF_2 and/or PbO_2	c, r, d, n, Y	$(10\bar{1}9)$**	(r, n) (n, n')	
J.O. Crystals of Redondo Beach, USA (Ramaura synthetic rubies)	Bi_2O_3-La_2O_3-PbF_2 and/or PbO_2	c, r, d	n	(r, r') (r, d)	$(10\bar{1}0)$ r

* after Schmetzer (1985)

** after Knischka & Gübelin (1980)

hexagonal prism as well as growth planes parallel to different second-order hexagonal dipyramids with the exclusion of n ($22\bar{4}3$), strongly indicates rubies of natural origin. On the other hand, the recognition of families of straight parallel growth planes which are parallel to the negative rhombohedron d ($01\bar{1}2$), or parallel to the negative rhombohedron Υ ($01\bar{1}5$) have to be taken as an indication for a synthetic gemstone of one of the commercial productions. Families of growth planes parallel to the positive rhombohedron ($10\bar{1}1$) and parallel to the second-order hexagonal dipyramid n ($22\bar{4}3$) are common in synthetic rubies. However, the recognition of one single family of growth planes parallel to the aforementioned faces alone is of no diagnostic value, because straight parallel growth planes of r and n faces were occasionally observed in natural gem rubies also.

By the investigation of growth planes it is possible to recognize single planes parallel to prism faces in some of the commercially available synthetic rubies also. However, this structural feature, which is often found in Chatham synthetic rubies, is not a single growth plane but a twin boundary (Table 2). This single plane (twin boundary) is quite different in its appearance in the gem microscope from a family of straight parallel growth planes. However, it is important to avoid confusing these two structural properties.

Under these preconditions it is possible to discuss the applicability of angular growth banding in synthetic flux-grown rubies for diagnostic purposes. Parallel growth planes which do not intersect were often described in flux-grown rubies of commercial productions. These growth bands, however, were, until now, assumed not to be of diagnostic value. In particular, families of parallel growth bands that form an angle were taken as identical in natural and synthetic ruby and not diagnostic (cf. Crowningshield, 1969–1970; Kane, 1979, 1983; Knischka & Gübelin, 1980; Gübelin, 1982 a,b). The samples of natural and synthetic ruby which were investigated for this paper, however, strongly indicate distinct differences between families of parallel growth planes that form an angle. Families of parallel growth planes that form an angle of 120°, which are parallel to two distinct faces of the second-order hexagonal prism a ($11\bar{2}0$), are found to be common in natural rubies of different localities (Figs. 8–10). Characteristic growth planes that form an angle are summarized for synthetic rubies in Table 2. The angle made by the two faces in synthetic rubies (cf. Table 1) is different from 120° (Figs. 8, 11–15). Growth structures of this type might be observed only quite rarely in natural rubies. On the other hand, this type of growth structure is common in synthetic rubies of commercially available productions. The recognition of families of growth planes that form an angle different from 120°, i.e. the angle is not formed by families of growth planes parallel to the prism a ($11\bar{2}0$), though not unambiguous, could be used as a hint towards synthetic ruby. The recognition of one of these structural features in a ruby, which is assumed to be of natural origin, strongly indicates further investigations in order to find properties which unambiguously solve the problem. In other words, structural features as described above in a sample which is not confirmed as natural by other characteristic properties, strongly indicate great caution because they are typical and common for synthetic stones.

It has to be underlined that the determination of growth planes in rubies of unknown origin with the method described in this paper should be used as an additional investigation supplementary to the routine methods which, in general, are applied to unknown samples of this type in order to prepare certificates for the stones. The possibility of giving general and simple determinative properties, which

Fig. 9. Families of straight parallel growth planes that form an angle, Kenya ruby; planes parallel to prism faces a ($11\bar{2}0$) form an angle of 120°. – 14x.

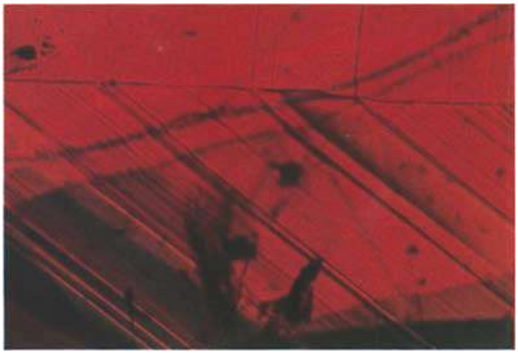


Fig. 10. Families of straight parallel growth planes that form an angle, ruby from Sri Lanka; planes parallel to prism faces a ($11\bar{2}0$) form an angle of 120°. – 35x.

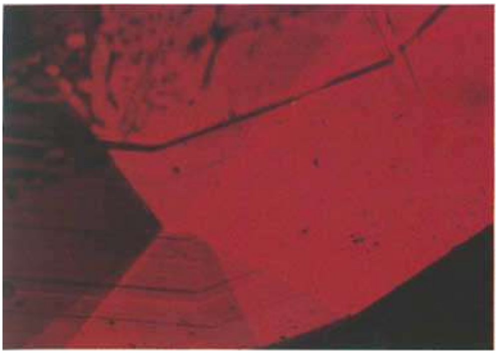


Fig. 11. Families of straight parallel growth planes that form angles, Chatham synthetic ruby; planes parallel to n $(22\bar{4}3)$, r $(10\bar{1}1)$ and n' $(22\bar{4}3)$ form two angles of 154.0°. – 35x.

Fig. 12. Families of straight parallel growth planes that form an angle, Chatham synthetic ruby; planes parallel to d $(01\bar{1}2)$ and n $(22\bar{4}3)$ form an angle of 148.0°. – 45x.

Fig. 13. Families of straight parallel growth planes that form an angle, Kashan synthetic ruby; planes parallel to r $(10\bar{1}1)$ and n $(22\bar{4}3)$ form an angle of 154.0°. – 28x.

Fig. 14. Families of straight parallel growth planes that form angles, Knischka synthetic ruby; planes parallel to n $(22\bar{4}3)$, r $(10\bar{1}1)$ and n' $(2\bar{2}\bar{4}3)$ form two angles of 154.0° (upper part of the photograph, representing the centre of the crystal); planes parallel to n and n' form an angle of 128.0° (lower part of the photograph, representing the rim of the crystal). – 38x.

Fig. 15. Families of straight parallel growth planes that form an angle, Ramaura synthetic ruby; planes parallel to r and r' $(10\bar{1}1)$ form an angle of 86.1°. – 40x.

are found either in natural rubies from different localities or in synthetic rubies of different producers, is more and more diminished with the appearance of every new type of synthetic ruby. The method for a distinction of natural and synthetic ruby using absorption spectroscopy in the ultraviolet region as described by Bosshart (1981, 1982), for example, was not applicable to the recently produced Ramaura synthetic rubies (Bosshart, 1983). This type of synthetic ruby, however, very frequently shows families of straight parallel growth planes that form an angle of 86.1° (Fig. 15) consisting of two families of growth planes parallel to the predominant positive rhombohedron (r, r′). This structural feature, at present, was neither observed in other synthetic rubies nor in natural stones by the author. In addition, the presence of parallel growth planes parallel to n $(22\bar{4}3)$ in an unknown sample under consideration strongly indicates that the stone is not a Ramaura synthetic ruby.

For the determination of rubies of unknown origin the investigation by conventional microscopic techniques, and the investigation of the absorption spectrum in the ultraviolet region is suggested in addition to the determination of growth features which are described in this paper. By a combination of all methods mentioned an almost complete set of data should be available which enables an unambiguous determination of an unknown sample.

A further possible application of the new sample holder is the distinction of natural and synthetic yellow corundum. Curved growth bands are known to every gemmologist from the investigation of synthetic Verneuil-grown ruby. In synthetic Verneuil-grown yellow corundum, however, these bands are developed very weakly or are not even recognizable by use of the gem microscope. An unambiguous criterion for Verneuil-grown sapphire, however, is the presence of glide planes parallel to the prism a $(11\bar{2}0)$, which are long known in gemmology under the designation Plato lines (cf. Schmetzer, 1985). Plato lines are described as families of intersecting structural planes parallel to the prism face that form an angle of 120°. In order to recognize glide planes in cut samples of doubtful origin it is important to place the optic axis of the sample exactly parallel to the microscope axis using immersion liquid and crossed polarizers. This optical orientation is very easily achievable with the horizontal and vertical axes of the new sample holder. Using the conventional type of sample holder with a vertical axis only, the orientation of the cut sample which is necessary for the recognition of glide planes (Plato lines) is very time consuming and often impossible.

Distinction of natural and synthetic amethysts

The efficiency of several experimental methods suggested for a distinction of natural and synthetic amethyst is discussed in great detail by Lind *et al.* (1983, 1985). The investigation by the gem microscope shows a number of characteristic properties which are recognized in a great percentage of natural amethysts:

- Sharp lamellar structures connected with a distinct colour zoning were, in general, observed parallel to several rhombohedral faces of the cut amethyst crystal.
- Feathers consisting of fluid inclusions and two-phase inclusions, frequently in the form of negative crystals, are common in natural amethyst.
- Mineral inclusions were determined as reddish-brown or black Fe-oxides or Fe-hydroxides.

These properties are used as criteria which indicate amethyst crystals of natural origin. In synthetic amethysts residues of the seed were determined occasionally. In some stones colour zoning consisting of broad bands parallel to one single rhombohedral face, i.e., parallel to the seed used in crystal growth was observed (cf. Lind *et al.*, 1983, 1985). In 1983, Schneider & Dröschel pointed out that a diagnostic polysynthetic twinning on the Brazil law is found in natural amethysts. In contrast, synthetic amethysts of the trade were determined as untwinned single crystals. Unfortunately, the possibility of recognition of an optic axis figure indicating polysynthetic twinning by use of the conventional conoscope is strongly dependant on the direction of the optic axis versus the table of the cut gemstone. Furthermore, natural amethyst crystals generally consist of twinned and untwinned growth sectors, which reduces the applicability of the method (compare a more detailed discussion in the papers of Lind *et al.*, 1983, 1985). The revealing of a finger-print pattern by a repolishing procedure which is interpreted by Schneider & Dröschel (1983) to be due to the bringing-out the lamellar repeated twinning, certainly needs a skilled investigator and two distinct steps of polishing.

The disadvantages in the distinction of natural and synthetic amethysts using the methods mentioned above, which are based on polysynthetic twinning in natural amethyst, are avoidable by the application of the improved sample holder which is described in this paper. With this sample holder polysynthetic twinning is observable in the gem microscope independent of the orientation of the optic axis versus the table of the cut stone and without an additional repolishing procedure.

In order to understand the diagnostic properties of polysynthetically twinned natural amethyst

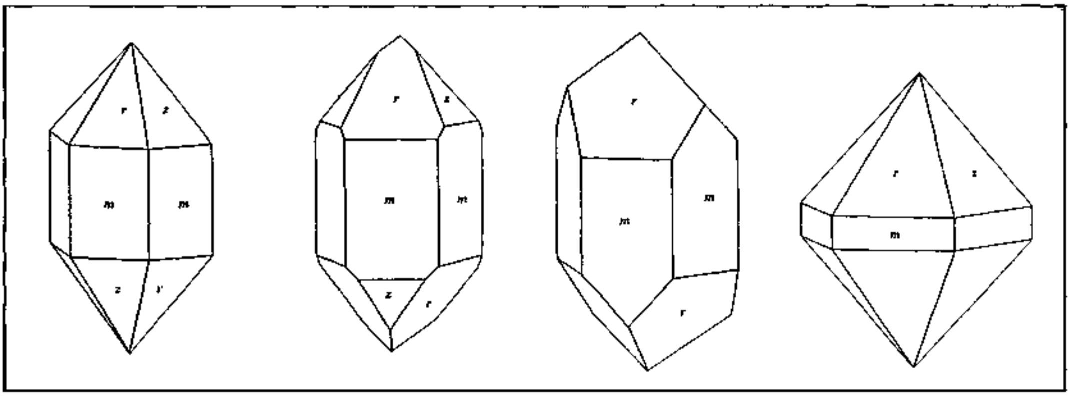


Fig. 16. The characteristic habit of quartz crystals with prism m (10$\bar{1}$0) in combination with the major rhombohedron r (10$\bar{1}$1) and the minor rhombohedron z (01$\bar{1}$1) as dominant forms; from Frondel, 1962.

crystals which are observable by use of the gem microscope, a short description of twinning in natural amethyst is given before the typical interference figures which are presented in this paper. The habit of natural amethyst is characterized generally by the major rhombohedron r (10$\bar{1}$1), the minor rhombohedron z (01$\bar{1}$1) and the prism m (10$\bar{1}$0). The size of both rhombohedral faces, r and z, is different in crystals from various localities (Fig. 16). In a part of the natural amethyst crystals, the major rhombohedron r is dominant over the minor rhombohedron z; in other amethyst crystals both crystal forms are almost identically developed. In addition, a part of the natural amethyst crystals is more or less of distorted habit. In order to understand the observations in the gem microscope it is important to mention that, in general, the sectors confined to the major rhombohedron r (10$\bar{1}$1) consist of polysynthetically twinned lamellae of alternating right-handed and left-handed quartz. The sectors confined to the minor rhombohedron z (01$\bar{1}$1), however, do not show this type of twinning on the Brazil law; only a single twin boundary entering each z growth sector is observed (Fig. 17). The structure of twin boundaries in natural amethyst which is polysynthetically twinned on the Brazil law is extremely complicated. A detailed description was recently published by McLaren & Pitkethly (1982). This paper is suggested for additional reading. The complex interference figures of natural amethyst, consisting of black extinction bands, are known since the extraordinary paper of Brewster (1823), and, therefore, are sometimes also designated Brewster fringes in the literature.

The investigation of polysynthetically twinned amethyst in polarized light under crossed polarizers reveals more or less broad, straight or even curved black interference fringes (extinction bands) provided that the optic axis of the amethyst is arranged exactly coincident with the microscope axis. The extinction bands were found to separate lamellae of right-handed and left-handed quartz. The fringes appear black because light travelling along the optic axis passes through almost equal distances of right-handed and left-handed quartz. This is due to the complicated zig-zag structure of the Brazil twin boundaries as described in detail by McLaren & Pitkethly (1982). For additional reading compare the papers of Brauns (1932), Frondel (1962), Schlössin & Lang (1965), Hassan (1972), Balakirev *et al.* (1975) and Balitsky (1981).

In order to recognize interference figures of polysynthetically twinned amethyst or interference figures of amethyst single crystals for diagnostic determinations, it is only necessary to place the optic axis of the sample coincident with the microscopic axis. This is accomplished using both the horizontal and vertical rotation axes of the improved sample holder. Under these preconditions, tilting the amethyst towards a position, in which the angle between the optic axis and the microscope axis is small, and tilting the crystal back towards the original position again, the interference figure of an amethyst single crystal is found to consist of interference rings moving towards the rim and back towards the centre of the interference figure again (Figs. 18 and 19, compare also the interference figures of corundum in this paper). The interference figures of amethyst single crystals are easily distinguished from interference figures of polysynthetically twinned amethyst crystals (Figs. 20–30). These interference figures of cut amethyst crystals are dependent on the development of growth sectors confined to the major rhombohedron r versus the development of growth

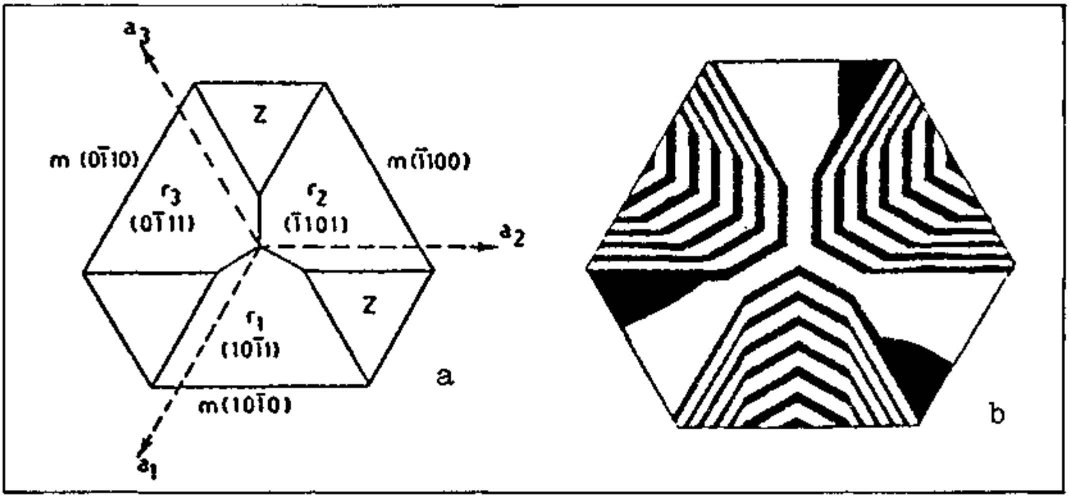


Fig. 17. Polysynthetic twinning in natural amethyst: a) amethyst crystal viewed in a direction parallel to the optic axis showing the major rhombohedron r and the minor rhombohedron z (from McLaren & Pitkethly, 1982); b) amethyst crystal viewed in a direction parallel to the optic axis showing polysynthetic twinning in sectors confined to the major rhombohedron with a single twin boundary entering each z growth sector; right-handed and left-handed quartz is white and black respectively (from Schlössin & Lang, 1965).

sectors confined to the minor rhombohedron z in the crystal under investigation. In addition, it is important from which part of the crystal the cut amethyst sample is originating. Furthermore, the relative distortion of an amethyst crystal may become important for the correct interpretation of the interference figure.

Most of the investigated natural amethyst crystals from different localities were found to be polysynthetically twinned on the Brazil law. Only few natural amethysts showed interference figures of quartz single crystals, e.g. some samples from Ceará, Brazil. These amethysts, however, were easily recognizable as natural samples due to solid state inclusions (reddish-brown Fe-oxides or Fe-hydroxides) in combination with a distinct colour zoning parallel to several rhombohedral faces. The investigated synthetic amethyst samples of commercial Japanese and Russian production, which are available to the author at present, were found to be single crystals not having the characteristic interference figures of polysynthetically twinned natural amethysts as described above. Only one sample of synthetic amethyst from Russian production showed twinning structures similar to a sample which was recently described by Balitsky (1981). In this type of synthetic amethyst a small part of the crystal consists of left-handed

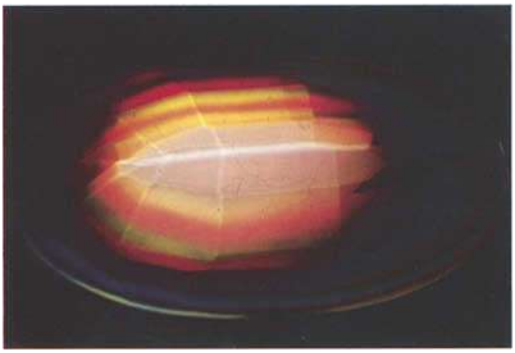


Fig. 18. Interference figure of an amethyst single crystal, the optic axis is nearly perpendicular to the table of the stone; synthetic amethyst of Russian production. – x pol., 12x.

Fig. 19. Interference figure of an amethyst single crystal, the optic axis is nearly parallel to the table of the stone; synthetic amethyst of Russian production . – x pol., 20x.

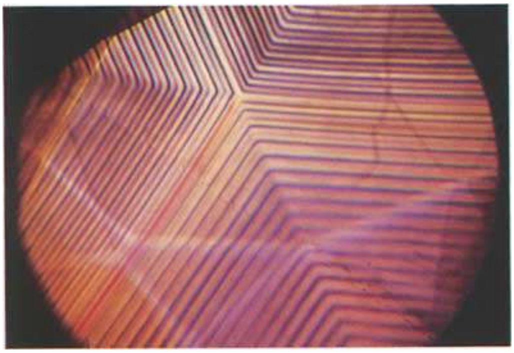


Fig. 20. Interference figure of a polysynthetically twinned natural amethyst, Zambia; twinning is observed in three sectors confined to the major rhombohedron. – x pol., 32x.

Fig. 21. Interference figure of a twinned natural amethyst, Zambia; twinning is observed in three sectors confined to the major rhombohedron. – x pol., 20x.

Fig. 22. Interference figure of a polysynthetically twinned natural amethyst, Montezuma, Brazil; twinning is observed in two sectors confined to the major rhombohedron, a single twin boundary entering one z growth sector. – x pol., 14x.

