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and

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OF GREAT BRITAIN

GEMMOLOGICAL ASSOCIATION
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THE JOURNAL OF GEMMOLOGY
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B. W. ANDERSON

This number of the *Journal* is isssued under the shadow of the death of B. W. Anderson, who died on 24th February. Tributes from Keith Mitchell and Alec Farn follow on pages 188 and 194.

The world has lost a great man and gemmology has lost a great gemmologist. He will be greatly missed by all who at any time have met him, whether in work or in play or only through the medium of the written word, and to those who have been privileged to be his colleagues and to know and love him for many years both in work and in retirement—though in a sense he never retired but was working until the day of his death—his loss is indeed desolating; and all our thoughts of sympathy and gratitude must go out to his devoted wife, Barbara, who gave him so much help and comfort for the last twenty-five years.

A gemmologist of genius, poet, teacher, bird-watcher, athlete and much else—a whole man with a gift for friendship—we shall not see his like again.

J.R.H.C.

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NOTES FROM THE LABORATORY

By KENNETH SCARRATT, F.G.A.

London Chamber of Commerce and Industry, Gem Testing Laboratory

It is not unusual for a group of gemmologists to disagree over the colour of a gemstone. Some coloured diamonds in particular tend to possess colours which are most difficult to describe. However, when you see a diamond actually change from one distinct colour to another before your eyes it can shake any confidence you may have in your own eyesight.

Such was the case when late one afternoon I decided to make a start on identifying the nature (natural or treated) of the colour of a 2.02 ct brilliant-cut diamond.

All I really had time for was to make out my work-sheet, giving a full description of the stone, and a short microscopic examination before it had to go into the safe for the night. On the work-sheet I stated in a most positive fashion that the colour of the stone was green. The next morning when the safe was opened I immediately retrieved the envelope containing the diamond, took it to a work-bench and removed the stone from it. There before me lay a brilliant *yellow* stone! After checking the envelope to make sure that it was the one I put in the safe the night before (it was) I decided to check the stone's weight against my record, but as I picked it up to take it to the balance its colour started to change through various shades of yellow and yellow/green until it was back to the colour it was the night before.

These so called 'chameleon diamonds' have been reported upon before,(1) and the change has been variously described as being associated either with changes in temperature or in the amount of light reaching the stone. A manufacturer would notice the effect because it is said that these stones glow red on 'the wheel'(1) and change to yellow shortly afterwards, from which they return to their normal green at room temperature; whereas a trader might become aware of the type of stone he had in a similar manner to that in which I had become aware of the peculiarities of this stone.

The colour change from green to yellow, unless one includes the slight cooling which may occur if the stone is placed in a safe overnight, is usually described as being dependent upon a

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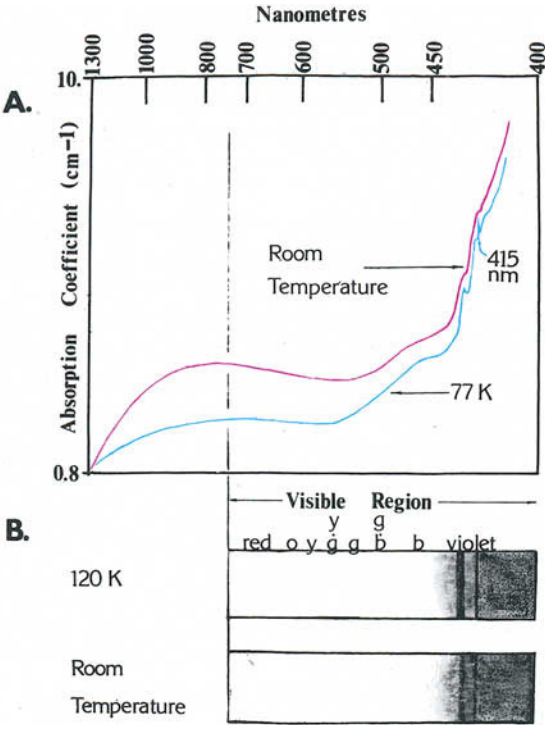

FIG. 1 The room and low-temperature spectra of a 'chameleon' diamond. (A) As a recorded absorption curve and (B) as seen with the hand spectroscope.

temperature increase, such as placing the stone on a hot plate, rather than a decrease; and so it was interesting to discover that when we reduced the temperature of this stone to at first 120K in the Laboratory and then to 77 K at King's College, London, whilst recording the spectra reproduced in Figure 1, the colour of this stone once again became a brilliant yellow.

The differences between the room and low temperature spectra depicted in Figure 1 are quite evident. The general appearance of the spectrum at room temperature is approaching that of a normal Type 1b with a weak 415 (Type 1a) peering out of the gloom and an unusual absorption hump covering the yellow, orange, red and N.I.R.—the area of greatest transmission being in the green. At the lower temperatures there is clearly a sharpening up of the 415, but more importantly there is a lessening of the absorption hump in the red, orange and yellow, allowing the stone to transmit to a greater extent in this region as well as in the green, thus resulting in a yellow stone.

One assumes that changes of a similar nature may take place when the stone is heated; however, we restricted ourselves to room and low temperature spectroscopy only.

The luminescence effects produced by this stone were—long-wave ultraviolet, a very strong bright yellow followed by a very strong greenish phosphorescence; short-wave ultraviolet, a strong and bright yellow/green followed by a very strong greenish phosphorescence; and x-rays, a blue/green followed by a strong green phosphorescence.

* * *

An item that we have seen quite a number of examples of over the past few years is the imitation crystal.

One interesting specimen made to imitate ruby was composed of fragments of natural and synthetic (Verneuil) ruby held together by an adhesive and coated in mica. More often than not though, these imitations are made to resemble emerald, in particular the type of mica-coated rough that emanates from East Africa.

Sometimes produced with obvious crystal form, as in the example shown in Figure 2, or more convincingly with the minimum of form, the basic material for this type of imitation is either very poor quality emerald, beryl or glass. The poor quality emerald or beryl varieties may be manufactured either by slicing the crystal down its length and gluing the two pieces back together with a green adhesive and then coating the whole in mica, or by hollowing out the crystal, infilling with a green substance and then coating the base with a matrix-like material.(2)

The example in Figure 2 is made of green glass and has just enough mica adhering to the surface (Figure 3) to be reasonably convincing.

* * *

FIG. 2 An imitation emerald crystal made of glass and with mica adhering to its surface (see Fig. 3).

FIG. 3 The mica adhering to the surface of the imitation crystal in Fig. 2.

FIG. 4 A colourless natural sapphire before exposure to x-rays.

FIG. 5 The same natural sapphire as seen in Fig. 4 after a ten-minute exposure to x-rays.

A requirement of most gem identification processes is that whenever possible they must be of a non-destructive nature; indeed in the vast majority of cases gemstones can be and are identified in this manner. There are some cases, though, where the only means left open to one require either a 'minor' destructive test, such as taking an insignificant scraping from the girdle of a stone for an x-ray powder diffraction photo, or something possibly more destructive such as attempting to fade or drive off the colour of a suspected x-ray irradiated stone.

Understandably not many people are very happy when we ask for permission to test for colour stability upon being presented with a yellow sapphire for examination, but in some instances it is essential having established the natural origin of such a stone that a test of this nature is carried out. Some colourless sapphires may attain a yellow colour quite quickly when they are irradiated with x-rays,(3) but this colour is not permanent, and exposure to sunlight will gradually return the stone to its normal light yellow or colourless state.

It didn't take long to realize when recataloguing the laboratory collection recently, that a 'colourless' stone found in a stone paper marked 'irradiated "yellow" sapphire' (Figure 4) was not a misplaced stone but one that had been x-ray irradiated and had subsequently faded. It took just a ten minute exposure at a setting of 45 kV and 19 mA in close proximity to the x-ray tube window to reproduce the yellow colour (Figure 5).

When a little while ago we were confronted with two large apparently natural, intensely orange sapphires of a hue that we had not observed in nature before, quite naturally our suspicions were aroused. The two stones weighing 32.44 and 8.72 ct (Figure 6) were very similar in colour to the Verneuil type synthetic orange sapphire and did not approach the colour of the heat treated yellow sapphires we see so many of nowadays (Figure 6). The refractive indices were normal for corundum, but the absorption spectrum (Figure 7) was a very intense version of that expected from a synthetic yellow sapphire—the stones were strongly absorbing in the blue and violet and there were no signs of any sharp lines in the red or the 'normal' sapphire bands in the blue.

To the unaided eye the stones had a somewhat cloudy appearance and a microscopic inspection revealed the cause of this to be light reflecting from a multitude of dust-like particles within

FIG. 6 Four small heat-treated yellow sapphires and two large orange sapphires which owe their colour at least partly, if not wholly, to heat treatment.

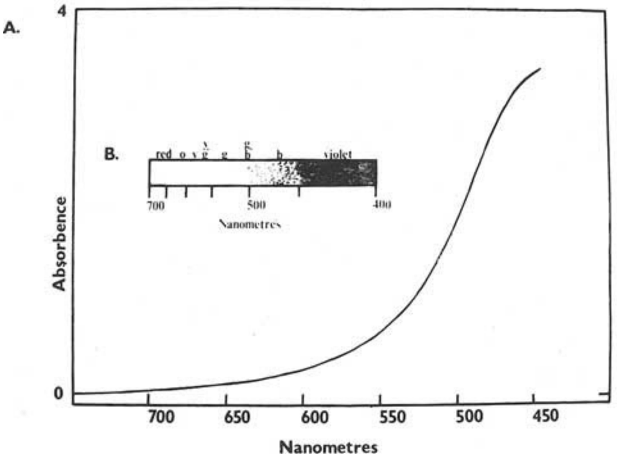

FIG. 7 The absorption spectrum of the smaller of the two large orange sapphires seen in Fig. 6, (A) as a recorded absorption curve and (B) as seen with the hand spectroscope.

FIG. 8 Fine dot-like 'silk' producing a cloudy appearance to the orange sapphires seen in Fig. 6.

FIG. 9 Fine dot-like 'silk' orientated around small angular areas in the orange sapphires seen in Fig. 6.