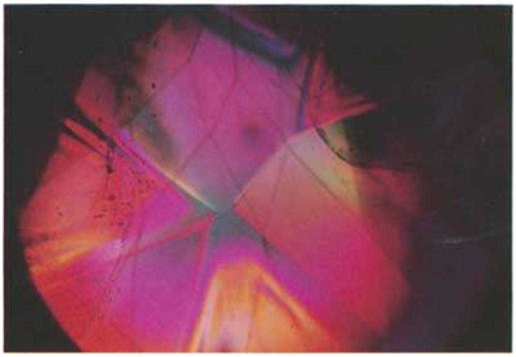


Fig. 23. Interference figure of a twinned natural amethyst, Zambia; twinning is observed only in sectors confined to the major rhombohedron and not in the sectors confined to the minor rhombohedron. – x pol., 20x.

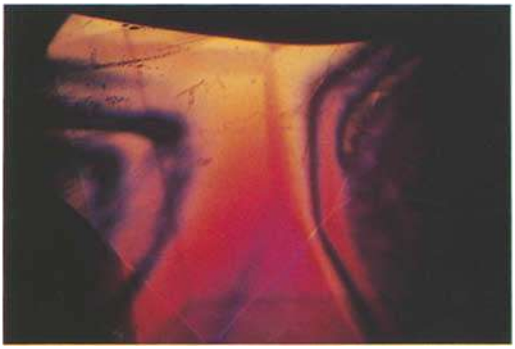


Fig. 24. Interference figure of a twinned natural amethyst, Uruguay; curved extinction bands. – x pol., 28x.

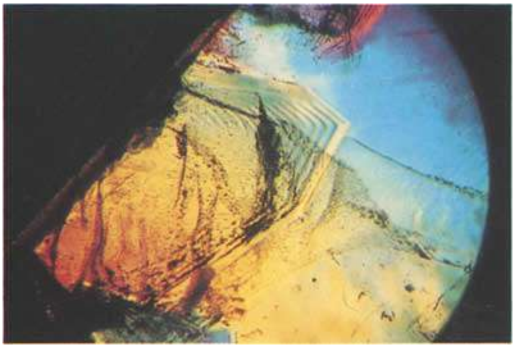


Fig. 25. Interference figure of a polysynthetically twinned natural amethyst, Jakobina, Brazil; twinning is observed in one sector confined to the major rhombohedron. – x pol., 25x.

quartz which is incorporated in a matrix of right-handed quartz in the form of thin triangular plates. Interference figures of samples having this type of twinning are distinctly different from the interference figures of natural amethyst crystals with polysynthetic lamellar twinning on the Brazil law.

The properties of natural and synthetic amethyst which are described in this paper should be taken as supplementary possibilities for a distinction of both types of gem materials. In general, in the opinion of the author, conventional microscopic investigation in combination with the study of the interference figure of a sample reveals enough information to separate natural and synthetic amethyst crystals. For those few samples, which cannot be determined by a combination of both microscopic techniques, infrared spectroscopy is suggested for further investigation (cf. Lind & Schmetzer, 1982, 1983). The study of interference figures is also applicable to the distinction of heat-treated natural amethyst, which is called citrine in the trade, and synthetic citrine crystals, which are also single crystals without a polysynthetic lamellar twinning on the Brazil law (cf. Balitsky, 1981).

Acknowledgements

Numerous ruby and amethyst samples, which were investigated in this paper, were kindly supplied by different firms in the gem trade as well as by private collectors. The comprehensive collections of Prof. Dr H. Bank of Idar-Oberstein, FRG, and of Dr R. Ledig of Stuttgart, FRG, were available for the present investigation. Additional samples were provided by Prof. Dr E. Gübelin of Meggen, Switzerland, and Dr H.A. Hänni of Basel, Switzerland. The author is grateful to the following firms of the gem trade including Gebr. Bank, Gebr. Goerlitz, Gebr. Henn, Gebr. Leyser, R. Litzenberger, J. Petsch, J.Ph. Wild, all of Idar-Oberstein, FRG, Karl Egon Wild of Kirschweiler, FRG, E. Blink of Pforzheim, FRG, and Dr Horst Krupp of Heidelberg, FRG. Gem materials which were not available in the gem trade were kindly given by the producers P.O. Knischka of Steyr, Austria, and T.H. Chatham of San Francisco, USA.

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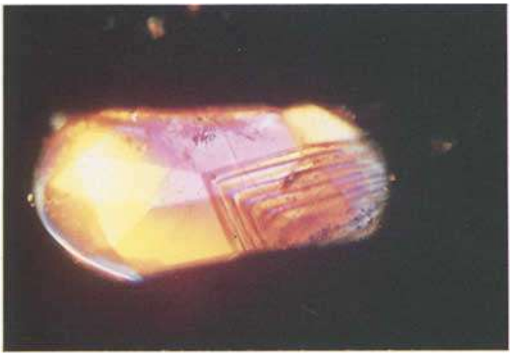

Fig. 26. Interference figure of a polysynthetically twinned natural amethyst, locality unknown; twinning is observed in one sector confined to the major rhombohedron. x pol., 24x.

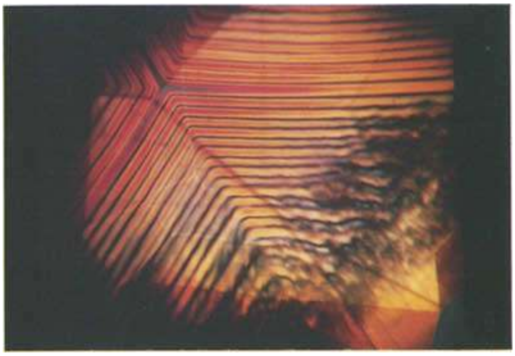

Fig. 27. Interference figure of a polysynthetically twinned natural amethyst, Area, Brazil; twinning is observed in three sectors confined to the major rhombohedron, in the right part of the crystal the straight parallel twin boundaries become irregularly curved lines. x pol., 20x.

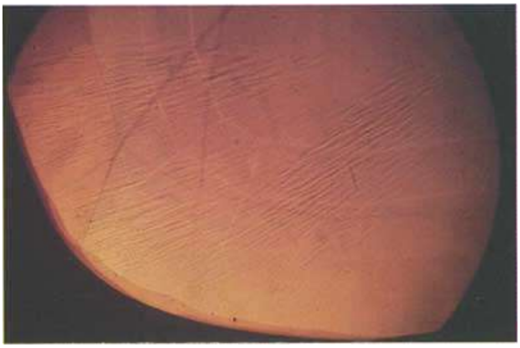

Fig. 28. In the area of Fig. 27 showing irregularly curved lines under crossed polarizers, without crossed polarizers an irregular growth structure is observed. – 28x.

Fig. 29. Interference figure of a twinned natural amethyst, Zambia; irregularly curved extinction bands. x pol., 20x.

Fig. 30. Interference figure of a polysynthetically twinned natural amethyst, Bahia, Brazil; irregularly curved extinction bands. x pol., 30x.

Accidental diamond coatings

Pamela J. Abramson, G.G.

Gemmologists who grade diamonds should be aware of unusual features that I noted recently while examining four diamonds. The four stones, set into two different rings, were in the estate of an elderly woman who had worn the rings constantly for over fifty years while she lived in Deland, Florida.

One diamond of 1.82 ct was set as a solitaire, and the other three stones, 1.23 ct, 1.53 ct, and 1.25 ct (all weights estimated by Leveridge method), were set side-by-side into the second ring. The first unusual feature of these stones was that they all fluoresced a brownish-yellow under short-wave ultraviolet light. The large solitaire showed a strong brownish-yellow fluorescence, while in the second ring the stones showed approximately the same brownish-yellow fluorescence although less intense.

Another unusual feature of the stones was that they showed evidence of a coating even though they had been thoroughly cleaned in a professional ultrasonic unit. At first I supposed that the coating had been nefariously applied, but then realized that it was too haphazardly placed for that to be the case and was most probably accidental. The coating looked like water spotting that had dried in a somewhat scalloped design around many of the facet junctions. Additionally, the coating in all cases covered the table completely.

Other features noted about the coating were: at certain places it seemed thicker than at others and in these thicker areas there was a tinge of a brownish-red colour; the coating could be scratched off with the metal tip of a pointer and had been scratched through wear especially on the tables. Looking through each of the stones, an effect very much like internal graining was quite evident.

With research I found the following information concerning accidental coatings in Eric Bruton's *Diamonds* (second edition, page 385):

> On very rare occasions a cut diamond acquires a coating by accident that depreciates its colour. One such case was reported by Robert Crowningshield, Director of the GIA Gem Trade Laboratory in New York, in 1966. An engagement ring with a stone of less than half a carat had become gradually yellow over eighteen months. Examination showed a brownish-yellowish coating that would not wash off. After treatment with hot acid, the original fine white colour was restored. The coating was apparently caused by the local iron-rich water.

Checking with the trust officer of the estate I found that the owner of the rings had worn them daily for many years in Deland, Florida, and had used well water at her home. Subsequent calls to State water management officials supplied the information that there indeed is a high level of iron in the well water of the Deland area.

Diamond graders and appraisers should be aware of this uncommon yet significant problem in determining colour grades of diamonds. Although I was not given permission to boil these diamonds in an acid bath in order to remove the coating, I am certain that colour grades would be improved with its removal. The most telling evidence of this, of course, is the fact that where the coating thickened a darker colour was quite visible.

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Notes from The Laboratory

K. Scarratt

British Gem Testing Laboratory of the London Chamber of Commerce and Industry

During the course of any one year anything between 80,000 and 150,000 pearls are submitted to the Laboratory for examination. Of these, approximately 80% are found to be natural pearls, and the remaining 20% cultured pearls. Imitation pearls are only rarely submitted. Insofar as our memory serves us, during at least the past ten years we cannot remember having seen pearls with internal structures similar to those depicted in the radiographs (Figs. 1 and 2) taken by Steve Kennedy.

Both radiographs are of single cultured pearls. One appears to show three separate nuclei (Fig. 1) i.e., two mother-of-pearl beads and a non-nucleated (tissue-nucleated) cultured pearl, inside the first pearl. The other (Fig. 2) shows two separate nuclei, both of which are non-nucleated (tissue-nucleated) cultured pearls, inside the second pearl.

Since recording these, we have seen further similar examples and are left wondering whether these pearls are the result of a deliberate culturing process, or whether they were just formed accidentally.

* * *

Some two years ago we were shown a transparent green idocrase by David Kent, F.G.A., which appeared to produce only a single shadow edge on the refractometer at 1.722. For the record, a scraping was taken from this stone to enable the production of an X-ray powder diffraction photograph, and the identification was confirmed. Few gemmological textbooks give the student of gemmology any warning that some idocrases have a very small measurable birefringence. Anderson(1) states, 'a very small double refraction' and gives a figure of 0.005, and Webster(2) does not mention birefringence in specific terms at all. G.F. Herbert Smith(3) on the other hand, states that the optical properties of idocrase are of 'unusual interest because of the remarkably small amount of double refraction displayed. It may be as little as 0.001 and rarely exceeds 0.010'.

In a parcel of three stones submitted to us for examination (Fig. 3) one, a 'pink' zircon, weighing just 0.26 ct was found to owe its colour to a stain which had penetrated its flaws. Another, which was also a small stone of just 0.35 ct, was found to be rutile, and the third, weighing 1.71 cts was found to

Fig. 1. Radiograph of a cultured pearl containing two mother-of-pearl beads and a non-nucleated (tissue nucleated) cultured pearl.

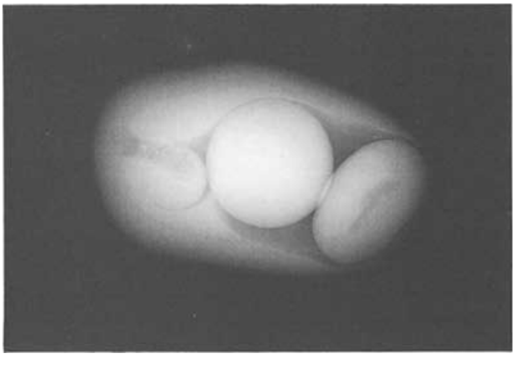

Fig. 2. Radiograph of a cultured pearl containing two non-nucleated (tissue nucleated) cultured pearls.

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Fig. 3. Rectangular natural rutile weighing 0.35 ct, round stained zircon weighing 0.26 ct, and an oval idocrase weighing 1.71 ct.

Fig. 5. A diamond-topped doublet set in a ring.

Fig. 6. Scratch marks seen in the plane of the girdle (junction plane) of the diamond-topped doublet depicted in Fig. 5.

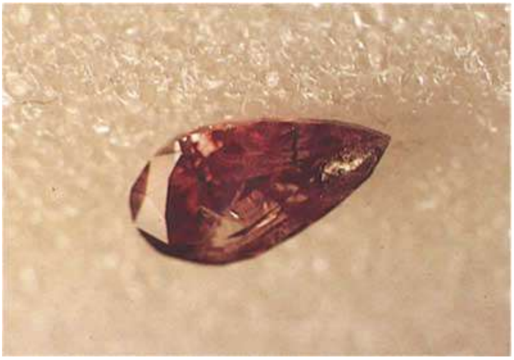

Fig. 8. A naturally coloured deep pinkish-mauve diamond weighing 0.76 ct.

Fig. 10. Three small haüynes weighing 0.152, 0.108 and 0.098 ct, and two larger sodalites, one oval and the other rectangular.

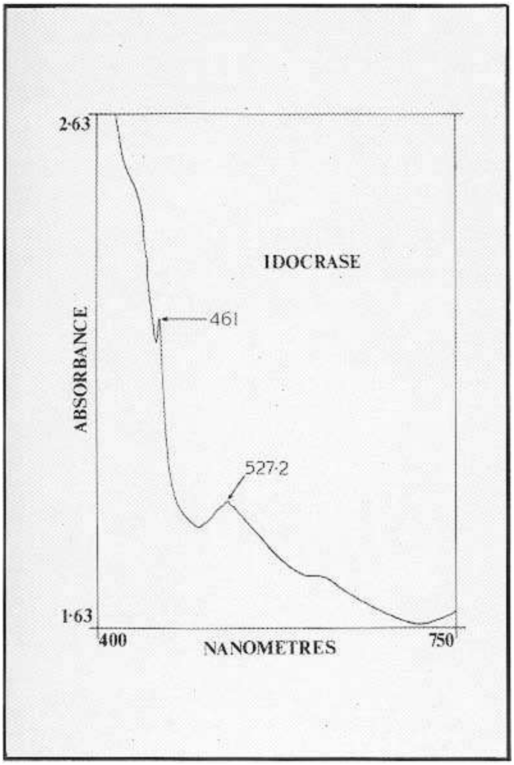

Fig. 4. The absorption curve of the 1.71 ct yellowish-brown idocrase depicted in Fig. 3. The curve was obtained using a Pye Unicam PU8800/03 UV/visible spectrophotometer (Basil Anderson model) with a speed of 0.5 nm/s and a bandwidth of 0.5 nm at room temperature.

be a yellowish-brown idocrase. For the third stone, a birefringence of 0.001 was just perceptible on a Rayner Dialdex refractometer (RI 1.705–1.706). The SG was found, by hydrostatic weighing, to be 3.35. The stone was free of any but the smallest dot-like inclusions, and its absorption spectrum taken with light passing almost parallel to its optic axis was typical for idocrase (Fig. 4).

* * *

Although a number of diamond-topped doublets are held in collections, only rarely are they encountered within the jewellery industry. Thus it may not immediately occur to a trader that the stone set in a ring we were asked to examine (Fig. 5) could be a doublet of this type.

An examination of the stone with a 10x lens though would reveal the many scratch marks and flattened bubbles which can be seen in the plane of its girdle (Fig. 6). With the alteration of the light angle and direction it would be noticed that the crown facets may be mirrored in this same plane; confirming that it is a doublet.

It should be remembered that the results obtained from testing this stone on a reflectivity meter or thermal conductivity probe will only indicate that the portion being tested (the crown) is diamond and not that it might be a composite stone.

* * *

The naturally coloured pink diamonds that have been submitted to the laboratory for examination have, in the main, tended to be of two types. The larger stones (and the majority) which are generally a light pink and have type IIa diamond characteristics. The smaller stones are usually at least partly type Ia, diamonds in which the colour may be seen to be concentrated within planes running through the stone.

A diamond we were asked to examine recently was of the second type in that the colour was located

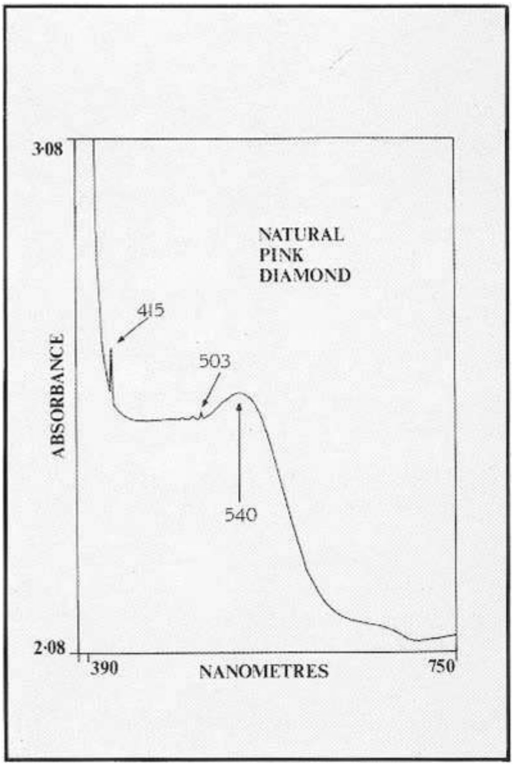

Fig. 7. The absorption curve of the naturally coloured deep pinkish-mauve diamond depicted in Fig. 8. The curve was obtained using a Pye Unicam PU8800/03 UV/visible spectrophotometer (Basil Anderson model) with a speed of 0.5 nm/s and a bandwidth of 1 nm at approximately 120°K. The path length was approximately 4.6 nm.

within planes and as can be seen from Fig. 7 the spectrum had type Ia characteristics. The spectrum is comparable with that of a natural pink diamond published by Collins(4) but the apparent body colour of this stone is remarkable in that it is as close to red as a stone could be without actually being that colour (Fig. 8). The colour is in fact a deep pinkish-mauve. The stone weighs only 0.76 ct.

* * *

Of all the items used in jewellery one would have thought the least likely to have an imitation made of it was the misshapen and individually graceless non-nucleated (tissue nucleated) cultured pearl that is being imported from China and Japan.

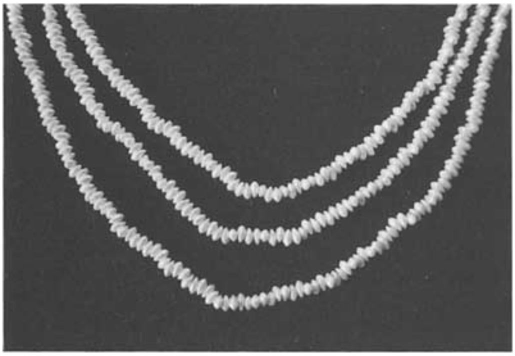

Fig. 9. A necklace of imitation pearls, simulating the appearance of non-nucleated (tissue nucleated) cultured pearls.

However, the current promotional campaign for this type of cultured pearl, which is aimed at the trade, is resulting in them becoming fashionable. As there is a tendency to imitate items in fashion, we should have expected the necklace of imitation pearls shown in Fig. 9 to appear.

* * *

As lapis-lazuli is said to owe its beautiful colour to the presence of haüyne or its sister mineral lazurite the author was pleased to receive three transparent examples of haüyne (Fig. 10) from Alan Jobbins for the purpose of examining their ultraviolet visible spectrum.

The three stones weighed 0.152, 0.108 and 0.098 ct. One fluoresced a weak orange under long-wave ultraviolet light whilst the other two were inert. Under the influence of short-wave ultraviolet light all fluoresced a dull red.

One stone produced only a vague shadow edge on the screen of a Rayner Dialdex refractometer in the region of 1.504, but much clearer readings were obtained for the other two stones, and for both an RI of 1.504 was recorded. A collective SG of 2.48 was obtained by the hydrostatic method.

For comparison purposes, the absorption curves of an oval faceted sodalite (Fig. 10), and a thin slice of lapis-lazuli were also recorded. The sodalite weighed 0.49 ct, gave a clear RI reading of 1.485 and had an SG of 2.327.

Two curves were recorded from two different areas of good blue colour in the lapis-lazuli sample and both revealed similar characteristics. The dotted curve in Fig. 11 shows that lapis-luzuli absorbs light strongly between 700 and 500 nm, has a transmission area centred at 458 nm in the blue and begins to absorb light strongly again at wavelengths shorter than 400 nm.