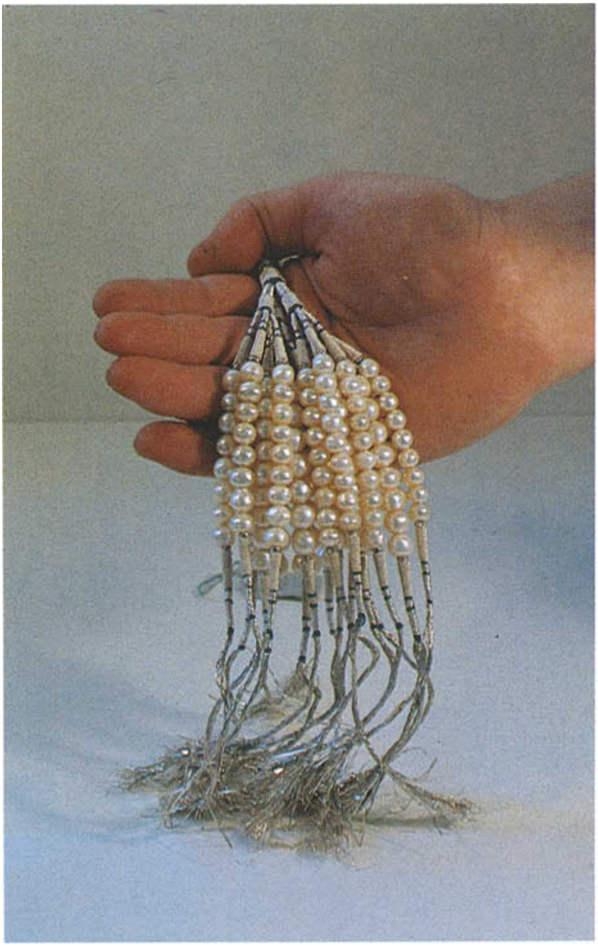

FIG. 10 A 'Bombay Bunch' of natural pearls.

the stones. Over all these particles took on the appearance of very fine 'silk' (Figure 8), and they were generally orientated in specific directions travelling through the stones, although as may be seen in Figure 9, the particles also tended to orientate themselves around small angular areas. Also included were other indications that these were natural sapphires that had undergone heat treatment, such as the glassy centres to some feathers.(4,5) However, as both the colour and its intensity were so unusual, it was felt that a colour stability test was definitely needed, firstly because of some recent reports of colour instability in some heat-treated yellow sapphires, and secondly just in case they were treated stones that had been subject to further x-ray treatment. Unfortunately permission to attempt to fade these stones under controlled conditions was refused, and so the situation remained unresolved.

* * *

Even though many thousands of natural pearls pass through the laboratory every year, it is quite rare nowadays for them to be submitted as 'Bombay bunches'.(6) The first such bunch to be submitted for many months (Figure 10) reminded us just what a work of art these items are in themselves.

* * *

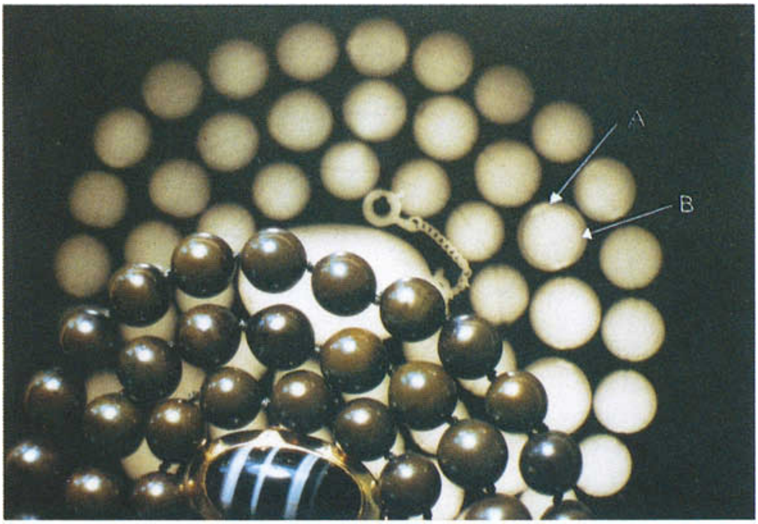

FIG. 11 A necklace of mottled brown stained cultured pearls together with the x-ray picture, showing the demarcation between the bead and the outer layers (B) and the way in which the stain alters the normal x-ray transparency of the demarcation (A).

The radiograph taken of an unusually coloured—mottled brown—'pearl' necklace (Figure 11) revealed not only that the pearls were cultured but also the way in which the stain had altered the normal x-ray transparency (11A) of the demarcation between the bead and the 'pearl' layer (11B).

* * *

Being a trade laboratory, naturally the majority of our work concerns the identification of the more important commercial stones, and so it is a most welcome break from routine when something outside this grouping is submitted. When the bead in Figure 12 was placed before us (looking for all the world like a lacquered peach stone), upon an eye inspection all sorts of suggestions about its possible identity were put forward, many of them not very complimentary.

The microscopic inspection revealed that the bead had a fairly thick coating of clear plastic (Figure 13), and, as this would inhibit an accurate SG determination and completely rule out RI measurements, it was quickly realized that, although the structure, visible now, appeared to be similar to that of coral, this was so distorted by the coating that we would have to resort to a destructive test so that we could 'get at' the structure without having to peer through the plastic.

We were fortunate in this case that the client had included in his instructions to us 'test to destruction if necessary'. Taking him at his word we sliced the bead into two, when a very coarse coral structure became all too obvious in its nakedness (Figure 14). A small drop of dilute hydrochloric acid was then placed on the newly exposed area as a confirmatory test, causing effervescence.

* * *

In the July 1979 issue of this *Journal*(7) I reported the occurrence in the visible spectrum of three brown diamonds of an absorption line that had previously only been associated with treated diamonds. Since then we have observed this line at 637 nm not only in brown stones but also in yellows and two 'odd' green stones.

I subsequently reported(8) that we were reasonably satisfied that when the 637 was observed in the sort of strengths described (that is, either very weak at room temperature or only visible at 120 K) and in the sort of stones described (that is, Type 1b in which the

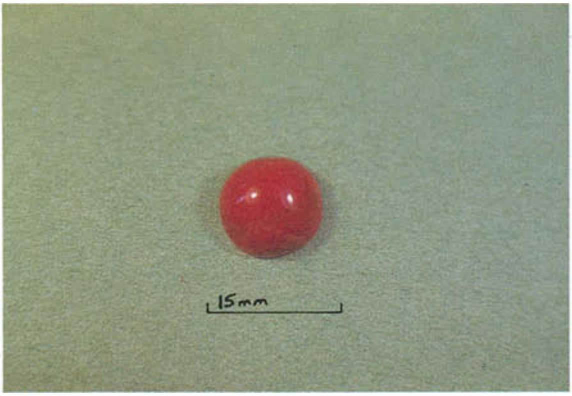

FIG. 12 A plastic coated coral bead.

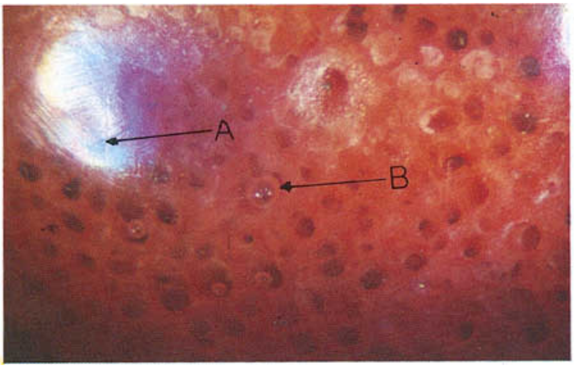

FIG. 13 (A) light reflecting from the surface of the clear plastic coating and (B) gas bubbles in that coating of the coral bead in Fig. 12.

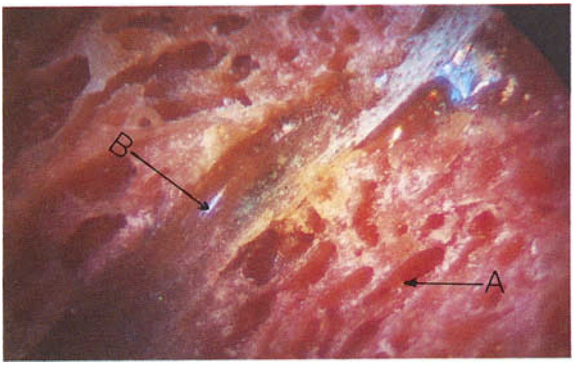

FIG. 14 (A) the 'coarse coral structure' and (B) the plastic coating adhering to the sides of the drill hole of the bead in Fig. 12.

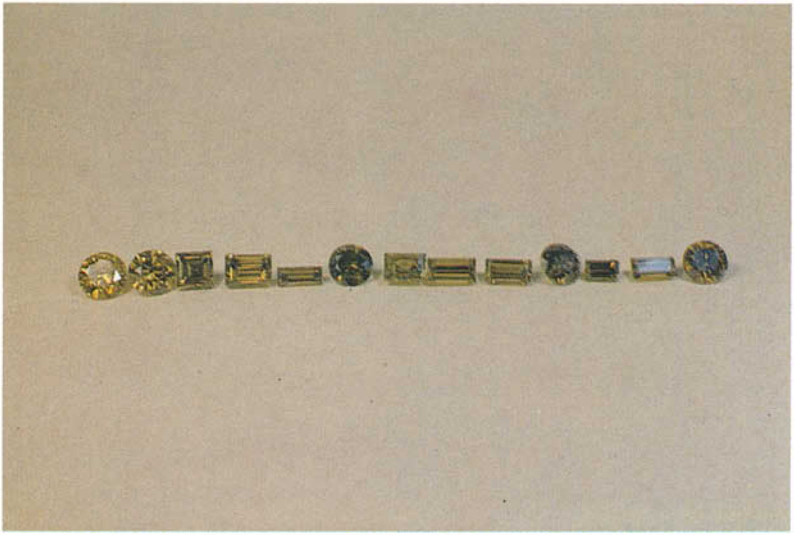

FIG. 15 Thirteen coloured diamonds which not only all come from the same item of jewellery, but also all contain the 637 nm absorption line in their spectra when examined at low temperatures.

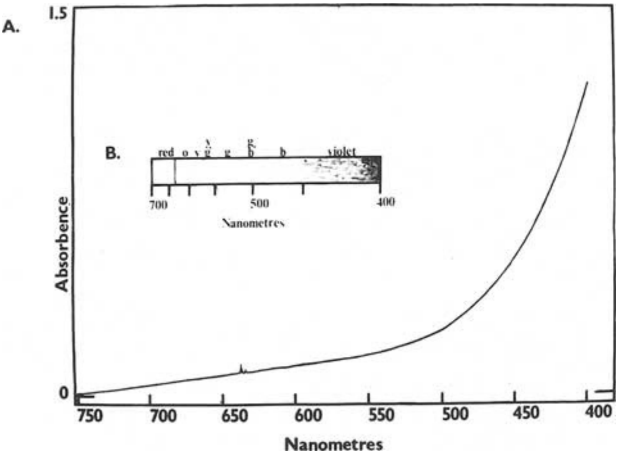

FIG. 16 The low temperature absorption spectrum typical of the stones seen in Fig. 15, (A) as a recorded absorption curve and (B) as seen with the hand spectroscope.

body colour was obviously due to the naturally occurring absorption in the violet and blue) it should be treated as yet another naturally occurring radiation-related band. We still believe this to be the case today.

During the four year period between the first report and a few weeks ago only 19 stones in which the naturally occurring 637 nm lines could be observed were examined in this Laboratory. More recently a further 15 have been added to that number. Somewhat incredibly though, 13 of this latest 15 (Figure 15) not only came from the same item of jewellery, a brooch, but also they were the only stones in that item.

Of these 13 stones, there was only one that revealed the 637 rather weakly at room temperature, all the rest only revealed the line at 120 K. Figure 16 shows the absorption curve of one of the two other stones at 77 K, this curve being fairly typical for the type of stone.

It is not too unusual with coloured diamonds to find the same type of stones, with similar spectra, in the same item of jewellery. This occurs quite often because the person making up the item has successfully matched the stones for body colour and in so doing has chosen stones of the same 'type'. What is unusual about this instance is that these stones are far from being matched for colour; as can be seen in Figure 15 the colours range from a distinct yellow through to brown.

* * *

A very high percentage of the coloured diamonds submitted to us for examination turn out to be naturally coloured, and so, when a treated stone turns up, although it may not be a pleasurable experience for the owner, for us this must undoubtedly produce a sense of achievement in that the lengthy procedures we strictly adhere to in the examination of coloured diamonds do pay dividends.

One such stone is worth a mention here, because it is so often said that only very low quality diamonds are irradiated, and in our experience this is very often not the case, certainly purity-wise if not colour-wise.

The stone weighed exactly 6 ct and was marquise shaped with a nice yellow body colour (Figure 17). Under both long-wave and short-wave ultraviolet radiations the stone fluoresced yellow/green and there was no phosphorescence. The absorption spectrum

FIG. 17 A 6.00 ct treated yellow diamond.

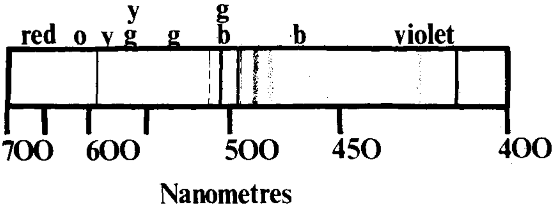

FIG. 18 The absorption spectrum, as seen with the hand spectroscope at 120 K, of the treated diamond seen in Fig. 17.

(Figure 18) at 120 K was unmistakably that of a treated stone with a strong 595 nm line and very strong lines at 503, 496 and 415 nm, the first three being induced by irradiation and subsequent annealing and the last naturally occurring. Whilst the 415 was fairly strong there was no 478 nm absorption, and therefore it is fair to assume, although it is by no means certain, that the pre-treatment colour of this stone would not have been significant, fancy-diamond-wise, but would have been evident under normal colour-grading standards.

Whilst we were not asked to grade the stone for purity, it is quite normal for us to give all coloured diamonds a thorough microscopic examination, and it was found that this stone at 10× magnification was clear of any internal imperfections apart from a few cleavages in the area of the girdle, which could have been removed to produce a flawless or loupe-clean stone.

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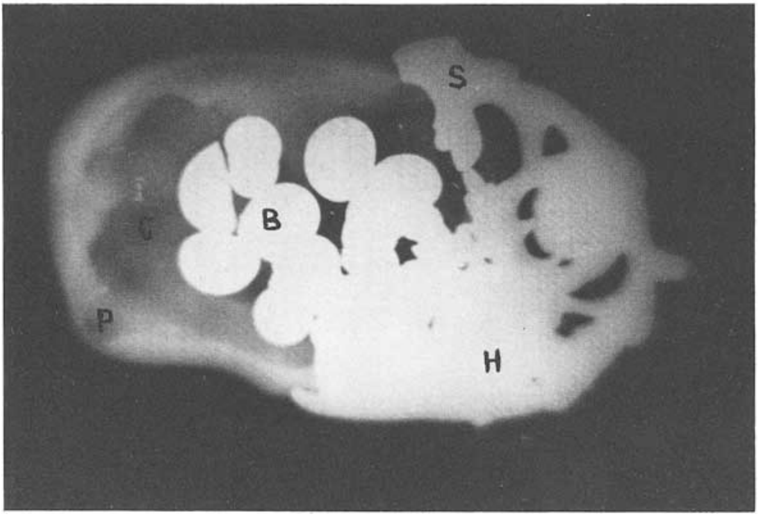

FIG. 19 The radiograph of a pendant-set large hollow baroque pearl, inside the cavity of which can be seen a number of beads with an opacity to x-rays similar to that of the setting. (P) pearl: (C) cavity: (B) beads: (S) setting: (H) the area of the setting which hides the 'cap'.

During one of our recent courses a participant produced a large baroque pearl, which seemed to be an ideal subject with which to demonstrate how direct radiography may help with pearl identification. The resulting picture, however, revealed a little more than was expected.

The pearl itself, which was mounted as a pendant, with the setting (S in Figure 19) covering the major portion of one 'corner', was found to be little more than a comparatively thin layer of nacre surrounding a large cavity (P and C respectivly). Within the cavity could be seen a number of beads (B) with an opacity to x-rays comparable with that of the setting. A further microscopic inspection exposed the 'cap' that had to be present. It was well hidden under the setting in the area marked H in Figure 19.

A fair assumption about the history of the pearl might be that at some stage it had been drilled and subsequently to this the area around the hole had collapsed, at which time it could have been decided to infill the cavity with a number of beads to give the pearl the weight expected of a pearl of that size.

* * *

The generally small 'Biwa' type(9) non-nucleated cultured pearls, when seen in long single or multi-row necklaces, are for the most part quite easy to identify when a radiograph is taken, and most people who handle pearls can virtually identify these necklaces just by seeing their shape and colour (usually very white). Increasingly, however, today we are seeing the much larger single non-nucleated cultured pearl in which the colour and shape vary considerably. It is certainly not possible without the aid of x-rays to even hazard a 'professional guess' about the origin of these pearls, and even when a direct radiograph is taken sometimes it is not the easiest of tasks to identify them.

Figure 20 shows some of the shapes, sizes and colours that are at present on the market. All eleven were identified as non-nucleated cultured pearls by direct radiography.

* * *

There are some gemmologists who appear to be able to find the most extraordinary items on their travels, and not least amongst these is one of the Laboratory's regular benefactors, Chris Cavey. During one of his visits with us latterly he placed in my hand what appeared to the naked eye to be a miniature portrait mounted as a fob (Figure 21). He then proceeded to tell us that he had bought it in a badly worn condition, and by way of offering a clue to its identity he added that he had had it *repolished.*

FIG. 20 11 non-nucleated cultured pearls.

A microscopic examination unveiled the true nature of the object. It was clearly made entirely of glass and was all one piece (not a mosaic) and the portrait, which was quite detailed (Figure 22) was continuous from one side of the object to the other with very little if any deviation—something similar to the name of a seaside town running through a long 'stick of rock' (candy)—therefore, no matter how many times it was repolished (provided there was still some of the item left!) the 'portrait' would remain practically unaltered.

Very often as gemmologists we are awe-struck by the artistic arrangement of included material in natural gemstones, but it is not so often that we are able to let out a gasp of admiration for the artistic achievements, within our sphere, created by man. This for me was certainly a case for the latter.

A week or so prior to Mr Cavey showing us this lovely object, he brought in five most attractive orange stones (Figure 23), the colour and lustre of which did not strike me as being peculiar to any of the more common gemstones. They had, he said, been offered to him as clinohumite from the U.S.S.R.

Clinohumite ($4Mg_2SiO_4.Mg(F,OH)_2$) (10) is a monoclinic member of the Humite group, and its constants are given in Dana's

FIG. 21 A coloured glass 'portrait' set as a fob.

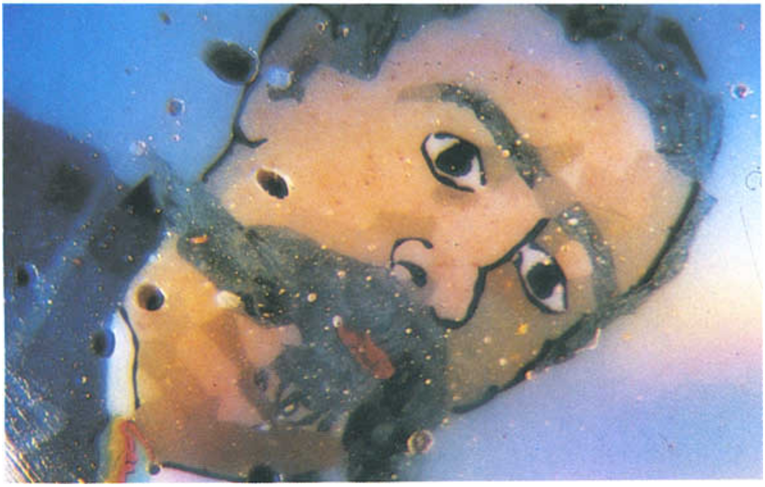

FIG. 22 Detail of the portrait in Fig. 21.

FIG. 23 Five faceted examples of clinohumite averaging approximately 3 ct.

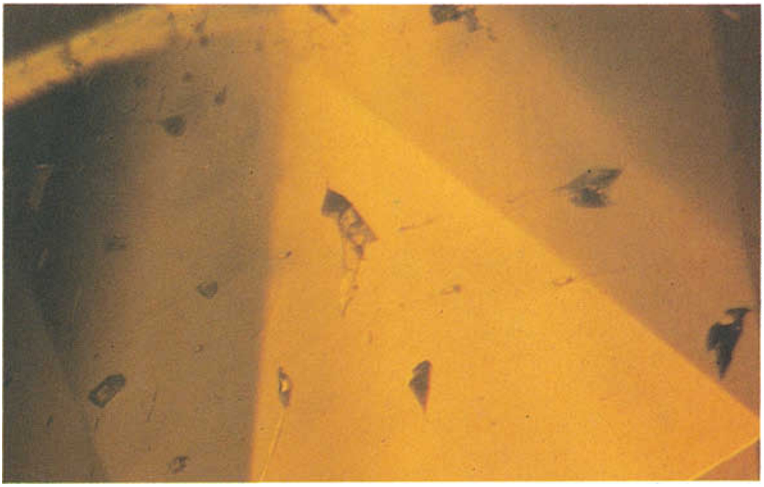

FIG. 24 2-phase inclusions in a clinohumite.

FIG. 25 A group of crystals in a clinohumite.

FIG. 26 Twin planes in a clinohumite.

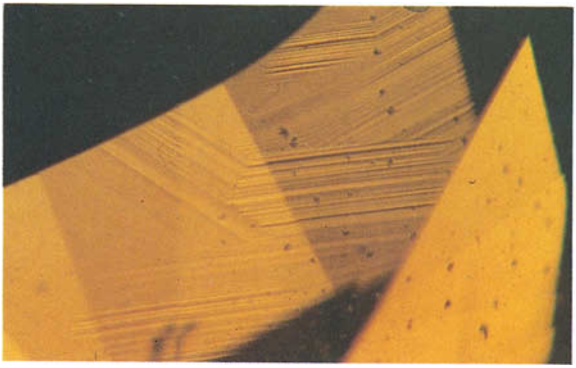

FIG. 27 Angular growth zoning in a clinohumite.

Textbook of Mineralogy(10) as RI α = 1.62 - 1.66, β = 1.64 - 1.67, γ = 1.65 - 1.69; SG 3.1 - 3.2 and H. 6 - 6.5; and one of the occurrences cited is near Lake Baikal in Siberia.