The curve recorded for the sodalite (dashed curve in Fig. 11) also revealed a strong and wide absorption area from the red through to the green part of the spectrum. However, the transmission area in this case is not in the blue but is centred at 380 nm in the violet. The sodalite also transmits further into the ultraviolet than does the lapis-lazuli.

Curves were recorded for all three of the haüyne samples (solid curve in Fig. 11) and each had similar characteristics. In all cases the absorption area centred at approximately 596 nm, peaked more sharply than did the same area in the spectra of the sodalite and lapis-lazuli samples. The transmission area, as in the lapis-lazuli, is centred in the blue but in these cases at 472 nm. In all of the haüynes an absorption peak was detected at 379 nm

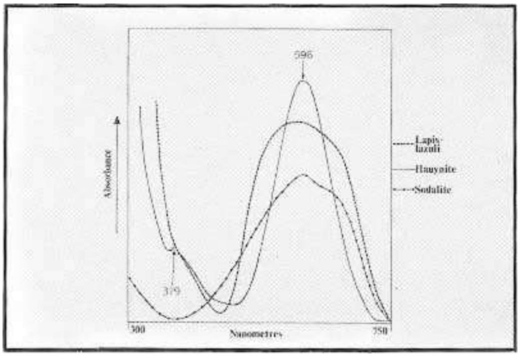

Fig. 11. The absorption curves of lapis-lazuli (dotted), haüyne (solid) and sodalite (dashed). All were obtained using a Pye Unicam PU8800/03 UV/visible spectrophotometer (Basil Anderson model) with a speed of 0.5 nm/s, bandwidth of 0.5 nm and a span of 2A, at room temperature. The path lengths were approximately 2.99 mm (sodalite), 0.46 mm (lapis-lazuli) and 1.87 mm (haüyne).

which was not seen in the sodalite or the lapis-lazuli samples. At wavelengths shorter than this peak the haüynes begin to absorb light strongly.

Acknowledgements

Thanks are due to Mr Alan Jobbins for the loan of the three haüynes and the oval sodalite. The author is also indebted to Mr C. Cavey for the loan of the lapis-lazuli and to Charles Mathews (Lapidaries) for cutting and polishing it.

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Blue and green beryls (aquamarines and emeralds) of gem quality from Nigeria

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Abstract

Beryls of gem quality from a recently discovered mining area near Jos in Nigeria are described. The samples with refractive indices of n_o 1.570–1.574, n_e 1.564–1.568 and densities between 2.66 and 2.68 g/cm^3 show blue or green coloration of variable intensity. Crystals with colour zoning are frequently observed. The variable colours and colour intensities of the beryl crystals are caused by strongly varying concentrations of V, Cr and Fe. By spectroscopic investigations, absorption spectra which are typical for the blue beryl variety aquamarine (coloured by iron) and spectra which are typical for the green beryl variety emerald (coloured by chromium and vanadium) were measured. By microscopic investigations, a distinct growth zoning parallel to the basal pinacoid, the hexagonal dipyramid and parallel to the first-order prism was observed in aquamarines and emeralds, as well as two different types of two-phase inclusions.

Introduction

During 1984, several green beryl crystals and cut gemstones from a new occurrence were submitted for investigation in order to confirm the natural origin of the samples. In addition, some of the samples were used for an investigation of causes of colour in order to verify if the gemstones deserve the designation 'emerald'. From trade information the green beryls come from a mining area near Jos in northern Nigeria, which recently has been supplying large quantities of gem-quality aquamarines. However, at present no detailed information about the geological situation or the paragenesis of the occurrences of the variously coloured beryls are available.

In this paper, a general survey of the chemical, physical and gemmological properties of the new beryls from Nigeria is given. The necessity of a detailed investigation arose from difficulties in proving the natural origin of the first cut gemstones of this new type of beryl, which were not assignable to one of the known occurrences of emeralds according to their microscopical properties.

Materials and methods

For the present investigation about 20 rough crystals and 50 cut beryls of various colours and colour intensities were selected from a great quantity of samples in order to represent the colour variation of the material available.

Chemical data of 20 samples were measured by an automatic electron microprobe (ARL-SEMQ). For determination of the Li_2O, BeO and H_2O contents, which are not available from microprobe examination, two representative samples were selected for wet chemical analysis. A small quantity of powdered material from each of these two crystals was investigated by X-ray diffraction for determination of the unit cell dimensions of the samples (Guinier camera, $CuK_{\alpha 1}$ radiation, internal Si standard). In order to characterize the different types of water incorporated into the channels of the beryl lattice, infrared spectroscopy was applied to several samples (Perkin-Elmer 180). For investigation of the causes of colour, the absorption spectra of a great quantity of chemically analysed samples were recorded (Leitz-Unicam SP 800) in addition to trace element analyses by electron microprobe. Inclusions were determined microscopically in rough and cut samples.

Mineralogical properties

The rough material available for this investigation consisted of transparent crystals with prismatic habit; only the hexagonal prism of first-order $(10\bar{1}0)$ was developed. A small number of crystals were doubly terminated and showed a combination of hexagonal prism and basal pinacoid (0001), occasionally also a small hexagonal dipyramid $(11\bar{2}2)$. Two of the aquamarine crystals were intergrown with black tourmaline (schorl). Additional information concerning the paragenesis of the crystals is not yet available. However, topaz and tourmaline of gem-quality are known to come from cassiterite pegmatites near Jos. It is not quite certain if there is any relationship between these pegmatites and the host rocks of the Nigerian beryls.

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The colour of the samples (Fig. 1) varies from medium blue to light blue and almost colourless (bluish) and from medium green to light green and almost colourless (greenish). A distinct colour zoning, medium blue/light blue/colourless or medium green/ light green/colourless, was observed in a great number of samples. This remarkable colour zoning forms sharp boundaries between different coloured parts of one single crystal. The orientation of these colour boundaries was found to be parallel to the basal pinacoid (0001), or, in other samples, to be parallel to the first-order prism $(10\bar{1}0)$. Quite rarely, a colour zoning with blue and green parts in one single crystal was observed.

Fig. 1. Cut beryls from Nigeria. Size of the aquamarine 12 × 18 mm, *(photo by O. Medenbach, Bochum).*

The chemical data of the investigated samples reflect the different colour shades and the distinct colour zoning of the beryl crystals. In all samples a strong variation of those trace elements which are responsible for the colour of the crystals, was evident by means of microprobe analysis. However, a direct correlation between the concentrations of the different colouring elements, Fe, V and Cr, was not observed in the samples investigated up to now. On the contrary, the trace elements Fe, V and Cr were found to vary independently in different parts of one crystal. An increase of the chromium concentration may be correlated with both, with an increase or with a decrease of the vanadium concentration. The Fe content, on the other hand, varies independently of an increase or decrease of the Cr- and/or V-concentration.

In Table 1 typical analyses of an intense blue beryl (sample 1) of a light blue, almost colourless crystal (sample 2), of a light green and a medium green coloured gem stone (samples 3 and 4) are quoted. The medium blue coloured sample 1 has a distinct Fe-content and very small amounts of V_2O_3 and Cr_2O_3. Though the Fe-content in sample 2 is almost twice as high as in sample 1, crystal 2 is almost colourless. This situation is explained by different valence states and/or lattice positions of Fe in the samples under discussion. Sample 4, which is medium green coloured, contains distinct amounts of V and Cr, in addition to a Fe-content of 0.13% FeO. The amount of these two colouring trace elements, on the other hand, is extremely low in the light green sample 3. The variation of the colouring trace elements in different beryl crystals from Nigeria is given in Table 2. It is worthwile mentioning that the V_2O_3 and Cr_2O_3 contents in

Table 1: Chemical and physical properties of four selected beryl samples from Nigeria

Sample	**1**	**2**	**3**	**4**
Colour	**medium blue**	**light blue, almost colourless**	**light green**	**medium green**
		Chemical data (wt. %)		
SiO_2	65.17	65.45	65.83	65.53
Al_2O_3	18.84	18.24	18.70	18.39
V_2O_3	0.03	–	0.01	0.06
Cr_2O_3	0.01	–	0.02	0.08
FeO*	0.46	0.89	1.13	0.31
BeO	13.60	13.65**	13.65**	13.70
Li_2O	0.02	0.02**	0.02**	0.01
MgO	0.03	0.04	0.02	0.20
Na_2O	0.10	0.17	0.14	0.15
H_2O	0.95	1.04**	1.04**	1.13
Total	99.21	99.50	100.56	99.56

* total iron as FeO **average values from the determinations of samples 1 and 4

		Numbers of ions on the basis of O=18		
Si	5.957	5.982	5.964	5.976
Al	2.029	1.965	1.997	1.977
V	0.002	–	0.001	0.004
Cr	0.001	–	0.001	0.006
Fe	0.033	0.068	0.086	0.024
Be	2.986	2.997	2.970	3.001
Li	0.007	0.007	0.007	0.004
Mg	0.004	0.005	0.003	0.037
Na	0.018	0.030	0.025	0.027
H_2O	0.290	0.317	0.314	0.344
		Physical data		
n_o	1.566(1)	1.566(1)	1.566(1)	1.566(1)
n_e	1.572(1)	1.572(1)	1.572(1)	1.572(1)
D [g/cm³]	2.67(1)	2.68(1)	2.67(1)	2.66(1)
a_0 [Å]	9.2198(6)			9.2150(6)
c_0 [Å]	9.1924(9)			9.1909(6)

green beryl from Nigeria are low compared with emeralds from other localities.

Emeralds, in which the V and the Cr concentrations are almost in the same range are known, until now, mainly from Colombia. Similar to the trace element concentrations in Nigerian beryls, Colombian emeralds may contain higher amounts of V than Cr or higher amounts of Cr than V (Staatz *et al.*, 1965; Gübelin, 1982 a,b; Hänni, 1981, 1982; Kuhlmann, 1983). The amounts of Na_2O and MgO in Nigerian beryls are very low, compared with the concentrations in beryls, including emeralds, from different localities (Staatz *et al.*, 1982; Franz, 1982; Graziani *et al.*, 1983; Schrader, 1983; Hänni & Kerez, 1983). Again, the Na- and Mg-contents in Nigerian beryls are similar to the contents in Colombian emeralds.

The contents of Na_2O and MgO in Nigerian beryls showed variations in different parts of one crystal or cut gemstone similar to the variation of the colouring trace elements. A correlation of different trace elements, e.g., an isomorphic replacement of the scheme $Al^{3+} \rightarrow (Fe^{2+}, Mg^{2+}) + Na^{+}$, could not be proved experimentally due to the small concentrations of Na and Mg. In addition, the knowledge of the Fe^{2+}/Fe^{3+}-ratios would be necessary to ascertain a correlation between (Fe^{2+}, Mg^{2+}) and Na^{+}. These ratios, however, cannot be determined by electron microprobe.

Investigations of both beryl varieties from Nigeria

Table 2: Variation of chemical and physical properties of beryls from Nigeria

Chemical data (colouring trace elements)	
V_2O_3	0.00 – 0.06
Cr_2O_3	0.00 – 0.08
FeO	0.08 – 1.20
Physical data	
n_o	1.570 – 1.574
n_e	1.564 – 1.568
$\triangle n$	0.006
D [g/cm^3]	2.66 – 2.68

(medium blue aquamarine and medium green emerald) by infrared spectroscopy in the area between 4000 and 3000 cm^{-1} showed absorption bands at 3695, 3655 and 3590 cm^{-1}. According to Wood & Nassau (1967, 1968), these absorption bands are caused by two different types of water molecules incorporated into the channels of the beryl structure. In general, both types of water are present in natural beryl. The amounts of water, which were determined by chemical analyses in two selected samples (0.95 and 1.13 wt%, respectively) are found to be within the normal range of natural beryls.

The values of the refractive indices and densities for beryl samples from Nigeria (Tables 1, 2), are found to lie close to the lower limit of values which were published for natural beryls of different localities Černý & Hawthorne, 1976; Schrader, 1983). Only a small variation of the physical properties was measured in the Nigerian beryls investigated (Table 2).

The unit cell dimensions of both samples, which were investigated by X-ray powder diffraction, were found to be similar to the values of beryls with low contents of Fe, Mg and Na (Bakakin *et al.*, 1970; Filho *et al.*, 1973; Franz, 1982).

Absorption spectroscopy and naming of the beryl varieties investigated

The absorption spectra of the beryl samples from Nigeria are subdivided into three basic types. The medium blue beryls reveal a typical "aquamarine spectrum" (Fig. 2) with absorption bands of Fe^{3+} in the bluish-violet and in the ultraviolet area, absorption bands in the near infrared (with polarization $\parallel$ and $\perp c$) due to Fe^{2+} on two different lattice positions and an absorption band in the red area (with polarization $\parallel c$), which is assigned to a Fe^{2+}/Fe^{3+} charge transfer process (cf. Samoilovich *et al.*, 1971; Price *et al.*, 1976; Parkin *et al.*, 1977; Goldman *et al.*, 1978; Platonov *et al.*, 1978, 1979; Blak *et al.*, 1982).

In light blue beryls (aquamarines) the intensities of the Fe^{2+}/Fe^{3+} band (with polarization $\parallel c$) in the red area and the Fe^{2+} absorption (with polarization $\parallel c$) in the near infrared are weak compared to medium blue samples. This decrease of the intensities of both absorption bands is explained by a decrease of the concentration of one of the two Fe^{2+} types. Both absorption bands are not observed in nearly colourless beryls. The spectra of such colourless crystals, however, show the Fe^{3+} absorption bands in the bluish-violet and the ultraviolet area and the Fe^{2+} absorption band (with polarization $\parallel c$) in the near infrared, none of which need be considered in the coloration of beryl.

In green beryl from Nigeria (Fig. 2), in addition to the Fe^{3+} and Fe^{2+} bands of colourless samples, strong absorption bands of V^{3+} and Cr^{3+} are observed in the red and bluish-violet area. In the absorption spectra of Colombian emeralds (Schmetzer *et al.*, 1974) and in the spectra of other oxides and silicates with similar V- and Cr-contents (Schmetzer & Ottemann, 1979; Schmetzer, 1982), a superposition of the V^{3+} and Cr^{3+} absorption bands is observed in the visible area. In general, both absorption bands in the visible area, which are responsible for the colour of the V- and Cr-containing minerals, e.g., for the colour of Colombian emeralds, and also for the colour of the new green beryls from Nigeria, are caused by both trivalent trace elements V^{3+} and Cr^{3+}. The influences of Fe^{3+} and Fe^{2+} on the colour of Colombian and Nigerian beryls are negligible. The only differences in the spectra of Colombian and Nigerian beryls are the variable intensities of the Fe absorption bands, e.g., the low intensity of the Fe^{2+} band in the near infrared (with polarization $\perp c$) in the spectra of Colombian emeralds. Therefore, the designation emerald for the medium green beryls from Nigeria is an appropriate one for these crystals.

A continuous transition between well coloured and almost colourless crystals is observed for both beryl varieties from Nigeria. A light green sample, for example, contained only 0.01% V_2O_3 and 0.02% Cr_2O_3 (cf. Table 1, sample 3). Bluish-green beryls with a distinct aquamarine and emerald component, reported to be common for crystals from Zambia (Schmetzer & Bank, 1980, 1981), are quite rare in the Nigerian material available at present.

Inclusions in beryls from Nigeria

In general, the beryl samples investigated (aquamarine and emerald) show prominent growth zoning parallel to three crystal faces: the basal pinacoid, the hexagonal dipyramid and the prism of first-order (Figs. 3–8). Mineral inclusions have not yet been observed in the material available.

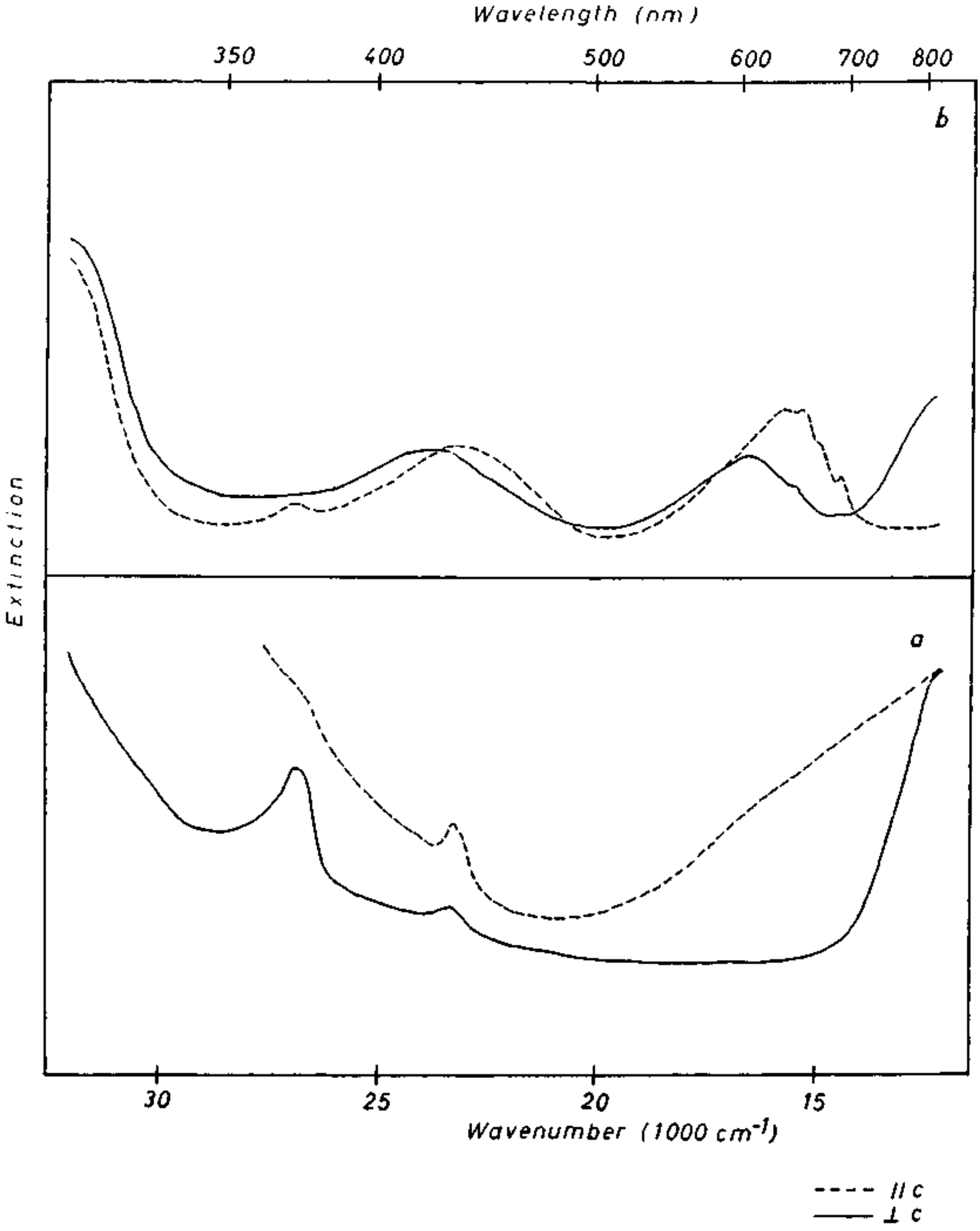

Fig. 2. Absorption spectra of beryls from Nigeria; a. aquamarine, not heat treated (analysis 1); pleochroism ∥ *c* blue, ⊥ *c* almost colourless, light greenish. b. emerald (analysis 4); pleochroism ∥ *c* bluish green, ⊥ *c* yellowish green.

Frequently, however, two different types of two-phase inclusions were found. The first type forms irregular feathers, in most cases in the cores of the crystals (Figs. 4, 9–11). The second type of two-phase inclusions was generally observed at the rims of beryl crystals with growth zoning parallel to the prism faces. This second type forms elongated, often jagged cavities parallel to the prism face (Figs. 12–14).

Acknowledgements

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Fig. 3 Beryl from Nigeria: growth zoning parallel to the prism face $(10\bar{1}0)$; view parallel to the *c*-axis. 20 x.

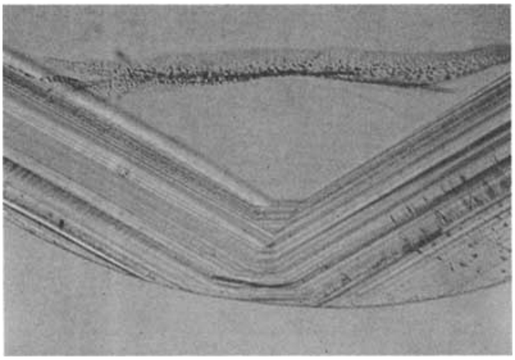


Fig. 4. Beryl from Nigeria: growth zoning parallel to the prism face $(10\bar{1}0)$; view parallel to the *c*-axis; in the core of the crystal feather of fluid-inclusions and two-phase inclusions. 30 x.