The average weight of these five stones was approximately 3 ct, the largest stone weighing 4.59 ct. Their SGs ranged from 3.223 - 3.230 and their RIs were α 1.630 - 1.633, β 1.644, γ 1.662 - 1.665 with DR varying from 0.031 to 0.033, all of which fall reasonably close to the range recorded by Dana.

By way of confirming their identity Steve Kennedy took a small powder scraping from the girdle of the smallest stone and produced an x-ray powder diffraction photograph which proved to be characteristic of clinohumite.

Under the microscope all the stones were a feast for the eyes. Figures 24-27 show the main types of included features (2-phase and other cavity types in Figure 24, crystal groups in Figure 25, twin planes in Figure 26 and growth zoning in Figure 27), and of course the double refraction was clearly evident upon viewing the facet edges through the stones.

The absorption spectrum for each stone resembled closely that produced in Figure 7 in that there were no sharp absorption lines or bands, just a strong absorption of wavelengths shorter than 450 nm in the visible region.

* * *

When something a little unusual is submitted to the Laboratory for examination it sometimes occurs that in the coming weeks several other examples of the same material are placed before us. However, in the weeks, months or indeed years, following this surge we may not be required to examine it again.

At the end of last year the pearl trade became very worried about the number of large mauve pearls entering the market, and we were asked to examine a number of examples. All were examined by direct radiography and none revealed any evidence on the radiographs which might have indicated a cultured origin, either non-nucleated or nucleated. Indeed the only structure revealed, indicated a natural origin. Apart from a re-examination of one of these pearls recently, we haven't seen any new examples, since the initial 'surge'.

FIG. 28 Two very pale pink natural pearls flanking a natural mauve pearl weighing 16.47 ct.

FIG. 29 The 'flat' side of the centre pearl in Fig. 28.

An example of the type of pearl involved is depicted in Figures 28 and 29. In Figure 28 it has been placed between two very pale pink natural pearls weighing 4.96 and 22.36 ct. The mauve pearl itself weighs 16.47 ct and measures 16.38 × 8.81 mm, and in Figure 29 the difference in colour between the base and the top of the pearl can be noted, and a peculiar central area can also be seen.

Whilst we could find no evidence to indicate that this pearl or any of the others we examined were cultured, it must be said that it should not be long before non-nucleated cultured pearls of a similar colour to these are available in this country.(11)

* * *

In the early part of 1983 we noticed an advertisement in one of the trade publications in which the various merits of the 'Angelo pearl' were being expounded. The descriptions given of these 'pearls' and some of the claims made intrigued us enough to request a sample of the material from the U.K. distributors, who immediately forwarded to us a number of loose specimens for our examination. All were fully drilled beads measuring approximately 5.5 mm in diameter.

A major portion of the advertisement hinges around the fact that 'the core' of the Angelo pearl 'is made of fragments of fresh water shells which are found in the waters of the Mississippi River', and it is stated further that 'only first class shell material for the core is used and is identical to that implanted in oysters for the nucleus of the cultured pearl'.

Shell based imitation pearls are not new.(12, 13) In 1978(14) Farn described an imitation pearl that produced a Laue diffraction pattern typical of a cultured pearl; it was in fact a lacquered mother of pearl bead, and before I received these samples, this was the sort of 'pearl' I was expecting to see—but this was not to be the case.

Firstly, by way of confirming the manufacturers' statements about the nucleus of the samples, one was sliced into two, whereupon it could be seen that they were in fact constructed of a solid central bead and some kind of coating to that bead (Figure 30). As the central bead effervesced when a small drop of hydrochloric acid was brought into contact with it and as it also had a banded structure (Figure 32) along with other properties

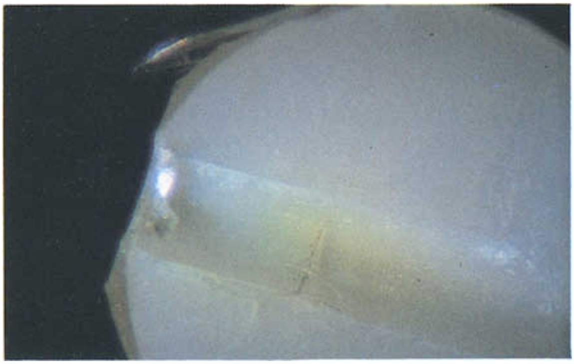

FIG. 30 A sliced 'Angelo' imitation pearl showing the shell bead centre and the thickness of the outer layer.

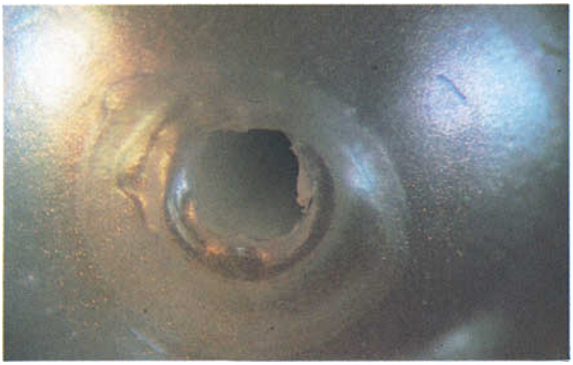

FIG. 31 The 'Angelo' imitation pearl showing a discretely speckled play of colour.

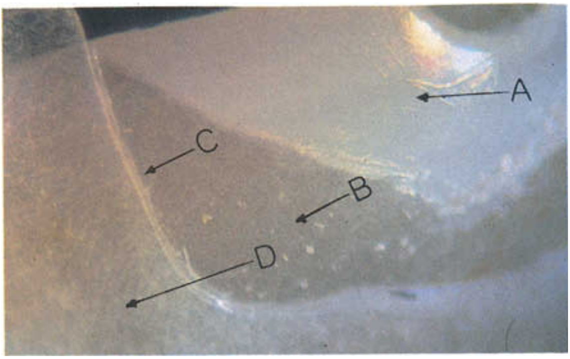

FIG. 32 The 'layers' of the 'Angelo' imitation pearl. (A) The shell bead nucleus showing a banded structure. (B) The layer closest to the bead, (C) the layer in which the 'play of colour' appeared to be confined and (D) the outermost layer.

which are characteristic of Mother of Pearl, such as x-ray induced fluorescence and phosphorescence and the production of four- and six-spot Laue diffraction patterns, the manufacturers description of the central core would seem to be accurate. The specific gravity of the whole pearl was found to be 2.65.

To the unaided eye there seemed to be a little more 'life' to these Japanese manufactured 'pearls' than there normally is with imitation pearls, although to the experienced eye they were 'not quite right' in comparison to the natural or cultured pearl. Under magnification it was found that this 'extra life' could be attributed to a discretely speckled play of colour (Figure 31) and that the coating consisted of three easily separable layers (Figure 32). The play of colour appeared to be confined to the centre layer, C in Figure 32, and did not seem to be present in the two other layers of this 'plastic like' material. Imitation pearls usually 'leave me cold' but I was really quite impressed with the visual impact of these. However, it remains to be seen just how resistant the coating is to damage from contact with the various cosmetics.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the continued assistance given by Dr A. T. Collins in the production of absorption curves and in particular those depicted in Figures 1, 7 and 16. Thanks are due to Delroy Jewellery Ltd for supplying the samples of the 'Angelo' imitation pearl.

It is also a pleasure to acknowledge the generosity of Mr C. Cavey, F.G.A. over the years, and more particularly in this instance we wish to thank him for taking the time and trouble to show us the coloured glass portrait and the samples of clinohumite.

As ever, these notes could not be completed were it not for the assistance of the Laboratory staff, and on this occasion the author thanks Mr I. Shenker for the production of Figures 8 and 9, Mr E. C. Emms for Figures 10, 11 and 17, and Mr S. Kennedy for the production of the x-ray powder diffraction photograph of the clinohumite specimen.

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'RAMAURA'—A NEW SYNTHETIC RUBY MADE IN U.S.A.

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INTRODUCTION

The flux growth of ruby was first introduced by Remeika (1963). Following his Patent, Chatham and Arden Associates (Kashan) now produce synthetic rubies extensively to match the various colours and hues of natural ruby. P. O. Knischka from Austria introduced another undisclosed method of growing suitable crystals of ruby. Japanese manufacturers, influential in every branch of our industry and technology, reproduced the red and orange varieties of the corundum family under the trade name 'Inamori'.

In the course of time the growth of crystals in laboratories expanded. More research continued into the synthesis of corundum varieties than into any other crystal growth. In addition to the majority of synthetic rubies available from different manufacturers, Chatham & Son grew blue and orange varieties of the family, which are now obtainable as rough or faceted stones (Gübelin, 1983b). To crown each effort the production of corundum in laboratories has developed, and another commercially available successful growth of ruby by a Californian manufacturer is now known.

During the Tucson gem and mineral show in 1983 a Los Angeles distributor announced the availability of a new synthetic ruby. The Overland Gems Inc. of California now market this new product under the name 'Ramaura' synthetic ruby. The distributor further reported the marketing of the faceted stones at the beginning, and lower grade (heavily included) stones later for fashioning into beads and cabochons, as well as single crystals and clusters. According to Mr Peter Flusser, principal of Overland Gems Inc., over 1000 carats of cut Ramauras are already marketed. He intends to cut the goods in Thailand, in the United States and in Idar-Oberstein. However, enquiries made during his very recent visit to Thailand and also in Idar-Oberstein have revealed to the author that up to date no steps have been taken to cut the Ramaura

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product in either of these localities. However, if the intentions of the distributor are carried out, gem cutters in Asia and in Europe will probably join the business in the near future.

The intention of this article is to provide an extensive and up-dated report on the new product. During the investigations many Ramauras were examined including two rough crystals. Gemmological methods have been thoroughly considered rather than the mineralogical methods which are far beyond the reach of the average gemmologist. However, certain important criteria involving such methods are discussed. The procedures mentioned below would readily indentify the Ramaura products.

IDENTIFICATION CHARACTERISTICS OF RAMAURA SYNTHETIC RUBY

Appearance and colour

The stones examined by the author revealed the colours of Ramaura flux ruby in relation to those of natural rubies. They resembled the colours of most Thai and Burma rubies and even the lighter pink of Sri Lanka corundums (pink sapphires). Therefore this least dependable factor of colour cannot any longer be used, even as an aid, in separating natural from synthetic rubies. According to Mr Flusser, the Ramauras are cut with very precise angles (Figure 1). However, this cannot be considered as a means of recognition, since certain natural and other synthetic rubies too undergo similar fashioning processes. Refractive indices, birefringence values, optical character and specific gravity of corundum as reported in the literature were noted in Ramaura synthetic rubies.

Dichroism

The respective two colours of the Ramaura synthetic ruby clearly showed a purple hue along the ordinary vibrations and an orange hue parallel to the extraordinary vibrations. The overall dichroic effect varied from weak to strong with intermediate intensities. However, only a well experienced eye can distiguish such differences. Therefore the average gemmologist should not depend on this effect of purple || and orange ⊥ hues as a characteristic sufficient alone for identification.