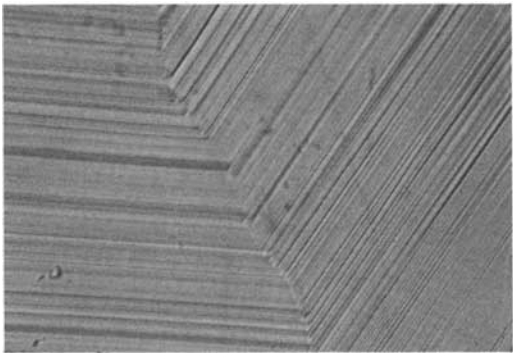
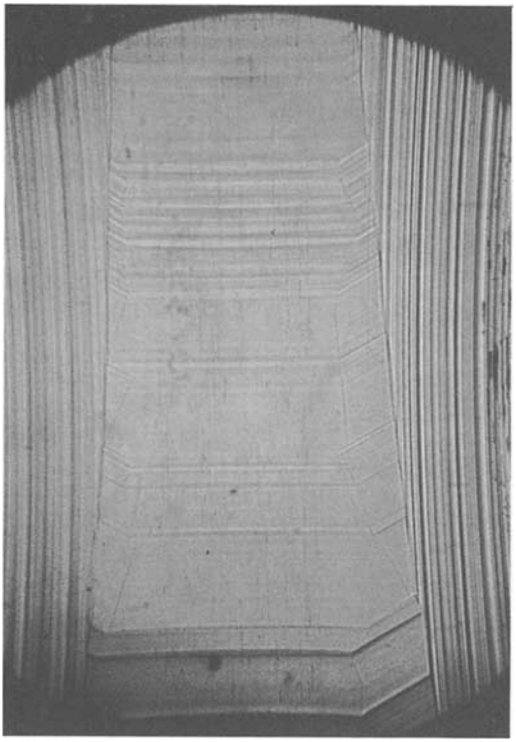
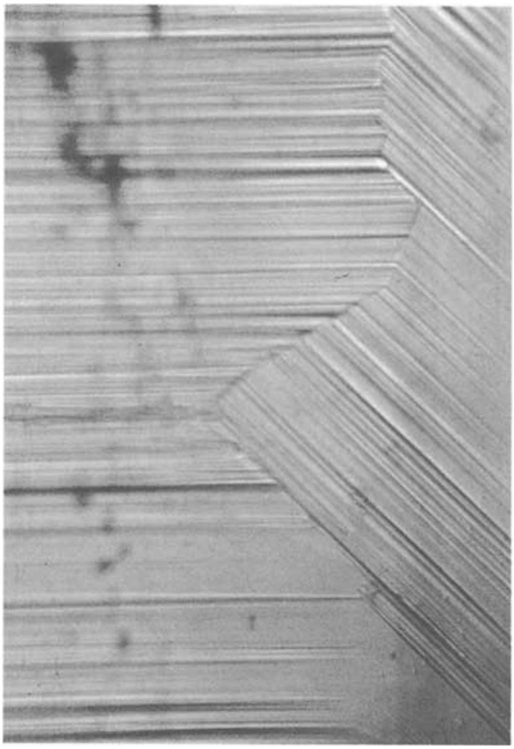


Fig. 5. Beryl from Nigeria: growth zoning parallel to the prism face $(10\bar{1}0)$; view parallel to the *c*-axis. 30 x.





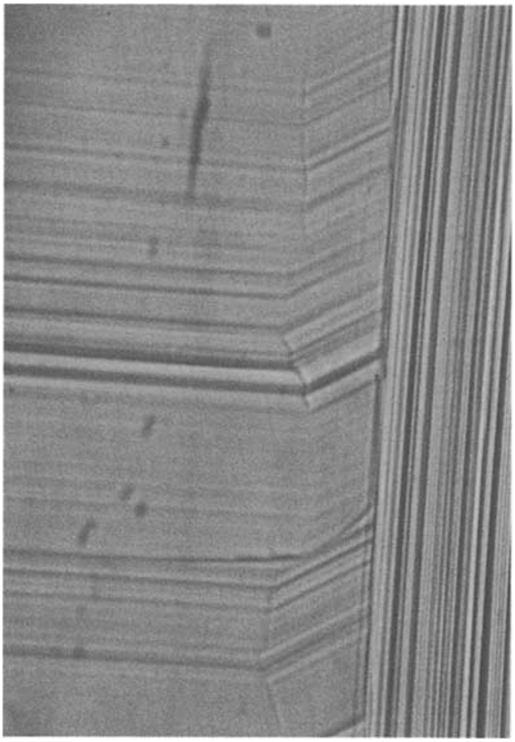


Fig. 6. (Above left.) Beryl from Nigeria: growth zoning parallel to the basal pinacoid, the hexagonal bipyramid and the prism faces; view perpendicular to the *c*-axis; the *c*-axis runs vertically. 22 x.

Fig. 7. (Above right.) Beryl from Nigeria: growth zoning parallel to the basal pinacoid, the hexagonal bipyramid and the prism faces; view perpendicular to the *c*-axis; the *c*-axis runs vertically. 50 x.

Fig. 8. (Left.) Beryl from Nigeria: growth zoning parallel to the basal pinacoid and the hexagonal bipyramid; view perpendicular to the *c*-axis runs vertically. 30 x.

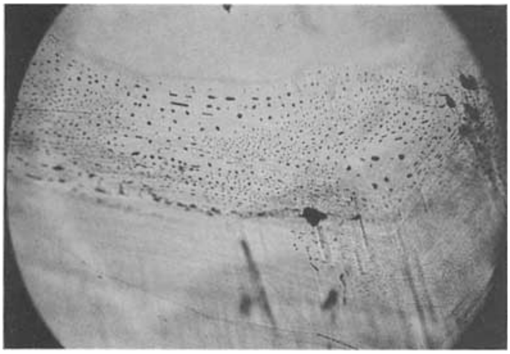


Fig. 9. Beryl from Nigeria: feather consisting of fluid inclusions and two-phase inclusions without orientation in the beryl lattice. 38 x.

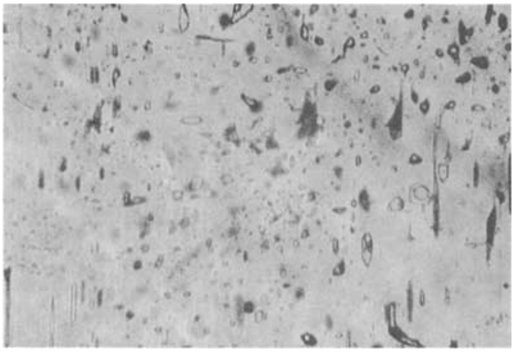


Fig. 10. Beryl from Nigeria: feather consisting of fluid inclusions and two-phase inclusions without orientation in the beryl lattice. 90 x.

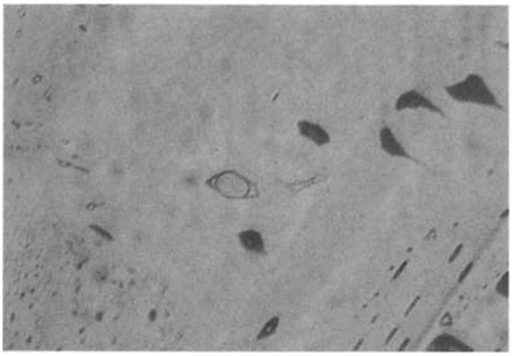


Fig. 11. Beryl from Nigeria: feather consisting of fluid inclusions and two-phase inclusions without orientation in the beryl lattice. 100 x.

Fig. 12. Beryl from Nigeria: fluid and two-phase inclusions with orientation parallel to the prism (10$\bar{1}$0). 55 x.

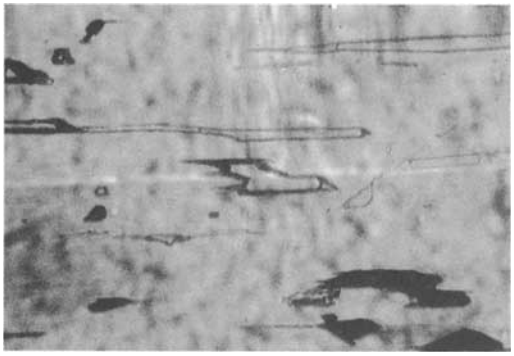


Fig. 13. Beryl from Nigeria: fluid and two-phase inclusions with orientation parallel to the prism (10$\bar{1}$0). 70 x.

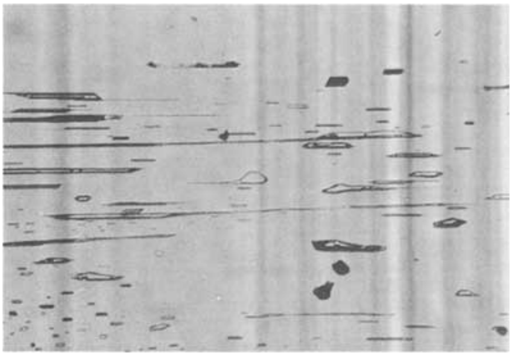


Fig. 14. Beryl from Nigeria: fluid and two-phase inclusions with orientation parallel to the prism (10$\bar{1}$0). 55 x.

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Visual optics without the gloom

James B. Nelson, Ph.D., F.G.S., F.Inst.P., C.Phys., F.G.A.

The Hodgkinson method

A simple method was described by Crowningshield and Ellison(1) about 35 years ago which yielded useful information about the optical properties of gemstones.

This 'through-the-stone' testing method was, surprisingly enough, not followed up by gemmologists until its usefulness was 'rediscovered' recently by Hodgkinson(2). He gave it the name 'visual optics' and showed in some detail how it could provide information on any faceted gemstone concerning its refractive index, birefringence, dispersion and spectral appearance. What is particularly intriguing about it is that this information, although highly approximate, can be obtained without the aid of instruments. In principle, all that is needed is a darkened room, a solitary, clear, small light source, and experience of the visual effects acquired from looking through known stones. The effects seen are quite independent of the size of the stone.

The technique, which has now come to be known as the Hodgkinson Method, is simplicity itself. It involves closing one eye and holding the stone between thumb and forefinger.

The table facet is presented to the seeing eye, so that it virtually touches the eyeball. If the source used is a *clear* domestic electric light bulb, then the stone is best held some three to six metres from it.

It is prudent to start with a brilliant-cut stone of low refractive index, like amethyst or citrine. When the stone's table is approximately perpendicular to the line-of-sight of the lamp's filament, concentric rings of tiny white or coloured images will be seen against a dark background. These spots are the spectral reproductions of the lamp's filament, arising from refraction through each of the stone's pavilion facets.

In such a stone of low refractive index, the complete inner ring of images can be seen by looking straight towards the light source. As the refractive index of the chosen stone is progressively increased, this ring of images becomes larger and larger. When the higher refractive indices are approached, only a portion of the innermost ring can be seen, and this by looking, not directly through the stone, but aslant.

For stones having the same pavilion angles, the diameter of the innermost ring of images is directly related to the refractive index. With a little practice, it is quite an easy task to estimate the refractive index of an unknown stone to an accuracy of ± 0.1 (e.g. 1.4, 1.5, 1.6, 1.7, 1.8). The diameter of the circle is mentally assessed, and compared with what has been observed for standard reference stones. Much experience is needed to judge the indices to an accuracy of, say, ± 0.02. Pavilion angles which depart greatly from those of brilliant-cut stones, such as those of 'fish-eye' or 'lumpy' cuts, can cause some initial confusion. However, with an awareness of this situation, suitable corrections can be made.

Birefringence is estimated from the appearance of the two tiny spectral images which constitute each facet spot.

Doubly refracting stones generally display two such images. For the low-dispersion stone, quartz, the two spectra overlap, producing some white. In the case of the highly birefringent peridot, the two spectra are widely separated. The gap between the same two spectral colours, say red, represents a measure of the birefringence.

Depending on the orientation of the optical axis/axes within the stone with respect to the viewing direction, the observed gap may be a maximum, zero or somewhere between the two. The latter situation is the one most commonly encountered.

Nevertheless, each stone must be rotated and tilted in different directions to ensure that it approaches, or attains, its diagnostic and maximum birefringence. Again, a range of reference stones is essential to guide the beginner.

Unlike birefringence, dispersion is virtually unaffected by the stone's optical axis orientation. The dispersion is estimated from the spread of the spectral images. The spectra are single for isometric

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stones or in pairs for uniaxial and biaxial stones. Overlapping spectra are easily coped with.

In an informative and entertaining article, Hanneman(3) suggested that the estimated birefringence: dispersion ratio (B ÷ D) could be a helpful variable. This article and a subsequent more theoretical one(4), together of course, with Hodgkinson's original paper, are required reading for anyone intending to explore the technique. His repeated view is that the mastery of the Hodgkinson Method ought to be a requirement in postgraduate courses in gemmology. This view is a sensible one, considering that with about ten minutes' practice, it is possible to recognize instantly a ruby, peridot or zircon, and this in a darkened room. With only a little more experience, diamond and cubic zirconia can be confidently distinguished. This is done by making use, not of the usual primary images, but of the faint, centrally-located secondaries, caused by internal total reflections.

The writer has found it possible to make the same distinction between ring-mounted stones using the crescent moon as a less prosaic light source. This moonlight experiment by a fiancée might well mark the collapse of a not-too-robust betrothal, if she happened to possess only this small piece of gemmological knowledge.

The method scores highest marks when the use of the normal range of instruments (apart from the 10X hand loupe and the Chelsea filter) is troublesome and awkward, is not rapid enough, or is frowned upon. These situations arise at the jeweller's shop-counter, the auction room, the valuers' premises and at the gem and jewellery shows. It also arises when collectors or commercial buyers are in certain foreign markets, especially in south-east Asia, where well-intentioned, but ill-informed traders can sometimes be encountered.

Difficulties in popularizing the method

What, one might ask, has the discussion of this still little-used technique to do with the subject of this article's title? It is this. In the formal teaching of a new procedure, difficulties always seem to be greatest at the beginning. If the method is to win widespread adoption, the most serious obstacles must be overcome. The main obstacle here, as it appears to the writer, is that of having a classful of beginners working in almost total darkness for more than a few minutes at a time. Each student will be labouring at different rates, levels and times, so that out of necessity the room will have to remain in the dimmest possible gloom for long periods. This hampers the normal classroom activities, such as 10X loupe stone-viewing, stone identity checking and exchange, note-taking, blackboard-explaining and the now, more frequent recovering of dropped stones. More importantly, this very different regime will find little favour with most instructors.

The other learning impediment concerns the single shared light source itself. The preferred source is a bare, non-frosted, 40-watt domestic bulb having a shallow "C"-shaped filament. It always comes as a surprise when looking through a stone to discover that this relatively weak illuminant can produce such a host of confusing and distracting images. These spring from mirror-like objects which are normally unobserved in a bright room. Also, the white walls and ceiling raise the background level of the stone's image from the desired velvety black to a disturbing white veiling or glare. When greater experience and confidence have been gained, such perturbances become much less important. Secondary and even large or multiple primary sources eventually come to be accepted as mild nuisances. However, they can cause beginners to regard the method as too complicated and stop them from investing the effort required to master it.

Modifications to the method

Both teaching obstacles could be overcome if it were found to be possible to carry out visual optics in a well-lit classroom. This is indeed practical if the source is sufficiently small and bright and is seen against a jet black background. Apparent source smallness is purely a matter of angular subtense (θ). Here θ is the angle seen at the eye, bounded by the actual size of the source (S) at a distance (D). For example, the full moon has a value of $\theta = 0.52°$*.

A few experiments made by the writer with known faceted stones showed that quite acceptable spectral resolutions could be obtained with a θ value equal to about one-tenth of this ($\theta = 0.05°$). Therefore an illuminated slit, 0.218 mm wide (S) and say, 3.0 mm long, viewed at the convenient distance of 250 mm (D) would subtend an angle of $\theta = 0.05°$. Or a pinhole of 0.50 mm diameter (S), viewed at D = 573 mm, would yield the same θ of 0.05°. The intrinsic source brightness is proportional to the aperture dimensions. Thus the slit has fifty-five times the actual brightness of the pinhole for the same spectral resolving power. The higher efficiency slit is more costly to make, so a choice is available.

The barrel light source of the spectroscope unit described by the author(5) is used to illuminate either of these two apertures. The electroformed slit

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* The moon's diameter = 3,476 km. Its mean distance from the earth (eye) is = 384,400 km. Its angular subtense is therefore $\theta = \frac{S \times 57.3°}{D} = 0.518°$.

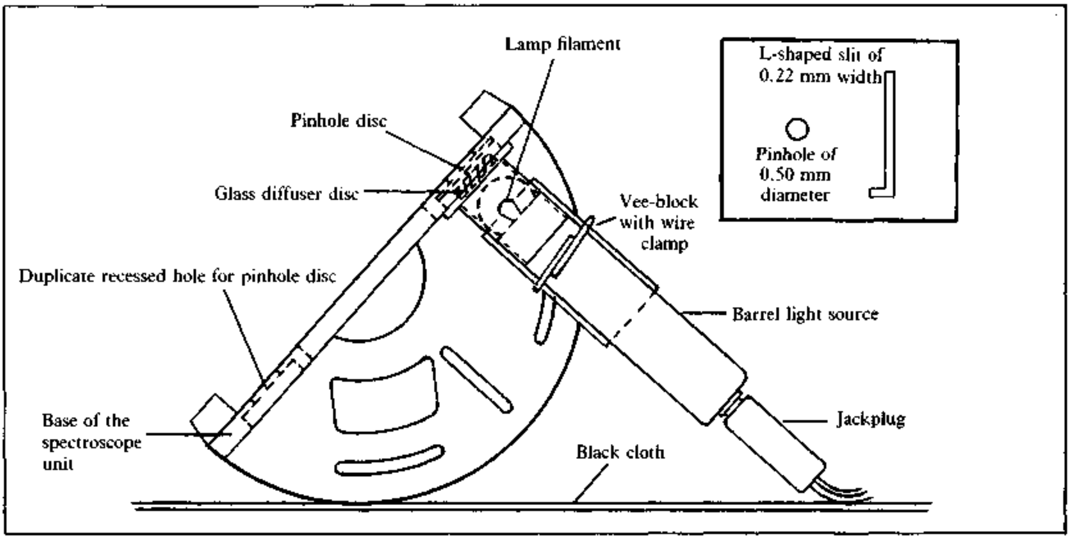

Fig. 1 Arrangement for viewing pinhole source

is enclosed in a cap containing a ground glass diffusing disc, which slides on to the barrel. As before, the vee-block clamp on the spectroscope unit's base allows the slit unit to be directed as desired. It can, of course, be used without the base.

For these situations 'in the field' already mentioned, it can be carried about with its pocket six-volt battery and flexible leads. See Fig. 2 of Reference 5.

The pinhole alternative consists of a small aluminium alloy disc with a pinhole drilled in its centre and with a glass diffuser filter disc cemented onto it. It is fitted to one of the two recessed holes in the unit's base. The disc can be seen in Fig. 5 of Reference 5.

The barrel light source is directed on to the pinhole disc and clamped. The unit as a whole can then be perched on end as shown here in Fig. 1. If the upturned unit is placed in the middle of a 400 mm square of black cloth, the beginner will see only the single, small, intense source of white light issuing from either the slit or the pinhole. There will be no other distracting light sources, so that when a stone is viewed, the tiny spectral images will be seen in sharp contrast against a truly black background.

Unlike the image of the C-shaped filament of the 40 watt light bulb, that of the pinhole is strictly symmetrical. This feature provides additional information about a stone. It enables the observer to judge the quality of flatness of the pavilion facets, provided that the refractive index (or indices) of the stone is uniform. Conversely, if the facets are seen to be reasonably flat, then mishapen, blurred or discontinuous spectral images may be observed. These are sure evidence of the presence of small local refractive index differences. These 'swirl marks' or striae effects are best seen with Sri Lankan hessonites and to a much lesser degree with many Burmese rubies. In the case of pastes, both features are usually present. Instant judgements can also be made as to the degree of angular regularity of the pavilion facets.

The slit source yields more intense and better quality spectra. The Oughton spectra(6) are easily visible with blue sapphires (except those from Sri Lanka), almandines, and didymium-bearing stones. The asymmetric shape of the slit permits distinctions to be made between primary and secondary images. Primary images will all have the same orientations; secondary images will have random orientations.

It is hoped that this review of the method and the suggestions for teaching aids might persuade more gemmologists to 'educate the eyeball' as Hanneman so succinctly puts it.

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An Unusual Star Diamond

(Cover photograph)

S.J.A. Currie, F.G.A., New Zealand

The star diamond illustrated on the front cover is thought to be one of only four known specimens and this one takes the form of an exquisitely symetrical cubo-octahedron, with eight glassy octahedral faces and six rectangular hexahedral faces which are covered with small four-sided pits, giving them a superficially rough appearance.

The weight of the specimen is 0.21 ct, and the octahedral face diameter approximately 2.5 mm. The crystal is of generally light brown colour with the rays of the star a rather stronger brown. It has no major inclusions other than the minute 'breadcrumbs' which when illuminated yield the star effect. The crystal was described previously by R. K. Mitchell(1).

The specimen was brought to New Zealand by the late Mr Alan Fleming and since his death its whereabouts are uncertain. There is an unconfirmed report that it was sold to a Sydney (Australia) museum collection, but Mr Fleming treasured this stone so much that the writer's great fear is that it might still be in the pockets of his Sunday-best waistcoat, never to see the light of day again.

Orientated four-sided etch pits on the tetrahexahedral faces of the 0.21 ct 'star diamond' described.
Photograph by S.J.A. Currie.

The cover photograph was taken using a single flash on to one of the octahedral faces. The camera was a Nikon FM2 body fixed to the eye-tube of a Kyowa stereo-zoom microscope.

Reference

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Gemmological Abstracts

ANDERSON, B. W. 1985. The search for the ideal high index refractometer. *Lapidary J.*, **39**, 4, 45-6.

A posthumous paper describing the history of attempts to manufacture a critical-angle refractometer from blende and diamond. M.O'D.

ATKINSON, D., KOTHAVALA, R. Z. 1985. Kaschmir-Saphir. (Kashmir sapphire.) *Lapis*, **10**, 10, 11-22, 22 figs (20 in colour).

An account of the recovery of blue sapphire from the Zanskar range in Kashmir, with references to other gem minerals found in the vicinity. These include tourmaline and aquamarine. M.O'D.

BALFOUR (I.). 1985. Famous diamonds of the world, XXII. The 'Eureka' diamond. *Indiaqua*, **41**, 2, 123-27, illus. in black and white and in colour.

Although the 'Eureka' diamond was found in late 1866 on the 'De Kalk' farm near Hopetown in the most northerly part of the South African Cape Colony, it is possible that several earlier finds may have preceded it and contributed to the realisation of the area's diamondiferous potential.

It was thought at the time that the diamond was discovered by Erasmus, son of Jacobs the farm owner, but later reports indicate that it was Jacobs' daughter who found the stone.

Early in 1867, the 'Eureka' passed through several hands before it was acquired and verified as a diamond by O'Reilly, a hunter and trader. O'Reilly tried to use the 'Eureka' as a means to persuade Parliament to reward him for being instrumental in the discovery of diamonds in South Africa, but he met with no success. Finally, he was persuaded to send the stone to Dr Atherstone, a well-known amateur geologist. Atherstone checked the stone and verified it as a 21.25 carat diamond woth £800.

After further verification in London, and the stone's inspection by Queen Victoria, who doubted South Africa as its country of origin (diamonds were only known to come from India or Brazil), it was purchased by Sir Philip Wodehouse who was Governor of the Cape Colony during the period of the 'Eureka's' discovery. The cut stone was eventually purchased in 1967 by De Beers and presented to the Speaker of the South African House of Assembly. The historic 10.73 carat cushion cut stone is now on permanent loan to the Kimberley Mine Museum. P.G.R.

BALFOUR (I.). 1985. Famous diamonds of the world, XXIII. The 'Star of South Africa'. *Indiaqua*, **41**, 2, 129-34, illus. in black and white and in colour.

The finder of the 83.5 carat 'Star of South Africa' was a young Griqua called Zwartboy. He made the discovery in 1869 near the De Kalk farm (where the 'Eureka' was found in 1866), and sold the gem to van Niekerk for 500 sheep, 10 head of cattle and a horse. The stone was initially valued at around £25000. Van Niekerk sold the stone to Lilienfeld Bros. for £11200.

The sale resulted in legal proceedings, as the Diamond Metal and Mineral Association had obtained a concession from Waterboer, Chief of the Griqua, for the sole prospecting rights to the territory. However, the judges of the Supreme Court in Cape Town found in favour of Lilienfeld, and the stone was sent to Amsterdam where it was cut into a 47.69 carat pear-shape. It was purchased by Lady Dudley, and after her death the stone reappeared at a Christie auction in 1974 where it was sold for £225000 to an unnamed purchaser. P.G.R.

BASSETT, A. M. 1985. The tourmalines of Nepal. *Mineralogical Record*, **16**, 5, 413-18, 5 figs (3 in colour).

Fine crystals of tourmaline up to 20cm in length have been found in two pegmatite mines in the Sankhuwa Sabha district of the Kosi zone of eastern Nepal. Some are bright grass-green elbaite, others are yellow-amber Mn-rich elbaite and still others are pink, lemon-yellow and green multi-coloured crystals. M.O'D.

BENESCH, F., WÖHRMANN, B. 1985. Toramalli: a short history of the tourmaline group. *Mineralogical Record*, **16**, 5, 331-8, 16 figs.

A summary of the references to tourmaline made by ancient writers and later. M.O'D.

BREUER, G., RATH, R. 1985. Influence of oblique illumination on the BECKE line. *Neues*

Jahrbuch für Mineralogie. Monatshefte, **6**, 251-4.

The Becke line is best observed using parallel light and with a small magnification. A mathematical reasoning supporting this is given. M.O'D.

BURSILL, L. A., GLAISHER, R. W. 1985. Aggregation and dissolution of small and extended defect structures in Type Ia diamond. *American Mineralogist*, **70**, 5/6, 608-18, 15 figs.

The structure formed by nitrogen at various states of aggregation in diamond is reviewed. The structure ranges from a few atomic diameters to platelet shapes several microns in size. M.O'D.

CHERMETTE, A. 1985. La couleur des mineraux et des gemmes. (The colour of minerals and gemstones.) *Monde et Mineraux*, 67, 20-4; 69, 12-19. 22 figs (11 in colour).

The various ways in which minerals and gemstones get their colour are discussed with some high quality photographs and useful diagrams. A short bibliography is appended. M.O'D.

DESHPANDE, M. L. 1978. Gemstones and semiprecious stones. *Indian Minerals*, **32**, 1, 1-17, 1 fig.

Brief details of the more important gemstones are given, followed by lists of Indian deposits with future prospects. M.O'D.

DIETRICH, R. V. 1985. The tourmaline group: a résumé. *Mineralogical Record*, **16**, 5, 339-51, 22 figs (8 in colour). Taken from a recently published monograph* by the same author (and with the same title) the paper gives an up-to-date account of the chemistry and properties of the tourmaline group of minerals. There is a useful bibliography. M.O'D.

FISCHER, K. 1985. Peridot-Olivin in Edelstein qualität. (Peridot – gem quality olivine.) *Lapis*, **10**, 9, 31-40, 11 figs (10 in colour).

Gem varieties of olivine are described and beautifully illustrated. The various localities are reviewed. M.O'D.

FRANCIS, C. A. 1985. Maine tourmaline. *Mineralogical Record*, **16**, 5, 365-88, 30 figs (12 in colour).

Detailed account of the occurrence of tourmaline in the pegmatites of Androscoggin, Oxford and Sagadahoc counties, Maine. Separate localities are described and there is a useful bibliography. M.O'D.

FRITSCH, E. 1985. La couleur des mineraux et des gemmes. (The colour of minerals and gemstones.) *Monde et Mineraux*, **70**, 12-22, 13 figs (8 in colour).

Discusses alteration of colour on irradiation, colour centres, diffraction colours, Tyndall scattering, asterism and chatoyancy. M.O'D.

HALL, A. M., THOMAS, M. F., THORP, M. B. 1985. Late Quaternary alluvial placer development in the humid tropics: the case of the Birim diamond placer, Ghana. *Journal of the Geological Society*, **142**, 5, 777-87, 6 figs.

Three chronostratigraphic units have been identified by radiocarbon dating of the diamondiferous sediments of the Birim River floodplain, Ghana; dates are 13000-11000, 9000-7000, and 21000 years BP to the present. Diamond grade is influenced by bedrock consistency, gravel thickness, gravel calibre and stratigraphic position, along with other external factors. M.O'D.

HEFENDEHL, K. 1985. Mineralien aus Sudkorea. (Minerals from South Korea.) *Lapis*, **10**, 9, 21-30, 20 figs (11 in colour).

Among the minerals found in South Korea are rhodochrosite, aquamarine, scheelite and fluorite, all of which may occur in gem quality. M.O'D.

HOFMEISTER, A. M., ROSSMAN, G. R. 1985. A spectroscopic study of irradiation colouring of amazonite: structurally hydrous, Pb-bearing feldspar. *American Mineralogist*, **70**, 7/8, 794-804, 14 figs.

Irradiation-induced colour in amazonite can develop only when both structurally bound H_2O and Pb impurities are present. The colour is caused either by an absorption minimum in the ß spectrum between three overlapping bands in the UV and a broad band in the area from 643 to 625nm (giving blue) or by a combination in the ß spectrum of one UV band and a broad band at 720nm giving a green colour or by both elements superimposed giving a blue-green body colour. All optical variations are correlated with an EPR pattern indicative of trivalent or monovalent Pb. M.O'D.

IVANKIN, P. F., ARGUNOV, K. P., BORIS, Ye.I. 1984. Changing environments of diamond formation in kimberlites. *International Geology Review*, **26**, 7, 795-802.

A relationship between injective and explosive processes of kimberlite formation is found and discussed. M.O'D.

KAZMI, A. H., PETERS, J. J., OBODDA, H. P. 1985. Gem pegmatites of the Shingus-Dusso

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*DIETRICH, R. V. 1985. The tourmaline group. Van Nostrand Reinhold.

area, Gilgit, Pakistan. *Mineralogical Record*, **16**, 5, 393-411, 34 figs (13 in colour).

Very fine crystals of multi-coloured tourmaline, aquamarine, sherry-brown topaz and almandine-spessartine have been found in the pegmatites of the Western Himalayas, Gilgit District, Pakistan. The location is along the suture zone of the Indo-Pakistan and Asian crystal plates. M.O'D.

LINDSTEN, D. C. 1985. Emerald – the rarest beryl. *Lapidary, J.*, **39**, 5, 25-32, 6 figs (5 in colour).

Misleadingly-written and predictable article on emerald. M.O'D.

MARCUSSON, C. R. 1985. Recent work at the Himalaya mine. *Mineralogical Record*, **16**, 5, 419-24, 8 figs (5 in colour).

Fine crystals of tourmaline are again being recovered from the Himalaya mine in the Mesa Grande district, 83km north-east of San Diego, California. The crystals occur in pegmatites. The most spectacular ones are bi-coloured pink and green. M.O'D.

MUSCAT, B. 1984/1985. Sri Lanka – island of gems. *South African Gemmologist*, **1**, 2, 5-9; **1**, 3, 8-10.

An account of gem mining, with a historical emphasis, on Sri Lanka. M.O'D.

NASSAU, K. 1985. Miscellaneous gemstone treatments. Part 2. *Lapidary J.*, **39**, 3, 30-40, 10 figs (7 in colour).

This part of a continuing paper deals with dyeing, oiling and other methods of altering colour. A useful bibliography is given. M.O'D.

NASSAU, K. 1985. Gemstone enhancement. *Lapidary J*. **39**, 4, 16-23, 13 figs (9 in colour).

Describes the coating and foiling of gemstones, composites and synthetic overgrowth. M.O'D.

O'DONOGHUE, M. 1985. Industrial review – gemstones. *Britannica book of the year*, 274.

The state of the world gemstone trade is discussed with notes on the influence of political developments on gemstone supply.

(Author's abstract) M.O'D.

ORLANDI, P., SCORTECCI, P. B. 1985. Minerals of the Elba pegmatites. *Mineralogical Record*, **16**, 5, 353-63, 19 figs (5 in colour).

Fine tourmaline is well-known from the pegmatites of the Isle of Elba and is described here, along with other minerals. The occurrence is at Monte Capanne where it occurs as prismatic crystals in veins. Many crystals have black terminations (these are particularly common from the Graziano veins near San Ilario in Campo). Recently crystals with pale pink tips and green bases have been found in a vein at Fonte del Prete. M.O'D.

POUGH, F. H. 1985. Spectral gemstones – frozen rainbows. *Lapidary J.*, **39**, 6, 19-21, 2 figs in colour.

A brief account of the cause of colour in gemstones and how some of the colour-causing phenomena were first observed. M.O'D.

POUGH, F. H. 1985. General Electric's synthetic jadeite. *Lapidary J.*, **39**, 7, 42-4, 4 figs (3 in colour).

Synthesis of jadeite was announced by General Electric in 1984. The product was made solely for temperature and pressure studies and not for commercial use, though this may develop later. A Japanese synthetic jadeite is being worked on. Up to 40 kilobars pressure would have been needed for successful synthesis. M.O'D.

RUMYANTSEVA, Ye.V. 1983. Chromdravite – a new mineral from Karelia. *International Geology Review*, **25**, 8, 989-92.

Chromium up to 31.6 wt % is found in a tourmaline emanating from the Onezhskiy depression, central Karelia, U.S.S.R. RI is (ω) 1.778 ± 0.005, (ϵ) 1.722 ± 0.005, SG 3.40 ± 0.01. Pleochroic colours are dark green and yellow-green. M.O'D.

SCHMETZER, K., BANK, H. 1985. Crystal chemistry of zincian spinels (gahnospinels) from Sri Lanka. *Neues Jahrbuch für Mineralogie. Monatshefte*. 8, 353-6.

Chemical composition and physical properties of zincian spinels from Sri Lanka are discussed. Samples chosen were from the solid solution series spinel-gahnite within a compositional range from 95-45% spinel and from 0.2-50% gahnite. A complete solid solution series between aluminous spinel and an intermediate gahnospinel with about 50% of the gahnite end-member was confirmed.

M.O'D.

SCHUMANN, W. 1985. Sculpting in precious stone. *Optima*, **33**, 2, 61-6, 7 figs in colour.

Short article, beautifully illustrated, about gem carving in Idar-Oberstein. Four of the illustrations depict cameos on show at the local gem museum.

E.S.

SHOR, R. 1985. What if India offers quality diamonds at bargain rates? *Jewelers' Circular*

Keystone, **156,** 8, 187-201, 12 figs in colour.

A report on the growth of the Indian diamond cutting industry which is threatening those of Israel and Belgium in its low-cost turnover of fair-quality small stones. A bourse has been established at Bharat but it has not yet been recognized by the World Federation of Diamond Bourses. M.O'D.

THOMAS, A. 1984/1985. Perspective on gemmology. *South African Gemmologist,* **1,** 1, 3-6; **1,** 2, 3-4; **1,** 3, 3-5.

A survey of the current gemmological scene with particular reference to synthetic productions. M.O'D.

THOMAS, M. F., THORP, M. B., TEEUW, R. M. 1985. Paleogeomorphology and the occurrence of diamondiferous placer deposits in Koidu, Sierra Leone. *Journal of the Geological Society,* **142,** 5, 789-802, 8 figs.

The Koidu alluvial diamond field in Sierra Leone is examined on the basis of diamond distribution and geomorphology to give some idea of the emplacement of placers during the later Cenozoic. M.O'D.

ZEITNER, J. C. 1985. Gem fraud: problem for all. *Lapidary J.,* **39,** 3, 76-9.

Discusses the commoner frauds with particular reference to false appraisals. M.O'D.

ZEITNER, J. C. 1985. Gem chrysocolla. *Lapidary J.,* **39,** 6, 28-33, 4 figs (1 in colour).

Brief account of the ornamental stone chrysocolla with particular reference to North American deposits. M.O'D.

IDCA Newsletter is the official journal of the Indian Diamonds and Colour Stone Association, 22 West 48th Street, New York, NY 10036. U.S.A. Issue 2 of volume 1 contains a variety of short informative pieces on diamond and on the trade. M.O'D.

Jewellery studies, 1983/1984, 1, contains papers on a Phoenician earring; a sardonyx cameo acquired recently by the British Museum; Jewish marriage rings; Mughal jewellery; Royal wedding jewellery; the Layard family with particular reference to Lady Layard and her penchant for the work of Cortelazzo and Castellani, with other shorter papers. M.O'D.

Book Reviews

BARIAND, P., POIROT, J.-P. 1985. *Larousse des pierres precieuses, fines, ornamentales, organiques.* Larousse, Paris. pp.261. Illus. in colour. Price on application.

Most of this attractive book consists of gem materials described in alphabetical order but preliminary chapters deal with the symbolism of gemstones, their origin and historical use, their properties (in this section are some very fine photographs of inclusions) their fashioning and synthesis. At the end of the book are identification tables and a short bibliography. Details of important collections are also given. Few of the photographs have been published before and the book is worth buying for the illustrations alone.

M.O'D.

BECK, R. J. 1984. *New Zealand jade.* A. H. & A. W. Reed, Wellington. pp vi, 174. Illus. in colour. NZ $24.95.

This fascinating and readable book is concerned with all aspects of New Zealand jade. The author is Director of the Southland Museum, Invercargill (South Island) and is a jade lover, carver and explorer.

Following a brief introduction there is a short chapter on terminology which includes descriptions of the varieties of nephrite recognized by the Maoris. A major part of the book (52 pages) is devoted to accounts of the various jade fields in the South Island. Their geology is clearly explained and is supplemented by descriptions of the Maori and European discovery and exploitation of the deposits. A short chapter on the local bowenite follows. Maori history and legends concerned with jade are outlined and this is succeeded by a most interesting chapter on Maori lapidary methods. The stages in the manufacture of the Maori implements themselves are described next. The history and methods of European exploitation is followed by a chapter on lapidary hints.

Four appendices describe the origin of nephrite, the physical properties of New Zealand nephrite, the jade substitutes and world sources of jade. The glossary, bibliography and index are all extensive and admirably complement the excellent text. This is a very well illustrated paperback which promises to become a 'mini-classic'.

E.A.J.

BECKER, V. 1985. *Art nouveau jewelry.* Thames and Hudson, London. pp.240. Illus. in black-and-white and in colour. £25.00.

Printed in Japan, this is a well-presented study of a field in which there is a growing interest. The author, who has already produced excellent surveys of antique and twentieth-century jewellery, starts with an introduction to the conception of art nouveau before turning to France, Germany and Austria, Great Britain and the United States, each of which has its own chapter. Developments in other countries are also covered. Particularly useful are biographies of the major jewellers and a section on makers' marks and signatures. There is an adequate bibliography and an index.

The publishers are to be congratulated on producing so attractive a book at so low a cost. Standards of reproduction are high and the text is easy to read.

M.O'D.

CLIFFORD, D. *Anne Clifford's jewellery: antique.* Nottingham Court Press, London. pp.49. Illus. in colour. £14.95.

Anne Clifford was an authority on cut steel and Berlin ironwork jewellery though many other types feature in this pleasant catalogue whose entries give provenance as well as description. The standard of reproduction is generally good though by no means outstanding and the catholic taste displayed by the collector has given a selection of pieces which cover many dates and styles. Reasonably priced, this would be a good introduction to jewellery for a beginner.

M.O'D.

EPPLER, W. F. 1984. *Praktische Gemmologie. 2nd edn.* (Practical gemmology.) Rühle-Diebener-Verlag, Stuttgart. pp. xi, 504. Illus. in black-and-white. DM 158.

Almost all the book is taken up by descriptions of species and details of testing methods are left until the end. This does not matter since there are already plenty of teaching manuals; fewer books go to such trouble to provide detailed descriptions of all gem

species. Photographs of inclusions, as in the first edition, are particularly noteworthy and care has been taken to bring the accounts of major species up-to-date. In addition there is a good deal of information on synthetic stones which are placed in the text with their natural counterparts. Though Knischka ruby is mentioned the Ramaura product is not; on the other hand there are some excellent photographs of alexandrite trillings grown from the melt with a flux of lithium molybdate. It is, in fact, to the photographs that the reader returns and the book is well worth having for these alone. The remainder of the text is unexceptionable; identification tables, a glossary, drawings of absorption spectra and an index completing the book. The only serious desideratum is an adequate bibliography.
M.O'D.

PSCHICHHOLZ, D. 1979. *Diamant: gradierung, gewinnung, kauf.* (Diamond: grading, recovery, cost.) Rühle-Diebener-Verlag, Stuttgart. pp. 152. illus. in black-and-white. DM. 42.60.