FIG. 1. Faceted Ramaura flux rubies marketed by Overland Gems Inc., of California. The average weight varies from 0.60 to 0.80 carat.

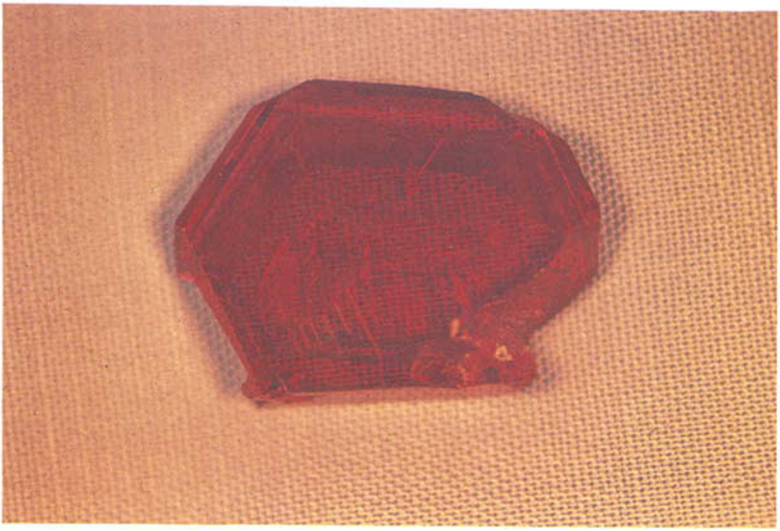

FIG. 2. A tabular crystal of Ramaura synthetic ruby weighing 7.46 carats.

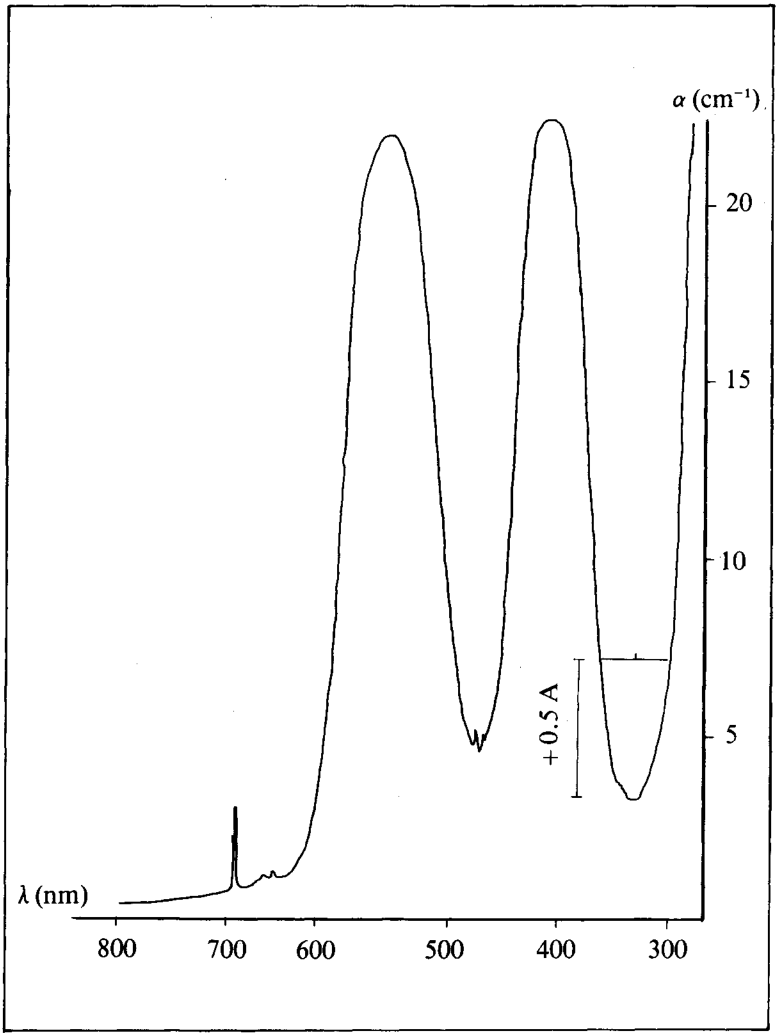

FIG. 3. Polarized absorption spectrum of a Ramaura synthetic ruby from U.S.A., recorded at room temperature in the range from 800 to 200 nm (*e*-vibration parallel, *o*-vibration perpendicular to the optic axis). Absorption coefficient is approximate *(legend after Bosshart)*.

Absorption spectrum investigations

A prism-type gemmological spectroscope reveals the diagnostic absorption spectrum of ruby on investigation of Ramaura flux rubies. The transparent flat crystal (Figure 2) was analysed by Mr G. Bosshart (Director of the Swiss Foundation for the Research of Gemstones, Zürich) on a Pye Unicam, SP8−100 spectrophotometer. The results are shown in Figure 3. According to Bosshart, new and interesting information was obtained in this connexion. The ultraviolet transmission of Ramaura quite overlaps the population regions characterized by natural and synthetic rubies (see Bosshart, 1982). He further added that the Ramaura samples investigated by him fall into the natural rather than into the synthetic region. The sample stone, which he kindly analysed on the request of the author, fits into the Knischka population field with $\lambda/W = 331/61 = 5.3$ at $\lambda = 331$ nm., Up to date, the ultraviolet spectrometric analysis overlaps, to a certain extent, the results of Ramaura synthetic ruby.

Reaction to ultraviolet radiations

The luminescence effects are variable on the new product under the long (365 nm) and short (254 nm) wavelengths of the ultraviolet region. Most of the stones fluoresced weak to very weak in effect. The results could be judged only under well controlled conditions. A few, however, consisted of fluorescence which was moderate to strong in intensity. The manufacturer has announced the doping of a chemical agent to influence the fluorescence, and this in turn would easily identify the Ramaura flux ruby. According to the available information the ultraviolet reaction is reported to be yellowish orange glow on the surface. One of the rough stones examined revealed this identifiable fluorescence, but it became no longer apparent during a repolishing process. It was therefore concluded that the doping is probably concentrated just below the crystal surface and not in any significant amounts deeper within the stone.

Microscopic examinations

It is now established that synthetic rubies of flux methods are grown on a seed crystal. However, the growth of Ramaura synthetic ruby is achieved by a self-nucleation involving the melt diffusion process. Owing to this spontaneous nucleation, as it is also referred to by the crystal chemist, the optical orientations as well as the resulting crystal faces of the crystals may obey random growth directions. Similar features were even distinct on Ramaura synthetic rubies. Frequent occurrences of flat crystals and crystal clusters are known. However, the manufacturer has obtained cuttable quality crystals in the growth process.

INCLUSIONS

The inclusions present in synthetic materials, in relation to their growth procedures, are quite definite in comparison to the unlimited number of inclusions enclosed within natural gemstones. The nature of included particles and the manner in which they have been trapped within the synthetic host supply evidence enabling the distinction of natural from synthetic stones as well as the separation of the various synthetics of different manufacturers. As has been frequently explained to the trade, this has up to now been true of synthetic rubies. Commercially available synthetic ruby from Verneuil (with its diagnostic curved growth striae), Chatham (with unlimited number of twisted veil-like flux feathers), Kashan (with remarkable drippy flux arranged in a parallel orientation) and Knischka (with its characteristic two-phases in which the outline of the cavity is almost invisible) have their well defined internal marks (see also Gübelin, 1983a; Gunawardene, 1983). To this list, the new product distributed by Overland Gems can be added. Those of Ramaura flux rubies, now available in the trade, consist of various structural growth phenomena, flux feathers and residues and occasionally negative cavities as their own particular characteristics. Recently Kane (1983) reported with similar inclusion descriptions about Ramaura synthetic rubies.

Structural growth phenomena and colour zoning

From the rough crystal to the fashioned gem, straight growth lines were clearly evident in most Ramauras (Figure 4). Their appearance may, as in Figure 5, recall to some the scenery of polysynthetic twin lamellae in natural ruby (compare Figure 8). Often they intersected nearly at 120° (Figure 4). These grainings, as they can also be described, often resembled the 'Scotch in water' effect (Figure 6). This identifying 'hallmark' of Ramaura can easily be seen in an immersion microscope using methylene iodide (n_D = 1.74) with a narrow beam of transmitted light. The effect can be seen in any undefined direction or directions and, as an example, Figure 7

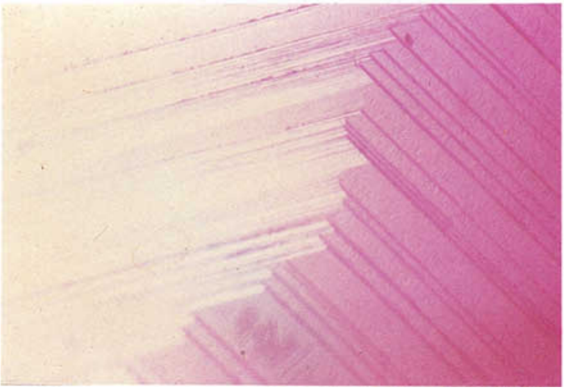

FIG. 4. Striations meeting at an angle of 120° arranged parallel to the basal plane [*c* (0001)] of the crystal. 30 × .

FIG. 5. Straight growth phenomenon seen under the immersion microscope using methylene iodide ($n_D = 1.74$) and a narrow beam of light. 20 × .

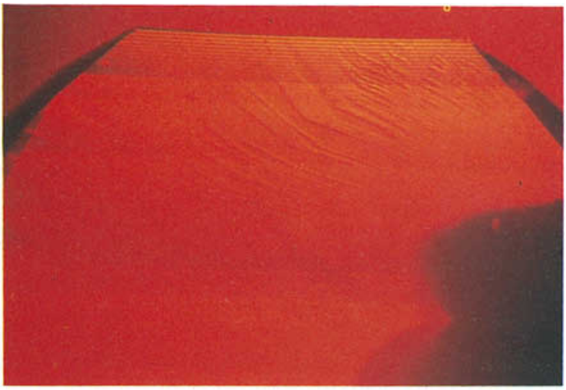

FIG. 6. Diagnostic 'hallmark' of Ramaura flux ruby 'Scotch in water' or 'heat wave' effect. (immersion microscope) 25 × .

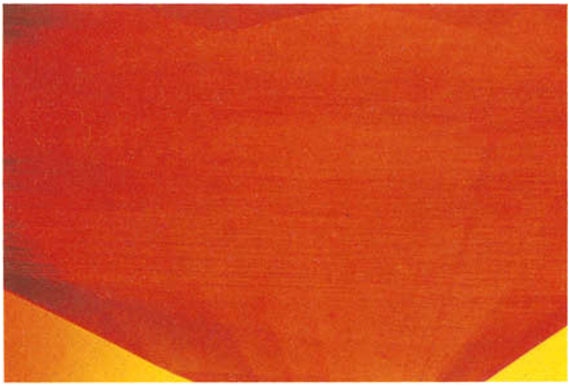

FIG. 7. Graining observed from girdle to girdle in the new synthetic ruby from U.S.A. (immersion microscope) 22 ×.

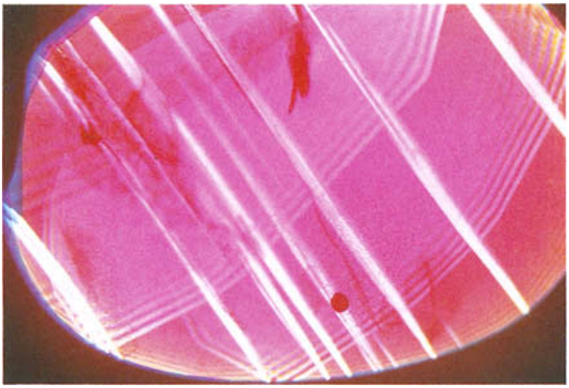

FIG. 8. Polysynthetic twin lamellae in a natural ruby from Chanthaburi, Thailand, with characteristic interference rings along the twin planes under crossed polars. 18 ×.

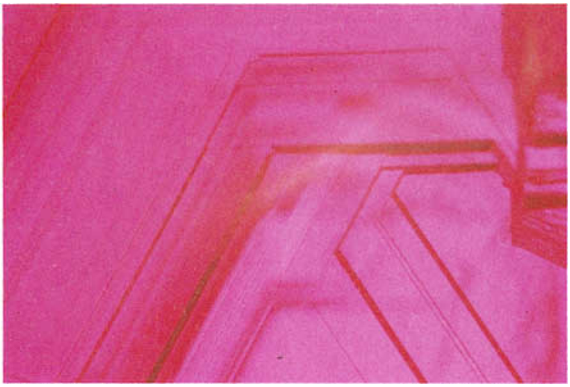

FIG. 9. Orientation of tube-like dense flux parallel to the pseudohexagonal zonal lines. Note the uneven colour concentrations. (dark-field illumination) 60 ×.

shows the observations made through the girdle of the stone. Since the growth features shown in Figures 4 to 7 are quite fine and arranged in a specific manner, the observation of them may undoubtedly pose difficulties to the unexperienced eye. On the other hand it may appear as a new type of inclusion to the gemmologist. How to avoid misunderstanding the graining effect in Ramaura flux ruby and to distinguish it from the polysynthetic twin lamellae present in many natural rubies is explained here. The most successful results in this connexion can be achieved by the use of an immersion microscope and crossed polarizers. The twinning in natural ruby distinctly reveals interference colour rings on the twin planes (Figure 8) between crossed polarizers. If such planes are examined while moving the objective towards or away from the stone, the twin lamellae will be distinct right through the stone. The twinning characteristics mentioned in natural rubies are absent in the Ramaura product.

Angular zonings are also observed in some of the sample stones. They intersect each other nearly at an angle of 120°. If dark-field illumination is used, the uneven coloration, as in Figure 9, along the zonal planes is evident. Concentration of the flux along the zonal planes can be seen (Figure 9) or a random orientation of flux to the zoning (Figure 10). If the microscope light is reflected into these dense flux tubes a yellowish metallic reflection can result and may misleadingly suggest the impression of rutile needles in a natural ruby.

Various flux inclusions

The flux formations in Ramaura synthetic rubies have undergone various stages of solidification. The flux inclusions are recognized as of three different types in accordance with their growth. They can be either (a) *opaque, dense straight tubes or comet-like, or* (b) *opaque to nearly translucent feathers of orange-yellow colour, or* (c) *translucent to nearly transparent fine 'fingerprints':*

(a) *opaque, dense straight tubes or rarely comet-like flux*

As shown in Figures 9 and 10 such dense linear flux is so far not detected in any of the other synthetic rubies made by Chatham, Kashan or Knischka. Although the 'comet tails' are frequently observed in Kashan flux rubies (Gübelin, 1983a) their presence in the observed samples were very rare. The only comet-like inclusion available is illustrated in Figure 10.

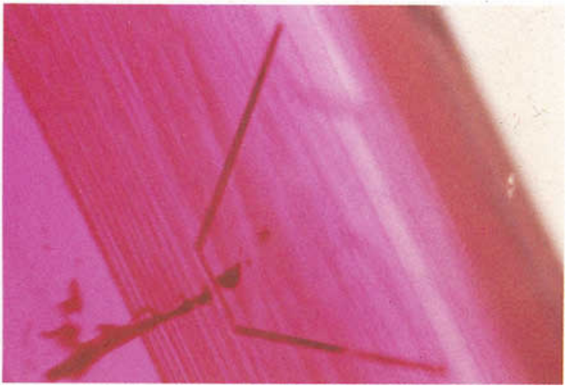

FIG. 10. Orientation of secondary dense flux in a random direction to that of the preliminary concentrated flux. The drippy appearance of the flux can also be noted. (dark-field illumination) 40 ×.

FIG. 11. Characteristic orange-yellow flux arrangement near the girdle of a Ramaura flux ruby. Observations reveal the dense to thin distribution of the flux. Another noted feature was the dragon's-tail-like contours of the residual feathers. (dark-field illumination) 30 ×.

FIG. 12. Orange-yellow flux globules with radiating fine flux feathers in Ramaura product. (dark-field illumination) 35 ×.

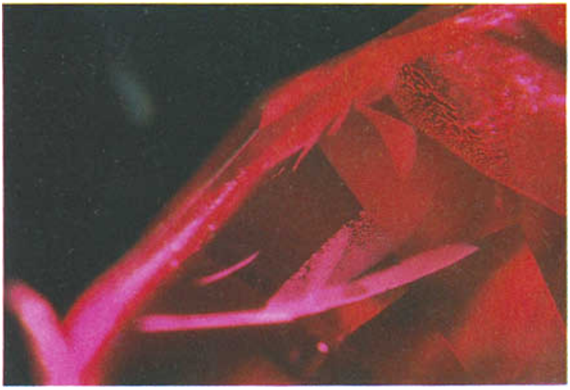

FIG. 13. Fine flux feathers resembling the appearance of feathers seen in heat-treated natural rubies from Thailand. They can be quite dangerous in future discriminations. (dark-field illumination) 30×.

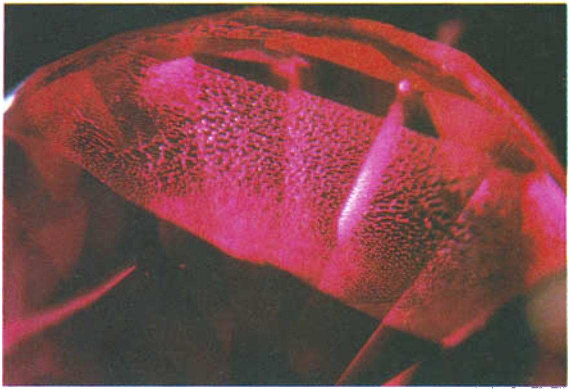

FIG. 14. Inclusions reminiscent of a lace curtain may mislead the eye. However, in Ramaura flux rubies the feathers show clear-cut boundaries. (dark-field illumination) 30×.

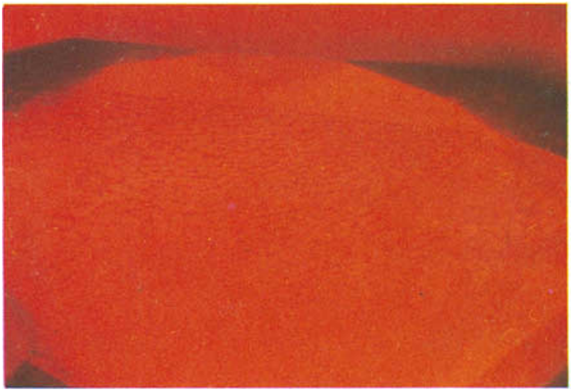

FIG.15. Further study of the feather in Figure 14, now observed in immersion microscope. The particles of flux remain darker than the transparent fluid inclusions in natural rubies. (transmitted light) 35×.

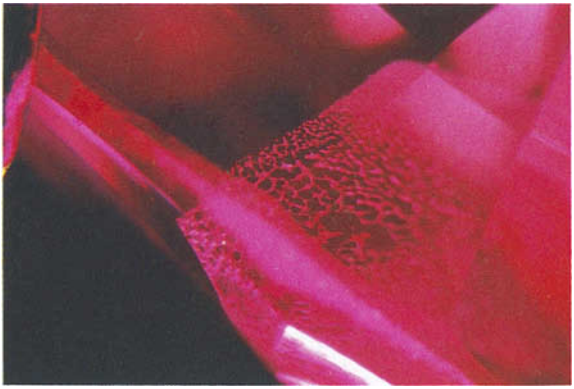

FIG. 16. The lace-like flux feather with diagnostic clear-cut appearance frequently seen in Ramaura flux ruby. (dark-field illumination) 30×.

(b) *opaque to nearly translucent feathers of flux having an orange-yellow colour*

Often observed in this new synthetic ruby are the opaque to translucent orange-yellow or, as in some cases, white flux feathers; which are concentrated mostly towards the girdle of the cut stone (Figure 11). The contours of semi-dense areas of the feather appear like the tail of a dragon (Figure 11). Opposed to the high relief portions of yellow-orange colour they also exhibit portions of very

FIG. 17. Under crossed polars some of the observed Ramauras revealed negative cavities. 35×.

low relief. As in Figure 11, they become almost invisible in certain areas. Although the veil-like twisting of flux feathers is absent in Ramaura, the flux feathers may often form a fan-like appearance (Figure 12) with fine mesh-like flux.

(c) *translucent to nearly transparent very fine 'fingerprints'*

Very fine, translucent to nearly transparent 'fingerprints' like flux feathers are noted in the new synthetic ruby. They may, at first glance, impress the eye as natural feathers, similar to those seen in heat-treated Thai rubies. The presence of such feathers, as in Figure 13, should not be considered as the only means of differentiating natural and synthetic rubies. Since their visibility is unreliable for a conclusive result, higher magnifications must be employed (Figure 14). It is advisable also to study the nature of the feather under dark-field illumination (Figure 14) or in immersion microscopy (Figure 15). In both these figures, the unnatural nature of clear-cut lace-like or cobweb-like feathers provides a positive answer that it is a synthetic. In Ramaura flux rubies the feathers often appeared with clear-cut outlines (Figure16). Influenced by the mode of crystallization, resulting negative cavities were evident in a few Ramaura flux rubies (Figure 17). They may often create voids within the stone and can appear in many other forms.

CRYSTALLOGRAPHY OF RAMAURA SYNTHETIC RUBY

Only very little can be explained in relation to the ideal crytallization of Ramaura synthetic ruby. Figure 18 reveals a tabular habit, often resulting from spontaneous nucleation. Such faces as c (0001), r $(10\bar{1}1)$, d $(10\bar{1}2)$ and n $(22\bar{4}3)$ can be recognized with many growth features.