A simple and attractively-presented guide to diamond with useful diagrams, especially clear on grading. This would make a good textbook for a preliminary diamond study course. M.O'D.

VAN LANDINGHAM, S. L. 1985. *Geology of world gem deposits.* Van Nostrand Reinhold, New York. pp. x, 406. Illus. in black-and-white. £51.15.

The book is divided into three sections, the first two of which contain 22 papers of a benchmark nature covering the general topics of the origin and development of gemstone deposits and their exploration, evaluation and occurrences. None are from obscure journals. The third section is a review of the geology of world gem deposits and consists of 126 pages of references preceded by a world survey, by continent, of the literature. This can only be selective as are the papers in the first two sections and I have been unable to find a linking thread. The references are useful as are the author and subject indexes but from the title I had hoped for a geological text. M.O'D.

ZEISS, W. 1984. *Setting of gemstones.* Rühle-Diebener-Verlag, Stuttgart. pp. 124. Illus. in black-and-white. Price on application.

The details of how to set gemstones are carefully and lucidly described, the author illustrating each stage with text diagrams. I know of no other book in which the techniques of the mounter and setter are so well covered and can strongly recommend it for those professionally engaged in setting and for those gemmologists who would like to know more about a topic so closely allied with their own. A bibliography would have been useful. M.O'D.

1984. *Goldschmiede- und Uhrmacher Jahrbuch 1985.* (Yearbook for the goldsmith and watchmaker.) Rühle-Diebener-Verlag, Stuttgart. pp. 176. Illus. in black-and-white and in colour. DM 17.20.

This issue of the valuable series contains papers on the history of platinum, the engraving of rock crystal, the colours obtainable from titanium, niobium and tantalum metals, together with papers chiefly of interest to the watchmaker. M.O'D.

Proceedings of the Gemmological Association of Great Britain and Association Notices

GIFTS TO THE ASSOCIATION

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

Mrs P. M. Goldie, London, for a copy of The Macdonald Encyclopedia of Rocks and Minerals, Macdonald & Co. Ltd, 1983, the Gemmologists' Compendium by Robert Webster, N.A.G. Press Ltd, London, 1979, and some back copies of the Journal of Gemmology.

Mr R. Lucas, F.G.A., Barnet, for a sovereign and half sovereign brass balance, and a small hand-held cased gem balance.

The Rayner Optical Co., Hove, for a copy of Dana's Textbook of Mineralogy, John Wiley & Sons, Inc., New York, 1966.

Mr Harry Wheeler, F.G.A., Chigwell, for a specimen of peridot from El Golfo Sands, Lanzarote, Canary Islands.

NEWS OF FELLOWS

Mr M. J. O'Donoghue, M.A., F.G.S., F.G.A., recently spent some time with the Gemstone Corporation of Pakistan visiting many of the gemstone mines and prospects.

Mr P. Read, C.Eng., M.I.E.E., M.I.E.R.E., gave two talks at the 2nd European Precious Stones Conference in Antwerp from 18th–20th October, 1985. His first talk illustrated the use of a computer gem data base as an aid to gem identification, and his second talk described the latest gem test instruments.

MEMBERS' MEETINGS

London

On 26th November, 1985, at the Flett Theatre, Geological Museum, Exhibition Road, South Kensington, London S.W.7., Mr J. I. Koivula, B.A., B.Sc., C.G., F.G.A., of the Gemological Institute of America, gave an illustrated talk entitled 'Microscopic characteristics of natural, synthetic and treated corundums'.

Midlands Branch

On 25th October, 1985, at Dr Johnson House, Bull Street, Birmingham, Mr E. Emms, F.G.A., of the British Gem Testing Laboratory, gave an illustrated talk entitled 'Inclusions and diamond grading'.

On 29th November, 1985, at Dr Johnson House, Mr D. J. Callaghan, F.G.A., gave a talk entitled 'From gem to jewel'.

North West Branch

On 17th October, 1985, at Church House, Hanover Street, Liverpool 1, the Annual General Meeting was held, at which Mr S. Hill, F.G.A., was elected Chairman and Mrs E. Cartmel re-elected Secretary.

On 21st November, 1985, at Church House, Mr P. Harrison gave a talk entitled 'The Blue John mines'.

South Yorkshire and District Branch

On 15th October, 1985, at Sheffield City Polytechnic, Pond Street, Sheffield, Mr D. Price, F.G.A., gave a talk entitled 'The cutting of gemstones'.

On 19th November, 1985, at Sheffield City Polytechnic, Mr D. H. Ariyaratna gave a talk entitled 'The gemstones of Sri Lanka'.

ANNUAL REUNION OF MEMBERS AND PRESENTATION OF AWARDS

The Annual Reunion of Members and Presentation of Awards took place at Goldsmiths' Hall on 28th October, 1985. The Chairman of the Association, Mr David Callaghan, F.G.A., opened the meeting by welcoming those present. He explained that this year 1184 students had taken their examinations in 26 countries. It was a great challenge to the Association's staff to organize this and he thanked and congratulated them.

He continued that it was a special evening because for the first time since 1974 someone from the U.K. had been awarded the Association's top award, the Tully Medal. The winner, Gwynneth Mary Green of Barnt Green, Birmingham, had won the Anderson Medal last year and was the first person ever to receive both awards.

An Honorary Fellowship had also been awarded, which was, Mr Callaghan explained, another rare event as there were only six altogether. It went to Mr Ted Thomson who had been in the coloured stone trade for many years. Mr Thomson, he continued, was a major figure in the London trade and was a past president of the Colour Stone Section of C.I.B.J.O.

He then called on Mr Richard T. Liddicoat, Jr, Hon. F.G.A., Chairman of the Board of the Gemological Institute of America, to present the awards.

After the presentations Mr Callaghan announced that the Basil Anderson Appeal for a spectrophotometer was now only £3000 short of the target figure of £25000. He thanked all those who had sent in donations.

Mr Liddicoat then delivered his address. He took the opportunity to congratulate all those who had passed their examinations. It took an effort, he said, as the G.A. courses were rigorous and demanding – it was a task that needed perseverance. Home study graduates, he said, were a 'special lot', rare people who had the perseverance to carry out such a programme without falling by the wayside. They were 'above the crowd', he added, and many employers looked for that extra something – people likely to get ahead and be successful employees.

But, he warned, do not be over-confident or arrogant, it was not helpful with peers. It was, in any case, imperative to regard the F.G.A. as a foundation on which to build a career, a start to which years of experience should be added. Basil Anderson, he reminded the audience, had never stopped learning.

It was important to keep abreast of what was going on by reading publications that gave material in enough depth to be of value to the F.G.A. Another aspect, he felt, was to establish if possible a communication network of peers in the locality. Although the large cities had association meetings, a closer relationship was really needed, especially for those outside the towns. Such links he felt, maintained contact, built credibility and could even be an early warning system too.

The trade, he said, was 'ever changing and never boring'. Not only was it one of the most exciting professions, he continued, it was dealing with people who were looking for beauty for a loved one. It was a happy profession and a constant challenge. Every day of his 45 years he'd enjoyed the thought of going to the G.I.A. and 'seeing what was new'. He hoped that those newly qualified would find it as enjoyable.

Thanking Mr Liddicoat, Mr Noel Deeks, Vice-Chairman of the Gemmological Association, said that he hoped those present would find time to give to the Association. Gemmology was like a garden – you only got out what you put in.

In conclusion Mr Callaghan told the audience that the Association was looking at the possibility of creating a new home study course for the Diamond Diploma. They were definitely revamping the whole G.A. examination course, and the Preliminary section would be available by September 1986.

COUNCIL MEETINGS

At the meeting of the Council held on 25th September, 1985, at the R.A.C. Club, London S.W.1, the business transacted included the following:

(1) Mr Ted Thomson were elected an Honorary Fellow;
(2) it was agreed that a warning about the dangers of using Clerici solution should be published in the Journal of Gemmology (see p.69 below);
(3) the following were elected to membership;

Fellowship

Abrahams, Roy H., Ruislip. 1985
Alexander, Nicholas A., Linden, S. Africa. 1984
Ambrose, Janice M., Enfield. 1985
Bateley, Linda A., Tenterden. 1985
Brook, Judith M., Knighton. 1985
Cooper, Berzes, London. 1985
Ellis, Trevor E., Rugeley. 1985
Evans, Gareth D., Potters Bar. 1985
Green, Fiona E., Stonehaven. 1985
Groves, Lesley C., Eastbourne. 1985
Helton, Janet L., Calgary, Alta, Canada. 1983
Herold, Richard A. J., Salisbury. 1985
Iacovou, Elena, London. 1985
Jacobs, Dalia, Harrow. 1985
Jones, Karen, Bangor. 1985
Jones, Kevin P., Coventry. 1985
Klimek, Karol S., Tunbridge Wells. 1966
Knight, Norman, New Milton. 1985
Kothari, Prajesh R., Madras, India. 1984
Layhe Cook, Judith A., Tiddington. 1985
Lewis, Doreen E., Monmouth. 1985
Loveday, Elsje, St Martins, Guernsey, C.I. 1985
Osborne, Malcolm G., Bordon. 1985
Ramsey-Rae, Philippa A., London. 1985
Sanders, Adam F., Ware. 1985
Savin, Vincent G., Rickmansworth. 1985
Sayers, Claire L., Twickenham. 1985
Shankar, Sangeeta, Luton. 1985
Stead, William A., London. 1985
Sturman, Nicholas P. G., London. 1985
Wilkinson, Richard C., Prestbury. 1985
Young, Gabrielle E. M., Wareham. 1985

Transfers from Ordinary Membership to Fellowship

Abe, Kazumi, Kofu, Japan. 1985
Ashraf, Ashraq A., London. 1985
Bell, Heather L., Formby. 1985
Brinkmann, Hans H., Idar-Oberstein, W. Germany. 1985
Broad, Arline E., Thames, New Zealand. 1985
Caycedo, Miguel J., Bogota, Colombia. 1985
Chilvers, Alan, Guildford. 1985
Chiu, King-Yip A., Hong Kong. 1985
Clancy, Allan W., Brisbane, Qld, Australia. 1985
Derks, Ruedi, Hetlingen, Switzerland. 1985
Doerr, Bertrand R., Kusnacht, Switzerland. 1985
Emmanuel, Michael R., St Helier, Jersey, C.I. 1985
Francis, Shirley J., Frinton-on-Sea. 1985
Fry, Kate E., Bath. 1985
Fujii, Shinichi, Tokyo, Japan. 1985
Gerhart, Anna M., San Diego, Calif., U.S.A. 1985
Gonggryp, Hendrik S., The Hague, Netherlands. 1985
Green, Gwynneth M., Birmingham. 1985
Hallier, Michele, Paradise Valley, Ariz, U.S.A. 1985
Harding, Keith J., Worcester, Mass., U.S.A. 1985
Harrington, Christine M., Seattle, Wash., U.S.A. 1985
Henderson, Mark M., Dundee. 1985
Hill, Arthur E., St Saviour, Jersey, C.I. 1985

Imai, Yoshiko, Tokyo, Japan. 1985
Kawamoto, Midori, Tokyo, Japan. 1985
Kirstein, Mark H., Eastbourne. 1985
Kochhar, Narinder, J. S., London. 1985
Kruithof, Pieter, Amsterdam, Netherlands. 1985
Larson, Len, Thornton, Colo., U.S.A. 1985
Ly, Khai, Sydney, N.S.W., Australia. 1985
McKee, Catherine A., London. 1985
Minton, Annie P., London. 1985
Moore, Elaine P., London. 1985
Morrison, Stephen P., London. 1985
Murakami, Ryutaro, Osaka, Japan. 1985
Ohshiro, Kenji, Tokyo, Japan. 1985
Or, Wai Lam, Hong Kong. 1985
Perrott, Christopher J., London. 1985
Quy, Caroline E., Chalfont St Giles. 1985
Roach, Michael P., Howell, N.J., U.S.A. 1985
Sasaki, Kiyoshi, Ehime Pref, Japan. 1985
Shum, Chan H., Kuala Lumpur, Malaysia. 1985
Stather, Memory H., Hong Kong. 1985
Stephenson, Timothy, Creetown. 1985
Taank, Avinash, Ilford. 1985
Taylor, Alec E., Lasswade. 1985
Thomis, Helen M., Halifax. 1985
Thornley, Joan A., Green Bay, Wis., U.S.A. 1985
Voce, Elizabeth M., Topsham. 1985
Wackan, Susan K., London. 1985
Waddington, Clive, Harrogate. 1985
Watson, Thomas N., London. 1985
Yoshiyama, Masaru, Chiba, Japan. 1985

Ordinary Membership

Akers, Patrick J., Wimborne.
Bonsor, Gordon L., Colchester.
Bowers, Barbara J., Borrego Springs, Calif., U.S.A.
Campbell, Norma, Repulse Bay, Hong Kong.
Castora, Loretta C., New York, N.Y., U.S.A.
Chooi, Siew-Thim, London.
Corcoran, Jocelyn M., New Plymouth, New Zealand.

Corliss, James C., Chalmette, La, U.S.A.
De'Ath, David, Luanshya, Zambia.
De Bevere, Dirk, Coogee, N.S.W., Australia.
Finnegan, Robin S., Stockton-on-Tees.
Gambini, Elena, Milan, Italy.
Gardiner, Kenneth, Lanchester.
Grumser, Pierre, Lausanne, Switzerland.
Hamawi, George, Nairobi, Kenya.
Hawkhead, Carol, Bournemouth.
Henderson, Paul T., Auckland, New Zealand.
Hinchliffe, Stanley E., Lota, Qld, Australia.
Hirst, Lindy M., Johannesburg, S. Africa.
Hossen, Iqbal H., Port-Louis, Mauritius.
Huntington, Richard C., Las Vegas, Nev., U.S.A.
Jakob, Beatrice, London.
Kennedy, Aleta J., Staines.
Kneip, John R., London.
Kwan, Patrick C., London.
Lamb, Walter R., Leighton Buzzard.
Leith, Harold B., Golden, Colo., U.S.A.
Lloyd, Susannah M. D., Abergavenny.
McCarthy, Raymond C. Jr., Chattanooga, Tenn., U.S.A.

MacGregor, Douglas I., Brazil.
McGurn, Walter E., Huntingdon.
Maclean, Mimi, Cherry Hinton.
Maetzener-Levy, Lydia, Zurich, Switzerland.
Markov, Mark, London.
Michaels, Amy J., Montgomery, Ala., U.S.A.
Michons-Bordes, Helena, Uppsala, Sweden.
Mitchell, Christopher, Leigh-on-Sea.
Murphy, David R., Haverhill.
Nielsen, Lolita A., Nairobi, Kenya.
Niklewicz, Danusia, Santa Monica, Calif., U.S.A.
Osmond, Mark E., Salisbury.
Pettinger, Richard H., Bristol.
Pozzi, Amelia, Appiano Gentile, Italy.
Pretty, Eric J., South Auckland, New Zealand.
Ravagnani, Daniele, Gromo, Italy.
Redcliffe, Jacqueline, Hove.
Roebuck, Joy A., Beckenham.
Rothon, Jeremy, Randburg, S. Africa.
Schloss, Sindi J., Scottsdale, Ariz., U.S.A.

Silvennoinen, Pirjo P., Sevenoaks.
Sinclair, Lyall W., Burwell.
Sinderholm, Evelyn W., Poway, Calif., U.S.A.
Smith, Adrian S., Portsmouth.
Stradling, Zoe V., Lausanne, Switzerland.
Suchcicki, Eugeniusz M., Nairobi, Kenya.
Sylvester, Elizabeth M., Seend.
Tripp, Julia M., Seoul, Korea.
Van Gelder, Lizbeth, London.
Wheeldon, Hayley, D., Ryde.
Witlin, Holly, Ambler, Pa, U.S.A.
Wong, Bambi, San Francisco, Calif., U.S.A.
Yandle, Lorna R., Bethesda, Md, U.S.A.
Yasui, Eleanore, Arlington, Va, U.S.A.
Yeo, Clarisse, Singapore.
Young, Roy T., Dunedin, New Zealand.
Yu, Stephen, London.

At a meeting of the Council held on 19th November, 1985, at the Marlborough Crest Hotel, Bloomsbury Street, London W.C.1., the business transacted included the election to membership of the following:

Fellowship
Ashton, Joan P., Hong Kong. 1985
Bolin-Möller, Anita, Taby, Sweden. 1985
Bosch, Coert E., Arnhem, Netherlands. 1985
Bram, Carol B., Hong Kong. 1985
Bryson, Varaphorn P., Washington Township, N.J., U.S.A. 1985
Carter-Van Roy, Anne E., London. 1984
Chan, Chi K., Hong Kong. 1985
Cheng, Bakke P., Hong Kong. 1985
Cheng, Oi L. A., Hong Kong. 1985
Cheung, King W., Hong Kong. 1985
Choi, Shu W. A., Hong Kong. 1985
Cholat, Nicole B., Hong Kong. 1985
Comber, Takako K., Hong Kong. 1985
Devereux, James P., Toronto, Ont., Canada. 1985
Dewever, Marc L. N., Sittard, Netherlands. 1985
Fang, Jin K., Kaohsiung, Taiwan. 1985
Farley, Eileen J., Dublin, Eire. 1985
Grafin von Francken Sierstorpff, Monika, Cologne, W. Germany. 1985
Hall, Sylvia, Guildford. 1985
Harrison, Margaretha, Geneva, Switzerland. 1985
Inamochi, Sachiko, Niigata Ken, Japan. 1985
Johannessen, Penny M., Hong Kong. 1985
Kallner, Anders B., Frolunda, Sweden. 1985
Kuehn, J. Wolfgang, Vancouver, B.C., Canada. 1985
Levy, Stephen A., Washington DC, U.S.A. 1985
Lloyd-George, Kim A., Hong Kong. 1985
Lovering, Paula G., Alexandra, New Zealand. 1985
MacLennan, David J., Glasgow. 1985
Manorotkul, Wimon, Bangkok, Thailand. 1985
Mulder, Mieke, Amsterdam, Netherlands. 1985
Nakazawa, Hiromi, Tokyo, Japan. 1985
Ng, Koon Y., Hong Kong. 1985
Nurminen, Tuija P. A., Helsinki, Finland. 1985
Ocampo, Antonieta R., Hong Kong. 1985
Olsen, John R., Dhahran, Saudi Arabia. 1985
Olsen, Sandra A., Dhahran, Saudi Arabia. 1985
Patterson, Shannon, Gahanna, Ohio, U.S.A. 1985
Poelen, Ellen B., Molenhoek, Netherlands. 1985
Ross, Howard D., Harare, Zimbabwe. 1985
Rowley, Phillip L., Vienna, Va, U.S.A. 1985
Scandella, Stefano, Liestal, Switzerland. 1985
Siegel, Paul L., Port Jefferson, N.Y., U.S.A. 1985
Skytta, Martti V., Kouvola, Finland. 1985
Snare, Melanie J., Toronto, Ont., Canada. 1985
Strick, Frank, Miami Beach, Fla, U.S.A. 1985
Squelch, Bruce C., Toowoomba, Qld, Australia. 1985
Taylor, William W., Brisbane, Qld, Australia. 1985
Teramae, Kiyomi, Chiba Ken, Japan. 1985
Tsaktanis, Michael, Athens, Greece. 1985
Van der Giessen, Wilma, The Hague, Netherlands. 1985
Vikamsey, Shilpa J., Bombay, India. 1985
Wakabayashi, Hisao, Tokyo, Japan. 1985
Watanabe, Masahiro, Tottori Ken, Japan. 1985
Wong, W. Y. Eva, Hong Kong. 1985

Transfer from Ordinary Membership to Fellowship
Molina, Alfredo J., Phoenix, Ariz., U.S.A. 1985

Ordinary Membership
Archer, Mary C., Edinburgh.
Arthur, Lynne, Denny.
Bellers, Veronica O., Horsham.
Browne, Dudley M., Great Missenden.
Buxton, Lynne H., Norwich.
Chang, Hwei, London.
Chang, Ming C., London.
Chino, Hiroaki, Kofu, Japan.
Christensen, Cherie, San Jose, Calif., U.S.A.
Cook, Alan C., Epping.
Dawson, Kathryn L., Leighton Buzzard.
Elkins, Heather, Nairobi, Kenya.
Furuya, Tsukasa, Kofu, Japan.
Gay, Michael, Romsey.
Horiuchi, Yuzi, Kofu, Japan.
Ito, Masahiro, Kofu, Japan.
Jack, Barbara M., Dunblane.
Kirk, Helena, Milton Keynes.
Kramer, Stephen A., Bradford.
McManus, Andrea, Sausalito, Calif. U.S.A.
Manning, G., Middletown, Ohio, U.S.A.
Muran, Holly L., Reno, Nev., U.S.A.
Muratore, Rosanilla, London.