CONCLUDING THOUGHTS

Ramaura synthetic flux rubies of various colour hues and different cuts are now available in the trade. They may be included in parcels of rubies either as rough or fashioned stones. The recognition of them must be concluded under the microscope. The inclusions mentioned, such as growth phenomena, flux feathers and residues and rarely the negative cavities, should be considered in future discriminations. Since the results provided by ultraviolet spectrometric analyses are, up to date, uncertain, the inclusions are the prime identification characteristics of this new product.

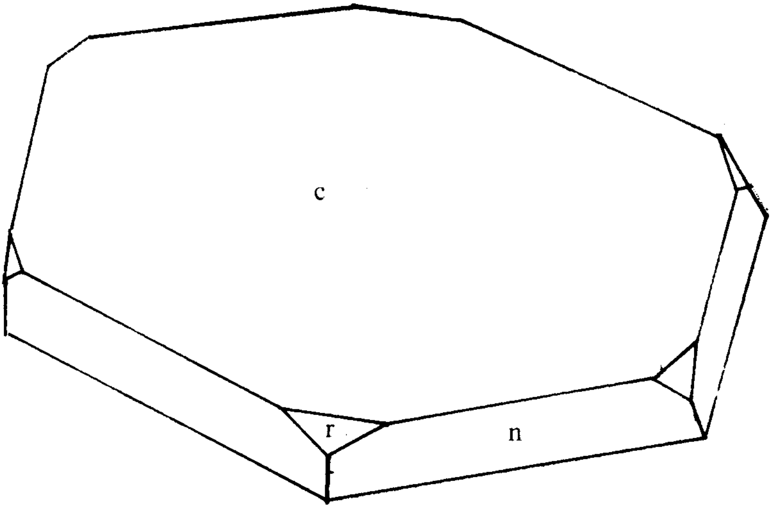

FIG. 18. Flat ruby crystal of Ramaura sketched to show the c (0001), r ($10\bar{1}1$) and n ($22\bar{4}3$) faces.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the following contributions. Vasantha Gunawardene, J. Maes and J. Henn, of Idar-Oberstein, for the loan of Ramaura flux ruby samples; G. Bosshart, G.G., Director the Swiss Foundation for the Research of Gemstones, Zürich, for the spectrum analysis and valuable comments made; Dr G. Lenzen, F.G.A., D.Gem.G., G.G., of Deutsche Gemmologische Gesellschaft, who provided the laboratory facilities for carrying out this investigation; and to J. R. H. Chisholm, F.G.A. for critical reading of the manuscript and valuable comments made.

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REDDISH-BROWN SAPPHIRES FROM UMBA VALLEY, TANZANIA

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INTRODUCTION

As known to the gemmologist and jeweller, East Africa's famous gem locality, Tanzania, is well known not only for garnets of various colour varieties, but also for corundums of many colours and hues. The occurrence of corundum in Tanzania is reported by many researchers (Zwaan, 1974; Dolenc, 1976; Amstutz & Bank, 1977; Bank, 1978). However, these reports mainly describe the common corundum varieties such as ruby and blue and yellow sapphires. Recent observations made by the author on new occurrences of sapphires from Umba Valley revealed a reddish-brown colour variety which has often been termed as 'padparadschah' in the trade. It therefore became necessary to investigate systematically the differences between the 'real' padparadschah and this new occurrence. The chemical and physical properties of the latter are given with special emphasis on the cause of colour. Further, the inclusions are reported, which may be of help in documenting the locality.

CHEMICAL AND PHYSICAL PROPERTIES

Visual colour observations revealed a reddish-brown to brownish-orange body colour often with a yellowish or greenish tint. According to the DIN colour system the colour indices were between 6:6:2 and 7:5:2. Stones with a darker body-colour showed distinct dichroism, which may be helpful to the field gemmologist in separating them from similarly coloured *pyralspite* (or *umbalite*) garnets, which also occur commonly in this locality.

The chemical composition of four samples was analysed by an ARL electron microprobe. Transition metal ions were detected to determine the cause of colour (described below). The analytical values along with the determined refractive indices and specific gravity are given in Table 1.

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TABLE 1. The physical and chemical data of reddish-brown sapphires from Umba Valley, Tanzania.

Sample:	1.	2.	3.	4.
Carat weight:	7.80	3.25	1.97	0.88
Colour:	reddish-brown	reddish-brown with a greenish tint	reddish-brown	reddish-brown
Dichroism:				
o — ray:	brownish-orange	brownish-orange	purplish-red	weak for visual observations
e — ray:	yellowish-green	yellowish-green	greenish	
Refractive indices:				
n_{ω}:	1.771	1.771	1.773	1.773
n_{ε}:	1.763	1.763	1.765	1.765
Birefringence:	−0.008	−0.008	−0.008	−0.008
Specific gravity at 4 °C*:	4.02	3.99	4.05	4.06
Microprobe analysis (oxides in Wt %)				
Fe_2O_3†	1.10	1.10	1.53	1.62
Cr_2O_3	0.12	0.13	0.09	n.f.
TiO_2	n.f.	0.36	0.03	0.03
V_2O_5	n.f.	n.f.	n.f.	n.f.

* accuracy ± 0.01

† the total iron is calculated as Fe_2O_3

n.f. = not found (below detection limit of the microprobe)

CAUSE OF COLOUR

The basic possibilities existing for colour of corundum are due to transition metals such as iron, titanium, chromium and vanadium or to lattice imperfections. Experiments have shown that in natural corundum the colour is mainly due to the usual presence of two or more transition metal ions as opposed to the rare occurrence of a single chromophore. If a colour is produced by a single transition metal ion the result is a basic colour which may be green to yellowish-green (due to Fe^{3+}) or pink (due to Ti^{3+}) or red (due to Cr^{3+}) or reddish-green to greyish (due to V^{3+}). Lattice defects may cause a yellowish colour in corundum (Schmetzer & Bank, 1981a and b; Schmetzer *et al*, 1982).

According to the data in Table 1, the reddish-brown stones from Tanzania contained a higher percentage of iron than of the total Cr and Ti content. However, the microprobe cannot determine the oxidation state of iron. It is probable that Fe^{2+} and Fe^{3+} are in different sites within the crystal lattice, causing a somewhat darker hue to the body-colour of the stone. On the other hand the possibility exists that lattice defects also influence the colour of these sapphires, with different positionings of Fe^{2+}, Fe^{3+}, Cr^{3+} and Ti^{4+} within the lattice. Both these explanations can apply to the coloration of the reddish-brown colour in sapphires from Tanzania. The minute quantity of Cr_2O_3 is easily masked by the much larger proportion of iron oxides present. Therefore these stones cannot be referred to as *padparadschah,* whose colour is due to Cr^{3+} and Ti^{4+}.

ABSORPTION AND ULTRAVIOLET BEHAVIOUR

Schmetzer & Bank (1981a) mentioned that the absorption spectrum of corundum can be due to the presence of one or more metal ions within the structure, which may also lead to the superposition of several basic types of spectra. This type of absorption spectrum was noted with those reddish-brown stones from Umba Valley.

The two colour-causing metals found are iron and chromium, in variable proportions producing orange-brown and orange-red hues. The most distinct line in the blue at 450 nm results, without doubt, from the higher iron content. In every spectrum the Cr lines and bands are detectable, sometimes in considerable strength (doublet at 693 nm, etc.). The presence of vanadium in Tanzanian

FIG. 1. Survey of the most typical internal scene, pressure parting lines in Umba Valley sapphire of reddish-brown colour. 40 × . (dark field illumination).

FIG. 2. Typical feather of crystallites, another common feature in reddish-brown sapphires of Tanzanian origin. 40 × . (dark field illumination).

FIG. 3. Round zircon crystal with high relief, inside a sapphire from Umba Valley. 80 × . (light-field illumination).

ruby, as indicated by Bosshart (1982), does not show up in the spectra of orange sapphire dealt with in this work. However, the rather weak and broad absorptions in the yellow and yellow-green are probably due to superposition of several absorption spectra (see again Schmetzer & Bank, 1981a).

Again, owing to the high iron content the stones were inert under both short- and long-wave ultraviolet radiations.

INCLUSIONS

Various internal scenes were investigated in a large number of corundums having the body-colour mentioned. The most common and typical internal parageneses are shown as photomicrographs in Figures 1 to 3. The crystal inclusions were minute fragments or platelets in appearence. Most of the fragments showed the habit taken by apatite, but were too small for the exact nature to be identified. The feathers were often formed of minute crystals or were healed. Dislocations caused during growth were apparent in most of the specimens. This can be taken as an inclusion typical of the sapphires of this colour originating from Umba Valley.

DISCUSSION

This new occurrence of reddish-brown sapphires from Umba Valley in Tanzania is another natural colour variety to the corundum family. The presence of the transition elements Fe, Cr and Ti along with certain growth defects cause the colour in these sapphires, and it should be mentioned that many intermediate colour hues may be presented in the trade, with false names such as 'padparadschah' or 'umbalite-sapphire'. However, the introduction of a separate name to this new find does not seem to be necessary. In future they can be called *reddish-brown sapphires.*

ACKNOWLEDGEMENTS

The author is grateful to Dr H. A. Hänni, F.G.A., of the University of Basel, for providing chemical data and for his important suggestions which lead to a better manuscript, and to Dr G. Lenzen, F.G.A., G.G., D.Gem.G., of Deutsche Gemmologische Gesellschaft, for providing the laboratory of the institute. Thanks are also due to the firm of Gustav Zang in Idar-Oberstein for a sufficient supply of material which was used in this determination.

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[*Manuscript received 30th December, 1982.*]

FURTHER LIGHT ON THE SANCY DIAMOND

By R. KEITH MITCHELL, F.G.A.

Some years ago the late John Forster, one time chairman of the Gem Section of the London Chamber of Commerce and the sole remaining active director of the firm of James A. Forster & Sons Ltd, retired and at the that time passed over to me a very mixed assortment of gemmological specimens originally collected by his uncle, or great-uncle, a Mr A. A. Forster, towards the end of the last century. Among these was a very nice cut-paste replica of the Sancy diamond in a simple silver mount as a pendant. With it was a tattered and yellowing scrap of paper. These I now illustrate (Figure 1), and I think this note goes some way toward clearing up any mystery which may still surround the ownership of the smaller of the two Sancy stones.[1] The larger stone apparently passed into the ownership of the Maharajah of Patiala. Its present owner is not known.

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[1] See E. A. Jobbins, A brief look at the Sancy diamond, *J.Gemm.*, 1977, **XV** (5), 240-2; H. Tillander, Another brief look at the Sancy diamond, *J.Gemm.*, 1978, **XVI** (4), 221-8; Ian McGlashan, Letter to the Editor, *J.Gemm.*, 1981, **XVII** (6), 433-4; Corrigenda, *J.Gemm.*, 1981, **XVII** (8), 647.—Ed.