Ortenburger, Thomas, Lake City, Fla., U.S.A.
Polycarp, Qkoro, Imo Stata, Nigeria.
Sample, Fiona J., Morpeth.
Schorn, Terence F., West Vancouver, B.C., Canada.
Stewart, Robert, London.
Trusch, Alec, Dartford.
Underdown, Derek W., Partridge Green.
Van Hoffman, Geraldine, Hove.
Watanabe, Tatsuo, Kofu, Japan.
Yamase, Toshifumi, Kofu, Japan.
Yung Ho Yang, Robert, Sao Paulo, Brazil.

GEM DIAMOND EXAMINATION, 1985

In the Post-Diploma Gem Diamond Examination 44 candidates sat and all succeeded in passing. The following is a list of the successful candidates arranged alphabetically.

Adlam, Raymond J., Glasgow.
Anderton, Brian G., Glasgow.
Bird, Nigel G., Epsom.
Brown, James E., Banner Cross.
Bugg, John R., Tettenhall.
Calduch Sendra, Ma. Esmeralda, Barcelona, Spain.
Carter-van Roy, Anne E., London.
Chieveley-Williams, John P. E., Poole.
De Vilmorin, Marie E., London.
Dent, Peter J., Normandy.
Donoghue, Martin D., Glasgow.
Dunn, Nigel P., Brierley Hill.
Ely, Jana M., London.
Ferran Estrada, Alejandro, Barcelona, Spain.
Floriach Devant, Ma. Teresa, Barcelona, Spain.
Franks, Karen M., Prestwich.
Gilmour, Kevin D., Shiregreen.
Gol Perlasia, Joseph Ma., Barcelona, Spain.
Hinchliffe, Brian, Sheffield.
Holden, Patricia, Market Harborough.
Hookins, Gary C., Thames Ditton.
Housley, John G., Sheffield.
Hu, Shirley, London.
Judez Martinez, Gregorio, Barcelona, Spain.
Liggett, Sonia A., Penylan.
Lim, Pauline, Kingswinford.
Morris, Kelsey, Hayling Island.
Payne, Susan E., Sheffield.
Pellicer Garcia, Miguel, Barcelona, Spain.
Percival, Colin A., Netherthorpe.
Porter, James W., Coventry.
Puig Ovejero, Joseph Ma., Barcelona, Spain.
Rich, Frederick S., London.
Ros Hernandez, Julio, Barcelona, Spain.
Seiz Ortiz, Vicente J., Barcelona, Spain.
Shah, Syed S., Fallowfield.
Shaikh, Leela, London.
Sulis Mariscal, Ma. Angeles, Barcelona, Spain.
Taylor, Caroline H., Ripley.
Tudor-Pole, Tom J., London.
Warriner, Elizabeth R., Solihull.
Wickramasinha, Tudor, London.
Woolf, Tania, London.
Yap, Ching S., London.

EXAMINATIONS IN GEMMOLOGY, 1985

In the 1985 Examinations in Gemmology, 716 candidates sat the Preliminary Examination and 396 (55%) passed, and 468 sat the Diploma Examination and 209 (45%) passed, 27 with Distinction.

The Tully Medal has been awarded by the Examiners to Mrs Gwynneth Mary Green of Barnt Green, Birmingham.
The Anderson/Bank Prize has been awarded to Mr Hans-Heinrich Brinkmann of Idar-Oberstein, West Germany.
The Rayner Diploma Prize has been awarded to Mr Roland Schlüssel of Colombier, Switzerland.
The Anderson Medal has been awarded to Mr Reinholdt Ziegler Unhjem of Oslo, Norway.
The Rayner Preliminary Prize has been awarded to Mr Reinholdt Ziegler Unhjem of Oslo, Norway.

The names of the successful candidates are as follows:

DIPLOMA

Qualified with Distinction

Bell, Heather L., Formby.
Brinkmann, Hans-Heinrich, Idar Oberstein, W. Germany.
Brook, Judith M., Leicester.
Cheng, Bakke Pik-Kit, Hong Kong.
Clancy, Allan W., Brisbane, Qld, Australia.
Ellis, Trevor, E., Rugeley.
Fujii, Shinichi, Tokyo, Japan.
Green, Gwynneth M., Birmingham.
Halton, Elizabeth M., Huddersfield.
Jander, Margrit A. J., Geneva, Switzerland.
Kochhar, Narinder J. S., London.
Levy, Stephen A., Washington DC, U.S.A.
Lovering, Paula G., Alexandra, New Zealand.
Manorotkul, Wimon, Bangkok, Thailand.
Molina, Alfredo J., Phoenix, Ariz., U.S.A.
Nakamura, Kayoko, Tokyo, Japan.
Ohshiro, Kenji, Tokyo, Japan.
Olsen, John R., Dhahran, Saudi Arabia.
Or, Wai L., Hong Kong.
Patterson, Shannon F., Gahanna, Ohio, U.S.A.
Pickrell, Rupert J., Turramurra, N.S.W. Australia.
Scandella, Stefano, Basel, Switzerland.
Schlüssel, Roland, Colombier, Switzerland.

Skoropad, John D., Bangkok, Thailand.
Teramae, Kiyomi, Tokyo, Japan.
Voce, Elizabeth M., Topsham.
Young, Gabrielle E. M., Wareham.

Qualified

Abbot, Anita M., Phoenix, Ariz., U.S.A.
Abe, Kazumi, Kofu, Japan.
Abrahams, Roy H., Ruislip.
Allen, Viven, Toronto, Ont., Canada.
Ambrose, Janice M., Oakwood.
Arno Fece, Nuria, Barcelona, Spain.
Arroyo Llorens, Ma Cristina, Barcelona, Spain.
Ashraf, Ashfaq Ahmed, London.
Ashton, Joan P., Hong Kong.
Athanassiades, Emmanouela, Athens, Greece.
Baquero Petricorena, Manuel, Barcelona, Spain.
Batalla Vivas, Jose I., Barcelona, Spain.
Bateley, Linda A., Tenterden.
Bau Martinez, Ma Luisa, Barcelona, Spain.
Benser, Eugenie M., Baltimore, Md., U.S.A.
Bernad Soria, Pedro J., Barcelona, Spain.
Biosca Bas, Ma de los Angeles, Barcelona, Spain.
Bloodworth, Roy N., Ossett.
Bodifee, Brigitte K., Naarden, Netherlands.
Boermans, Antoon Peter E. M., Venlo, Netherlands.
Bolin-Moller, Anita M. H., Taby, Sweden.
Bosch, Coert E., Arnhem, Netherlands.
Bram, Carol B., Hong Kong.
Broad, Arline E., Thames, New Zealand.
Bryson, Varaphorn P., Bangkok, Thailand.
Cabre Bores, Nuria, Barcelona, Spain.
Campos Ruiz, Ma Teresa, Barcelona, Spain.
Canas Aguilar, Jose V., Barcelona, Spain.
Capar, Allan P., Springfield, Va, U.S.A.
Carmena Coelho, Jose A., Barcelona, Spain.
Caycedo, Miguel J., Bogota, Colombia.
Chan, Chi K., Hong Kong.
Chaparro Lameda, Daisy A., Barcelona, Spain.
Cheng, Oi Lun Alan, Hong Kong.
Cheung, King-Wing, Hong Kong.
Cheung, Lee, Hong Kong.
Chilvers, Alan, Guildford.
Chiu, King-Yip Alan, Hong Kong.
Choi, Shu-Wing Alex, Hong Kong.
Cholat, Nicole, Hong Kong.
Comber, Takako K., Hong Kong.
Cooper, Berzes, London.
Derks, Ruedi, Hettlingen, Switzerland.
Devereux, James P., Toronto, Ont., Canada.
Dewever, Jan A., Sittard, Netherlands.
Dewever, Marc L. N., Sittard, Netherlands.
Dickey, Timothy B., Ontario, Calif., U.S.A.
Doerr, Bertrand R., Kusnacht, Switzerland.
Dubbers, Maria-Theresia H., Plasmolen, Netherlands.
Emmanuel, Michael R., St Helier, Jersey, C.I.
Evans, Gareth D., Potters Bar.
Fang, Jin-Kuon, Kaohsiung, Taiwan.
Farley, Eileen J., Dublin, Eire.
Ferreira, Anslem C., Colombo, Sri Lanka.
Fournier-Laroque, Maryse M., Geneva, Switzerland.
Fox-Worthington, Peter J. J. E., Auckland, New Zealand.
Francis, Shirley J., Frinton-on-Sea.
Fry, Kate E., Bath.
Gabarro Val, Marta, Barcelona, Spain.
Gamblen, Philip M., Barrie, Ont., Canada.
Gascon Cuello, Fernando, Barcelona, Spain.
Georgopoulou-Kyriaki, Marianna, Athens, Greece.
Gerhart, Anna M., San Diego, Calif., U.S.A.
Gonggryp, Hendrik S., The Hague, Netherlands.
Gräfin von Francken Sierstorpff, Monika, Cologne, W. Germany.
Green, Fiona E., Stonehaven.
Grotenhuis, Ingrid, Winterswijk, Netherlands.
Groves, Lesley, Eastbourne.
Hall, Sylvia, Guildford.
Hallier, Michele, Paradise Valley, Ariz., U.S.A.
Harding, Keith J., Worcester, Mass., U.S.A.
Harrington, Christine M., Seattle, Wash., U.S.A.
Harrison, Margaretha, Geneva, Switzerland.
Henderson, Mark MacArthur, Dundee.
Herold, Richard A. J., Salisbury.
Hill, Arthur E., St Saviour, Jersey, C.I.
Iacovou, Elena, London.
Imai, Yoshiko, Tokyo, Japan.
Inamochi, Sachiko, Niigata Ken, Japan.
Insa Sales, Juan M., Barcelona, Spain.
Jacobs, Dalia, London.
Johannessen, Penny M. F., Hong Kong.
Jones, Karen, Bangor.
Jones, Kevin P., Coventry.
Jongenburger, Irma, Ede, Netherlands.
Juan Sampablo, Teresa, Barcelona, Spain.
Kai, Kock M., Hong Kong.
Källner, Anders B., Johanneshov, Sweden.
Kawamoto, Midori, Tokyo, Japan.
Kirstein, Mark H., Eastbourne.
Kittel, Gerhilde A., Toronto, Ont., Canada.
Knight, Norman, New Milton.
Kothari, Rekha Y., Bombay, India.
Kruithof, Pieter, Amsterdam, Netherlands.
Kuehn, Johann W., Vancouver, B.C., Canada.
Larson, Len, Thornton, Colo., U.S.A.
Layhe Cook, Judith A., Stratford-upon-Avon.
Lewis, Doreen E., Monmouth.
Liyanaarachchi, Tudor P., Colombo, Sri Lanka.
Lloyd-George, Kim A., Hong Kong.
Llucia Aguilera, Rosa, Barcelona, Spain.
Loveday, Elsje, St Martins, Guernsey, C.I.

Ly, Khai, Sydney, N.S.W., Australia.
McKee, Catherine A., London.
MacLennan, David J., Glasgow.
Major, Christine B., Sydney, N.S.W., Australia.
Marti Martinez, Nicolas, Barcelona, Spain.
Minton, Annie P. London.
Moore, Elaine, London.
Morrison, Stephen P., London.
Mulder, Mieke, Amsterdam, Netherlands.
Murakami, Ryutaro, Osaka, Japan.
Nakazawa, Hiromi, Tokyo, Japan.
Ng, Raymond Koon Yung, Hong Kong.
Ngai, Ramon Pui Chun, Hong Kong.
Niklewicz, Danusia, Santa Monica, Calif., U.S.A.
Nurminen, Tuija P. A., Helsinki, Finland.
Ocampo, Antonieta R., Hong Kong.
Olsen, Sandra A., Dhahran, Saudi Arabia.
Osacar Soriano, Ma Cinta, Barcelona, Spain.
Osborne, Malcolm G., Bordon.
Overbeek, Louise A.-M., Leiden, Netherlands.
Pajaron Gamon, Ma Loreto, Barcelona, Spain.
Papadopoylos, Fatalas C., Athens, Greece.
Parker, Claire E., Worthing.
Pascual Torres, Jose L., Barcelona, Spain.
Payette, Francine, Sillery, Que., Canada.
Penfold, Reginald C., Maidstone.
Perrott, Christopher J., London.
Platon Davila, Susana, Barcelona, Spain.
Poelen, Ellen B., Molenhoek, Netherlands.
Prezio, Anthony, Toronto, Ont., Canada.
Quy, Caroline E., Chalfont St Giles.
Radan, Milan, Toronto, Ont., Canada.
Ramsey-Rae, Philippa A., London.
Roach, Michael P., Howell, N.J., U.S.A.
Rodriguez Pellicer, Antonia L., Barcelona, Spain.
Ross, Howard D., Harare, Zimbabwe.
Rowley, Phillip L., Vienna, Va., U.S.A.
Ruiz Roser, Emilio, Barcelona, Spain.
Sanders, Adam F., Ware.
Sasaki, Kiyoshi, Ehime Pref., Japan.
Savin, Vincent G., Rickmansworth.
Sayers, Claire L., Plymouth.
Shankar, Sangeeta, Luton.
Shimizu, Yoshimi, Yamanashi, Japan.
Shum, Chan Hui, Kuala Lumpur, Malaysia.
Siegel, Paul L., Patchogue, N.Y., U.S.A.
Skyttä, Martti V., Kouvola, Finland.
Snare, Melanie J., Toronto, Ont., Canada.
Snijders, Adriana C. M., Mapert, Netherlands.
Spreckley, Vaughan G. M., London.
Spuida, Bernhard H. A. A., Pfronten, W. Germany.
Squelch, Bruce C., Toowoomba, Qld, Australia.
Stather, Memory H., Hong Kong.
Stead, William A., London.
Stephenson, Timothy, Creetown.
Strick, Frank, North Miami Beach, Fla., U.S.A.
Sturman, Nicholas P. G., Marlborough.
Taank, Avinash, Ilford.
Tam, Man Wai, Hong Kong.
Taylor, Alec E., Lasswade.
Taylor, William W., Brisbane, Qld., Australia.
Tetteroo, Caroline C. B. O., Nootdorp, Netherlands.
Thomis, Helen M., Halifax.
Thornley, Joan A., Green Bay, Wis., U.S.A.
Tsaktanis, Michael, Athens, Greece.
Van Dergiessen, Wilma, The Hague, Netherlands.
Van Oyen, Jean-Paul, Wijchen, Netherlands.
Vassiliades, Dionyssi, Athens, Greece.
Vikamsey, Shilpa J., Bombay, India.
Wackan, Susan K., London.
Waddington, Clive, Harrogate.
Wakabayashi, Hisao, Tokyo, Japan.
Watanabe, Masahiro, Tokyo, Japan.
Watson, Thomas N., London.
Wilby, Christine A., Birmingham.
Wilkinson, Richard C., Prestbury.
Wong, Wai Yuk Eva, Hong Kong.
Yoshiyama, Masaru, Chiba Pref., Japan.
Young, Pak Chee Patrick, Hong Kong.
Zandvoort, Christine J. M., Rotterdam, Netherlands.

PRELIMINARY

Qualified

Abe, Kazumi, Kofe, Japan.
Abear, Marga, Northwood.
Abell, Alison M., Nairobi, Kenya.
Abramson, Pamela J., Orlando, Fla., U.S.A.
Adams, Amanda C., Leicester.
Agrawal, Nirmal, Aldershot.
Akers, Patrick J., Wimborne.
Albers, Hermina J., Vinkeveen, Netherlands.
Alexander, Jane E., Singapore.
Alford, Audrey E., Oslo, Norway.
Alliance, Alma B., Manchester.
Andrews, Olive M., Hong Kong.
Arias, Garnacho A., Madrid, Spain.
Armand, M., Auckland, New Zealand.
Arnold, Gillian M., London.
Arroyo Llorens, Ma Cristina, Barcelona, Spain.
Arthur, Lynne, Denny.
Artz, Rudolf J. M., Antwerpen, Belgium.
Axelson, Glenn N., Wawa, Ont., Canada.
Barber, Roxey L., Encinitas, Calif., U.S.A.
Barber, Susan A., Cowfold.
Bartholomew, Jurgen C., Shoreham-by-Sea.
Bateman, Linda D., Vancouver, B.C., Canada.
Bau Martinez, Ma Luisa, Barcelona, Spain.
Baz Seguido, Ma Luisa, Barcelona, Spain.
Beighton, Philip D., Sheffield.
Beljaars, Maria M. J., Schoonhoven, Netherlands.
Bellers, Veronica O., Horsham.

Benser, Eugenie M., Baltimore, Md., U.S.A.
Blackburn, James O., Winchester.
Blake, Nicholas P., Southampton.
Bolland, Marian W., Hong Kong.
Booth, Ian M., Leeds.
Borden, Parker A., Lakeside, Calif., U.S.A.
Bragg, Moira A., Bolton.
Braid, Robert N., Prestwich.
Bramlett, Christopher L., Albemarle, N.C., U.S.A.
Brelsforth, Jane, Chadderton.
Bres, Klesine N., Boxtel, Netherlands.
Brill, Douglas, Halifax.
Brinkmann, Hans-Heinrich, Idar Oberstein, W. Germany.
Brophy, Mark S. J., Gatley.
Brouwers, Godfried W. C., Valkenburg, Netherlands.
Brown, Malcolm R., Wigan.
Bruggeman, Renate F., Almelo, Netherlands.
Bryson, Varaplforn P., Bangkok, Thailand.
Buescher-Hain, Jane, Seattle, Wash., U.S.A.
Buglass, James J., Uckfield.
Burns, Gail P. L., Bethesda, Md., U.S.A.
Burton, Nicholas J., Fradley.
Butfoy, Carol A., Kenton.
Butler, John J., South Shields.
Caballeria Surinach, Ma Assumpta, Barcelona, Spain.
Capar, Allan P., Springfield, Va, U.S.A.
Carmody, Justine L., Thames Ditton.
Carnes, John E., Trowbridge.
Carroll, Elizabeth K., Auckland, New Zealand.
Casanova Guillen, Luis M., Barcelona, Spain.
Chalandon, Tohra, London.
Chan, Pik Yuk Addy, Hong Kong.
Chan, Richard Ki-Mun, London.
Chang, Nancy A., Hong Kong.
Chard, Duncan, London.
Chavan, Satish G., Bombay, India.
Cheung, Lai Chun Mercedes, Hong Kong.
Chow, Winston Wun-Sing, Hong Kong.
Chowdhury, Iqbal K., Solihull.
Chu, Veronica, Stockport.
Chung, Stephen Wui Kwong, Leeds.
Clark, Berenice M., Hobart, Tasmania.
Clarke, Anthony, Bromley.
Coleman, Rachel R., Newbury.
Colvin, Moranna, Hong Kong.
Cooney, Tracy J., Birmingham.
Corniplas, Elias L., Agincourt, Ont., Canada.
Courtenay, Penelope A., Barton-le-Clay.
Cox, Simon A., Blackpool.
Crowley, Deborah K., London.
Cullen-Spellman, Rosemary, Ennis, Eire.
Curwen, Ruth E., Tonbridge.
Cuthbert, Richard A., London.
Dangedara, Dezinzige A. N., Colombo, Sri Lanka.
Davidson, Helen, Durham.
Dawes, Percival E., Stevenage.
De Boer, Gerrit-Jan, Schoonhoven, Netherlands.
De Bruno, Philip, Clifton, N.J., U.S.A.
De Grafte, Hendricus A. M., Geldrop, Netherlands.
De Jong, Anna M. C., Boskoop, Netherlands.
Dean, John A., Ossett.
Delgado Chaubell, Cristina, Barcelona, Spain.
Dickey, Timothy B., Ontario, Calif., U.S.A.
Dieste Torres, Jose L., Barcelona, Spain.
Dikhoff, Frederikus J., Castricum, Netherlands.
Domenech Lahoz, Christiane, Barcelona, Spain.
Droste, Gregory S., Evansville, Ind., U.S.A.
Dworschak, Francis, Ottawa, Ont., Canada.
Ebrahim, Nazma R., Nairobi, Kenya.
Ekman, Lars A., Malmoe, Sweden.
Elkins, Heather, Nairobi, Kenya.
Endo, Takako, Kofu, Japan.
Epa, Widanagamage S. D., Mt Lavinia, Sri Lanka.
Eriksson, Brita A., Helsinki, Finland.
Fang, Jin-Kuon, Kaohsiung, Taiwan.
Fedell, Jean M., Crystal Lake, Ill., U.S.A.
Fernandez Nunez, Francisco J., Barcelona, Spain.
Fernandez Sanchez, Fernando, Barcelona, Spain.
Fernando, Malnaidelage T. W., Katunayaka, Sri Lanka.
Ferrer Verdasco, Marta, Barcelona, Spain.
Fessel, Robert P., Paulding, Ohio, U.S.A.
Fitzgerald, Trevor M. P., Folkestone.
Fu, Milal M., Hong Kong.
Gabarro Vall, Marta, Barcelona, Spain.
Gampola, Hennayake M. T., Katunayake, Sri Lanka.
Gardiner, Margot, Glasgow.
Garrigos McCarthy, Carlos L., Barcelona, Spain.
Gentsidou, Fotini, Athens, Greece.
Geolat, Patti J., Dallas, Tex., U.S.A.
Gillett, Graham, Bexhill-on-Sea.
Gillings, J., Croydon.
Girard, Patricia A., Kirn Dunoon.
Glaveau, Beatrice, Paris, France.
Glenister, James E., Eastbourne.
Glover, Andrew M., Horsham.
Gold, Francine, Markham, Ont., Canada.
Gollance, Caryl I. P., London.
Goodall, Andrew M., Rickmansworth.
Goodlin, Fran, Toronto, Ont., Canada.
Graham, Robert C. P., London.
Greeno, Philip M., Hastoe.
Gronlund, Tuulikki I., Espoo, Finland.
Grote, Isabelle, London.
Gunawardena, Warrussapperuma A. D., South Croydon.
Gunawardene, Kingsley de Silva, Dehiwala, Sri Lanka.

Hagen, Jeannette A., Leidschendam, Netherlands.
Hagnas, Lloyd, San Diego, Calif., U.S.A.
Hakanpaa, Miika J., Lahji, Finland.
Hall, Nicholas R., Bath.
Hallier, Michele, Paradise Valley, Ariz., U.S.A.
Halloran, Ellen M., New York City, N.Y., U.S.A.
Haque, Mohammed M., London.
Hash, Daniel W., Watrous, Sask., Canada.
Hatjis, John H., Athens, Greece.
Hawkhead, Carol, Bournemouth.
Heindorff, Judith H., Arana Hills, Qld, Australia.
Hellqvist, Ing-Britt E., Tumba, Sweden.
Helmore, Peter R., London.
Hemachandra, Chamindri, Colombo, Sri Lanka.
Hepburn, John A., Orpington.
Hewitt, Peter R., Horsforth.
Higgingson, Clare M., Colne.
Hinds, Andrew F., Rickmansworth.
Hirst, Susan C., Palmerston North, New Zealand.
Hodges, Mark C., Bristol.
Hogben, Richard N., Dumfries.
Holopainen, Outi T., Helsinki, Finland.
Holton, Yvonne, Edinburgh.
Horsup, Alexine, Birmingham.
Howell, Elizabeth J., Saffron Walden.
Hudson, Carole A., Ware.
Hui, Yat Sun K., Hong Kong.
Huiskamp, Eveline A., The Hague, Netherlands.
Humpage, Susan A., Birmingham.
Hyrsky, Kaisa M., Lahti, Finland.
Inestal Hermida, Susana, Barcelona, Spain.
Iwaki, Takakazu, Hyogo, Japan.
Jackson, Sarah E., Chorleywood.
Jain, Monica, Bombay, India.
Jokipii, Vesa E. K., Turku, Finland.
Jongeleen, Johannes T., Delft, Netherlands.
Kahari, Eeva P. K., Lahti, Finland.
Kalannayake, Lenaduwa L. Y. R., Kegalle, Sri Lanka.
Kallitsis, Henrietta, Athens, Greece.
Karunanayake, Sarath P., Dehiwala, Sri Lanka.
Keerthi, Koku H. U. J., Gampaha, Sri Lanka.
Kievit, Wouter, Rotterdam, Netherlands.
Kiewiet, Jantine A., Hong Kong.
King, Geoffrey R. G., Maidstone.
Kingshott, Clifford J., Brookmans Park.
Kirkland, Vanda J., Brighton.
Kishi, Masaki, Hiratsuka, Japan.
Kittilsen, Harald, Stathelle, Norway.
Klein, Linda S., Saltsjo-Boo, Sweden.
Knox, George T., South Harrow.
Kojima, Yaeko, Choufu City, Japan.
Kolick, Donald, North Olmsted, Ohio, U.S.A.
Koski, Jouko I., Helsinki, Finland.
Kotewall, Pik Y., Hong Kong.
Kothari, Rekha Y., Bombay, India.
Kubota, Kazuyuki, Tokyo, Japan.
Kuwahara, Chizu, Yokosuka City, Japan.
Laaksonen, Susanna M., Saltsjobaden, Sweden.
Lam, Fung-Han A., Hong Kong.
Lam, Keturah, London.
Lampinen, Heikki S. J., Jyvaskyla, Finland.
Landholt, Karin, Beijing, P. R. of China.
Lash, Vincent S., Chevy Chase, Md., U.S.A.
Lau, Yim M. T., Hong Kong.
Lee, Mei-Ying, Hong Kong.
Leichtenstein, Cess H., Neuhof, Austria.
Leigh, Nancy E., Brisbane, Qld., Australia.
Lenting, Heike A., Purmerend, Netherlands.
Leung, Marilyn S., Hong Kong.
Levy, Stephen A., Washington D.C., U.S.A.
Lewis, Robert C., Redbourn.
Linley, Mark A., Worcester.
Liu, Chi W. R., Hong Kong.
Lo, Jeanette, Hong Kong.
Lode, Lillian, Egersund, Norway.
Loh, Man-Pak V., Hong Kong.
Loohia, Bhavendra B., London.
Luk, Woon C., Hong Kong.
McArthur, Niven R., Southland, New Zealand.
MacGregor, Douglas I., Brazil.
McKee, Catherine A., London.
McQueen, Colin F., Lincoln.
Manders, Andrew P., Gloucester.
Manorotkul, Wimon, Bangkok, Thailand.
Martens, Judocus M., Deurne, Netherlands.
Martin, David J., Warrington.
Martinez Garcia, Eva M., Barcelona, Spain.
Maskonen, Seija S., Helsinki, Finland.
Mehta, Smita D., Flushing, N.Y., U.S.A.
Merk, Roger L., San Diego, Calif., U.S.A.
Merry, Neil J., Broxbourne.
Meyot, Eline G., Huizen, Netherlands.
Michiels, Marina J. M., Bengambucht, Netherlands.
Michon-Bordes, Helena M. J., Uppsala, Sweden.
Millage, Michael D., Manchester.
Mills, Edwin T., Ely.
Mills, Ganny, Hong Kong.
Mitchell, Irene E., Worcester.
Molina, Alfredo J., Phoenix, Ariz., U.S.A.
Moreno Ribot, Ignasi, Barcelona, Spain.
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O, Yan K. R., Hong Kong.
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Perera, Shobana, Nugegoda, Sri Lanka.
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Powell, Warren, Manchester.
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Premadasa, Jayasinghage D., Gona Junction, Sri Lanka.
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Sabeti, Elham, Manipal, India.
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Sankar, David, London.
Sato, Kazuo, Fussa City, Japan.
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Tsuruta, Einori, Alameda, Calif., U.S.A.

Tucker, Charles, Swaffham.
Unhjem, Reinholdt, Oslo, Norway.
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Van der Meer, Bernadette W. M., Eindhoven, Netherlands.
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Varma, Pirjo A., Lahti, Finland.
Verdu Perez, Mariano, Barcelona, Spain.
Vikamsey, Shilpa J., Bombay, India.
Vilanova Cardona, Elvira, Barcelona, Spain.
Visvaratnam, Suppiahpillai, Colombo, Sri Lanka.
Wade, Helen N., Birmingham.
Wadey, Sarah R. B., Hove.
Waldeck, Stephen J., Plymouth.
Walsh, Claire E., London.
Wan, Chan K., Hong Kong.
Wat, Hoi Chi Wanda, Hong Kong.
Watson, Charles E., Kimberley.
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White, Robert, Northampton.
Wickramaratne, Premalal K., Avissawella, Sri Lanka.
Wilkinson, Richard C., Prestbury.
Williams, Bret J., Waikato, New Zealand.
Wirman, Anna L., Saltsjo-Boo, Sweden.
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Yamazaki, Koji, Tokyo, Japan.
Yandle, Lorna R., Bethesda, Md., U.S.A.
Yates, Alexa G., London.
Yau, Tai Wai, Hong Kong.
Yau, Vivian, Hong Kong.
Youngs, Michael A., Felixstowe.
Yung, Yuen H., Hong Kong.
Zagoritis, Sheelagh L., Nairobi, Kenya.
Zanghi, Eugenio, Amsterdam, Netherlands.

EXAMINATIONS 1986

The examination dates for 1986 are as follows:

Gem Diamond Examination:
Monday, 9th June.

Examinations in Gemmology:
Preliminary, Theory, Tuesday, 24th June
Diploma: Theory, Wednesday, 25th June
Practical, Thursday, 26th June (in London the practical examination may be held on other days in that week).

The last date for receiving examination entry forms is 31st March.

CLERICI SOLUTION A WARNING

In view of the extremely dangerous nature of Clerici solution and the possible hazards when used by individuals not accustomed to handling dangerous chemicals, the Council has decided that the Association (1) should not support its use in gem testing and (2) would not supply the solution in future.

LITERATURE GUIDES

The Science Reference Library hopes to publish two literature guides, one to mineralogy, the other to gemmology, over the next few months. Will anyone interested please write to External Relations Section, Science Reference Library, 25 Southampton Buildings, London WC2A 1AW – this will help the market assessment.

20th INTERNATIONAL GEMMOLOGICAL CONFERENCE, SYDNEY, AUSTRALIA

This very successful conference was held from 29th September to 4th October, 1985, at the Manly Pacific Hotel on the shores of Sydney Harbour. Delegates from 17 countries attended.

Authors and titles of papers are listed below in order of presentation.

Chalmers, R. O. Australian gem and ornamental minerals.
Sobolev, N., Efrimova E. S. Some physical and chemical characteristics of diamonds from Copeton, New South Wales.
Tombs, G., Sechos, W. Surface and internal features of Argyle diamonds, Kimberley Region, Western Australia.
Pienaar, H. Gemmology of 'Blue Lace' agate, Namibia.
Zoysa, G. Recent Sri Lankan gems.
Sherman, G. The Australian opal fields.
Arps, C. E. S. In search of the source rocks of Sri Lanka's gemstones: a progress report.
Zwaan, P. C. Gemmological news from the Embilipitiya and Kataragama areas in Sri Lanka.
Schiffmann, C. A. Note on a large rough taaffeite.
Vochten, I. R., de Grave, E., Zwaan, P. C. Characterization of some scapolite, corundum and spinel crystals from Kochipadana and Amarawewa, Sri Lanka.

Eliezri, I. Colombian emeralds.
Graziani, G. The effect of internal characteristics on the resulting aspect of gem minerals.
Kanis, J. Zambia's gemstones.
Dragsted, O. Numite from Greenland.
Myers, J. The Western Australian synthetic emerald.
Gübelin, E. Mexican opal and its inclusions.
Coldham, T. Inclusions in Australian sapphires before and after heat treatment.
Franklin, B., Giles, A. Use of electron microscope in gemstone determination.
Birch, W. D. Gemstones from Beechworth, Eldorado, Victoria.
Brown, G. Australian gem feldspars.
Lishmund, S., Pecover, S. Tertiary volcanoclastic rocks in New South Wales and the genesis of Australian sapphires.
Adrian, J. Geology as an aid to gemmology in New South Wales.
Kovac, C., Birch, W. D. Gem minerals of Pakistan.
Sutherland, F. L., Hollis, J. High pressure gem minerals in Eastern Australia.
Katz, M. Review of the geology of the gemstones of Sri Lanka.
Gordon, J. Gem minerals of the Harts Range, Northern Territory, Australia.
Darragh, P., Hill, R. E. T. The Warda Warra Emerald Deposit, Western Australia.
Mumme, I. Emerald occurrence in Australia.
Chikayama, A. Gemstones in China, especially jade and similar stones.
Superchi, M. An Italian gem material: the Chalky Alabaster from Volterra, Tuscanny, Italy.
Harding, R. R., Scarratt, K. A description of ruby from Nepal.
Segnit, E. R. A decorative serpentine from Western Australia.
MacGregor, E. The beneficiation and treatment of Brazilian emeralds.
Sunagawa, I. Why ruby and sapphire take different crystal habits.
Remau, G. Gem quality apatite from Transvaal, South Africa.
Scarratt, K., Harding, R. R. Ruby and sapphire with glass infillings.
Becker, G. Gem carving.
Ponahlo, J. A new identification method for synthetic emeralds, rubies and other highly valued gemstones.
Sato, K. Paper read by Sunagawa, I. and Shida, J. Gem testing based on the characterization of crystal defect and texture.
Schiffmann, C. A. Limitations of the spectroscopic identification of a treated diamond.
Jobbins, E. A. A.C.D. Pain and the gemstones of Burma.

Letters to the Editor

From Peter J. Crowcroft, Ph.D.

Dear Sir,

Peter Read's recent letter in the *Journal*[1] has made me realise that I completely underestimated the depth of feeling that traditional gemmologists have for the Beilby theory of polishing when I wrote my paper "Demise of the Beilby-Bowden Theory of Polishing" in 1981[2]. I thought that presenting a summary of the accepted scientific view today (that the theory is incorrect) would be sufficient to bring gemmology up to date on this rather small technical point. Comprehensive references were deliberately given so that interested readers could follow up the story for themselves (and also because the gemmology texts are so lacking in providing references to the scientific literature). I find Read's dismissal of these references as 'circumstantial' to be quite unscientific, particularly as neither he nor Anderson seem to have even examined them! Does Read or (did) Anderson seriously believe that there has been no significant work done on the nature of the polished non-metal surface since Finch (fifty years ago) or Beilby (eighty years ago)? I would encourage readers to search out the references I gave at their nearest University library and make up their own minds.

Read's letter is an excellent illustration of why the gemmology texts are out-of-date. This was the main point of my letter in the January 1985 edition of the *Journal*[3]. Gemmologists have not kept up with the huge explosion in scientific knowledge over the past 20–30 years. Consequently today they do not fully realise how far behind they are.

The Beilby theory is not the only example in gemmology of an 'emotional' attachment by gemmologists to a nice but incorrect theory. A second example is the idea that Hannay and others were successful in their attempts to produce synthetic diamonds at the turn of this century. This matter *should* have been decided in 1976. It was B. W. Anderson himself who wrote in this *Journal* reviewing a paper by Prof. A. T. Collins:
'These latest results thus reinforce the generally held judgement that Hannay's diamond fragments could not have been synthesised as the results of his experiments. . . The most probable explanation of the mystery seems to be that the starting materials were accidentally contaminated with particles of diamond dust'[4]. Earlier in the same review Anderson wrote: 'In 1959 and in 1962 the Hannay specimens were again examined by X-ray methods by Professor Lonsdale and her colleagues, and they now became convinced that the fragments consisted of *natural* diamonds'. (Italics in the original).

Yet when Anderson revised the 4th edn of *Gems* his previous conviction deserted him. He not only left Webster's text about Hannay unchanged ('Thus on the face of things the earliest experiment on diamond synthesis was successful'), but he allowed the crucial word 'natural' to remain omitted from in front of 'diamonds' in the description of Lonsdales work (page 374). Anderson even added an additional full page account of another 1900's attempt to produce synthetic diamonds. This addition was commended (and described as 'apparently successful') when Chisholm reviewed the 4th edn in 1984(5). The 'forgetting' of Prof. Collins work, the misrepresentation of Prof. Lonsdales work and the continued propagation of the idea that Hannay and others were successful in their experiments in the face of conclusive evidence to the contrary is reprehensible.

Both these examples demonstrate a reluctance by traditional gemmologists to accept scientific results when it does not suit them. This is not the way a Science works. Thus I am sceptical of Read's call to his scientific colleagues to produce evidence for him. I see little indication that the Gemmology of today would either welcome or even consider such results. Gemmology is in urgent need of academically qualified people to 'translate' the relevant sections of current day physics, chemistry, etc. into gemmological language. This will eventually happen but maybe the process will not start until the older generation of traditional gemmologists have passed from the scene.

Yours etc.,
Peter Crowcroft

19th August 1985
1302 World Trade Centre, Causeway Bay, Hong Kong.

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(1) *J. Gemm.*, 1985, XIX(6), 552.
(2) *J. Gemm.*, 1981, XVII(7), 459.
(3) *J. Gemm.*, 1985, XIX(5), 466.
(4) *J. Gemm.*, 1976, XV(3), 138.
(5) *J. Gemm.*, 1984, XIX(1), 70.

From G. Bosshart, M.Sc., G.G. and Dr K. Schmetzer

Dear Sir,

With reference to the article 'Spectrophotometric measurements of faceted rubies' by A. Banerjee, J. Himmer and H.-W. Schrader, *J. Gemm.*, 1985, **XIX**, 6, 489–93, we would like to make the following comments.

The normal practice in both our laboratories is to record the absorption spectra of *faceted* stones (in this case rubies) and not thin sections or polished platelets. We therefore wish to state that the spectra described in both of the papers quoted in the above publication (Schmetzer & Bank, 1980, and Bosshart, 1982) were not, as implied by Banerjee *et al.*, those recorded for polished thin sections but for faceted stones.

However, a problem not discussed by the authors of the above publication, is the measurement of polarized spectra in faceted anisotropic gems which may be difficult (in particular complete polarisation).

Furthermore, the immersion method described by Banerjee *et al.* has one main disadvantage: the absorption of methylene iodide is very high in the ultraviolet area. This spectral region, on the other hand, is assumed to be of diagnostic value for the distinction of natural and synthetic rubies. Methylene iodide would therefore mask all available spectral information.

One of us (G.B.) will submit an article discussing the measurement and presentation of absorption spectra for faceted gemstones, for publication in the *Journal* in the near future.

Yours etc.,
G. Bosshart*
K. Schmetzer†

6th December 1985

*Swiss Foundation for the Research of Gemstones, Zurich, Switzerland.
†Institute of Mineralogy and Petrography, University of Heidelberg, Heidelberg, West Germany.

THE JOURNAL OF GEMMOLOGY BACK NUMBERS

Anyone interested in either of the following should write to the Gemmological Association, Saint Dunstan's House, Carey Lane, London EC2V 8AB, quoting the box number.

Wanted
A member wishes to acquire copies of *The Journal of Gemmology*, volumes 1, 2 and 3. Box No. HC1.

For Sale
The Journal of Gemmology, volumes 8–19 inclusive are offered for sale. Also copies of The Gemmologist, Gems and Gemcraft. Box No. HC2.

DATES FOR 1986

Tuesday, 4th March
    Talk by Prof. Pieter C. Zwaan, F.G.A. The Flett Theatre, Geological Museum, Exhibition Road, South Kensington, London SW7.
Tuesday, 22nd April
    Talk by Dr Charles E. Arps, F.G.A. The Flett Theatre.
Tuesday, 13th May
    Annual General Meeting.
Tuesday, 27th May
    Talk by Mr Gunnar Raade. The Flett Theatre.
Tuesday, 16th September
    Talk by Mr Kenneth Scarratt, F.G.A. The Flett Theatre.
Tuesday, 14th October
    Talk by Dr Johann Ponahlo. The Flett Theatre.
Monday, 10th November
    Reunion of Members and Presentation of Awards. Goldsmiths' Hall, Foster Lane, London EC2.

Instructors in Gemmology

In September 1986 the Gemmological Association plans to launch the first part (Preliminary Section) of a new correspondence course in gemmology to replace the existing course which has remained substantially unchanged for many years.

In anticipation of an increased number of students annually, the G.A. wishes to recruit some additional instructors in order to spread the work load.

The minimum qualification is the Diploma of the Association (F.G.A.), but additional relevant academic qualifications and trade experience are desirable. It also will be an advantage to hold professional teacher/trainer qualifications and to have experience in these fields.

The work of an instructor is demanding both in terms of knowledge and commitment, but can also be very enjoyable.

Anyone who wishes to apply to be an instructor should apply in writing, as soon as possible, with detailed C.V., to the Secretary, Gemmological Association of Great Britain, St. Dunstan's House, Carey Lane, London. EC2V 8AB.

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 **octahadra and the gem-set ring indicates the use of gems in oranmentation. 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 scrutinising 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.**

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.

Twenty five copies of individual papers are provided on request free of charge; additional copies may be supplied at cost, but they must be ordered at first proof stage or earlier.

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The Journal of Gemmology

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