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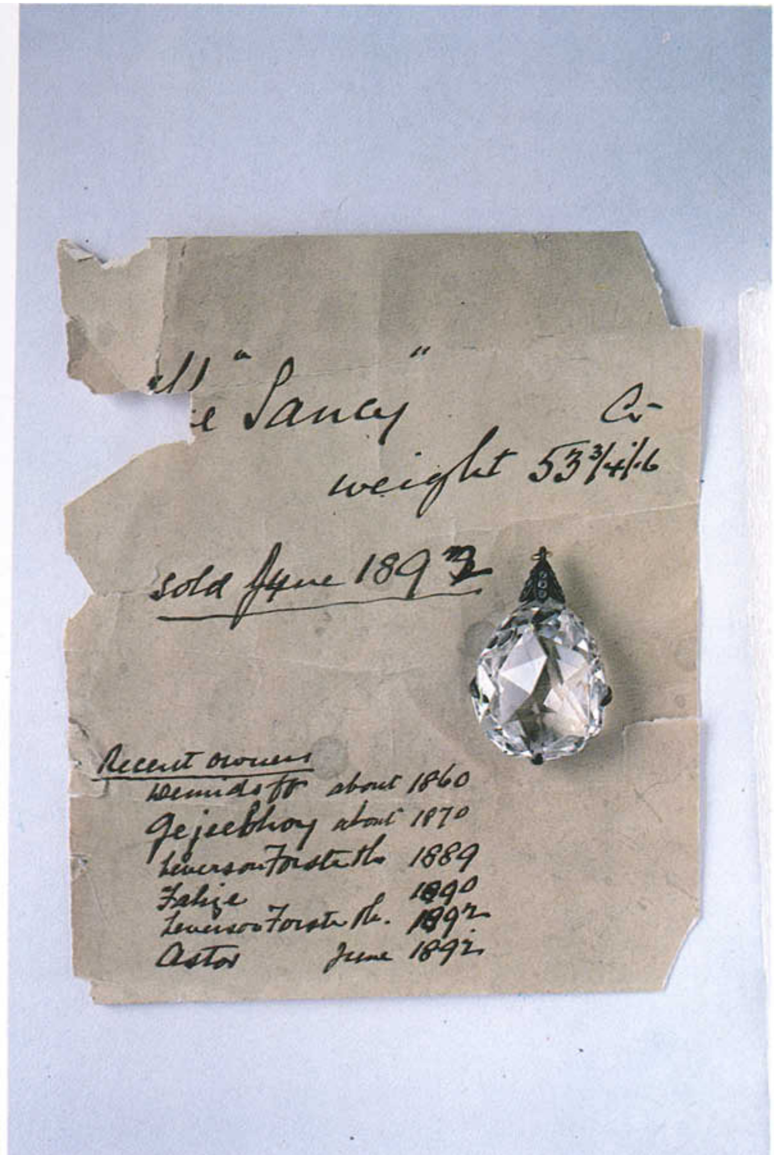

ll "
e Sancy" Cr
weight 53¾+1/16

sold June 1892

Recent owners
Demidoff about 1860
Jejeebhoy about 1870
Levenson Forster Ho 1889
Falize 1890
Levenson Forster Ho. 1892
Astor June 1892

The note, which is probably in the hand-writing of A. A. Forster, can safely be assumed to have been written in 1892, or very shortly afterwards, and lists a number of 'recent' owners of the Beau, or Little, Sancy.

The Russian Count, or Prince, Demidoff, who purchased it in 1828, died a year later, and the stone passed via his son Paul to Paul's wife, who remarried after his death to an Andrew Karamsin. It was acquired 'about 1870' by Sir Jamsetjee Jeejeebhoy, Bt., from Aurora Karamsin, who was again a widow. This date is probably five years out and there is reason to believe that this transaction took place in 1865.[2] The purchaser was originally Cursetjee Jeejeebhoy, who in accordance with tradition, assumed his father's name on succeeding to the title.[3]

The note next refers to the period in which the Forster family are involved, and it seems to establish that they held the stone in 1889, selling it the following year to Falize. This is undoubtedly Lucien Falize, goldsmith to the French Court, historian, archaeologist and painter of quite extraordinary merit. Back to Leverson Forster in 1892, when it was finally sold to Lord Astor. I think this date more or less disposes of the 1906 date suggested by Tillander.

Leverson Forster were precursors of J. A. Forster & Sons, or family connexions. There is a Leverson family in the Australian gem trade, and they had connexions with Haberer Brothers in London. I do not know anything about the Forster connexion.

It will be noted that the weight of the stone is recorded in fractions of a carat. This was the custom before the British carat went metric, the weights used in weighing being listed just as they were, without any attempt to add them together. Thus the weight of 53¾ $^{1}/_{16}$carats was in 'old' carats, pre-metrification, which in the gem trade means before 1913. It is the equivalent of 55.23 metric carats, the weight obtained by E. A. Jobbins in January 1976.

[*Manuscript received 10th July 1983.*]

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[2] *Illustrated London News,* 11th March 1865.—Ed.

[3] Sir Jamsetjee Jeejeebhoy(1783-1859) . . . created a Baronet of the U.K. in 1857 . . . was succeeded in the baronetcy by his eldest son, Cursetjee, who in 1860 assumed the name of his father in accordance with a statute which applied to every succeeding holder of the baronetcy. The second baronet died 17th June 1908. (D.N.B., compact edn, O.U.P., 1975, vol. I, p.1070).—Ed.

THE GREEN MONSTER

By DAVID MINSTER, F.G.A.

Pretoria, South Africa

It is, I imagine, everyone's dream to own a really outstanding gem specimen. A few years ago I was offered an emerald specimen which I considered of exceptional beauty, large size, good colour and crystal form. I immediately purchased it: maybe it is not of outstanding gem quality—no large stones could be cut from it—but nonetheless it deserves the name of 'The Green Monster'. I showed it to a large number of people attending the Gemmological Association's Golden Jubilee Celebrations in October 1981, and readers who were there may remember me as 'the Man with the Big Emerald'.

The size of the stone is exceptional: its dimensions are 87.85 × 41.5 × 37.6 mm, and it weighs 1250 ct (see Figures 1, 2 and 3). It is brilliant grass-green in colour. The prism faces are well developed with striations parallel to the length of the crystal. There is evidence of quartz inclusions, and part of the matrix (biotite mica) is apparent on the back of the specimen. The hexagonal symmetry can be clearly seen in Figure 2: unfortunately the basal face was sawn off by a previous owner to make the specimen stand well!

Clarity. The stone has a number of fissures extending right through at about 45° to the basal plane. The areas between these fissures are of fine clear green gem-quality, to which the photographs do not do justice. These areas, however, are not large enough to facet stones of more than 0.10 to 2 ct from.

Inclusions. Using a Gemolite Mark 5 Custom de Luxe microscope with both dark-field and bright-field illumination revealed numerous cracks running through the stone, a few biotite inclusions, and one unidentified very bright orange inclusion near the surface.

Spectroscope. A Beck 2522 spectroscope was used. In transmitted light, only red and green 'windows' from 480 to 560 nm and from 590 to 640 nm were observed, the rest of the spectrum being absorbed. In reflected light, there was a typical emerald spectrum, with strong absorption of the blue/violet.

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FIG. 1

FIG.2.

FIG.3.

FIGS. 1, 2, 3. Three different views of the 1250 ct emerald, with scales in inches.

Locality. I have every reason to believe that it was mined in Mozambique. I acquired it in 1979, just after the Portuguese exodus from Mozambique, when the new regime was installed. The man I bought the stone from is now untraceable, but at that time he had some of the Portuguese refugees staying with him, who had brought with them an amazing collection of gems from Mozambique. I myself saw some of this collection, which included a couple of *flawless* tourmaline crystals measuring approximately twelve inches in length and two or three inches thick; they were then on sale for about £35000 each and were promptly snapped up by Americans. There were also some fantastic beryls weighing thousands of carats, and I was able to obtain a 2 kg (flawed) morganite crystal. When the refugees had sold most of their stones, they moved on elsewhere with their money but left behind a few specimens, including the emerald which I subsequently bought, as payment to the people with whom they had stayed for services rendered.

I have enquired about the locality of the mine and understand that it is in northern Mozambique and is known as the Maria Mine—presumably the same as that referred to by Webster (1983). Details are unfortunately sketchy, because the mine is run by Russians and for political reasons it is difficult to obtain information in South Africa from Mozambique.* But my friend, Arthur Thomas, F.G.A., who I believe has actually visited the mine, tells me that the inclusions in my emerald are similar to those in emeralds from the Maria Mine.

All in all, this stone really 'measured up' to my expectations.

REFERENCE

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[*Manuscript received 12th May 1980; revised 17th May 1983.*]

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*A news item in *The Times* (23rd December 1983, p.5) stated that, according to an official of the Soviet Embassy at Maputo, guerrillas of the Mozambique National Resistance in August 1983 had attacked a mine in Zambezia Province, where they had killed two Soviet geologists and kidnapped twenty-four, of whom two had subsequently died and eight had been freed and returned to the U.S.S.R. This may well well refer to the Maria Mine.—Ed.

VERDITE AND RUBY-VERDITE FROM ZIMBABWE

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The deep green rock verdite has been known from the Barberton district of Transvaal since 1907. More recently, deposits have been found in Zimbabwe and local artists and craftsmen are using the material to produce a variety of carvings which range from small animals for the tourist market to exclusive, large, 'spirit' carvings. Many of the latter have been created by world-famous sculptor-carvers and have drawn critical acclaim during exhibition in London, Paris and New York. The superb woman's head illustrated in Figure 1 shows the range in both colour and texture which is commonly found in the Zimbabwe verdite, and the buffalo (Figure 2) is a fine carving in green and golden brown banded verdite. The material comes from the Concession Corundum Mine about thirty miles north of Harare and is a by-product of the open-cast working for corundum. About 75% of the verdite recovered from this operation contains too much corundum for working by the sculptors, but some ruby corundum in the verdite is accepted and can add significantly to the beauty of the carvings. In the absence of corundum the verdite is a relatively soft rock with hardness 3 on Mohs's scale, but it varies considerably according to its mineral composition and corundum-rich bands approach hardness 9.

In view of the renewed interest in the rock and in order to determine in detail the composition of the Zimbabwe verdite, two examples were examined in detail using optical microscope and electron microprobe techniques, and a series of 19 samples representing different colours and rock textures were subjected to specific gravity measurement. The SG values obtained from verdite range from 2.70 to 2.87, specimens with substantial brown areas or with significant contents of albite (SG 2.63) giving the lower values. Higher specific gravities generally correspond with overall green colour and two dark green specimens from the Transvaal gave values of 2.85. The presence of corundum also raises the overall density and the ashtray of ruby-verdite (Figure 3) has a specific

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FIG. 1. Woman's head carved in green and brown banded and brecciated verdite from Zimbabwe. Carving 28 cm high.

FIG. 2. Buffalo carved in green and golden brown finely banded and brecciated verdite from Zimbabwe. Carving 27 cm long.

FIG. 3. Ashtray, 26 cm long, fashioned from typically banded ruby-verdite, Zimbabwe.

gravity of 3.15. The higher the proportion of ruby corundum, of course, the closer will the SG approach the value of 4. It is not easy to obtain spectra in a hand-held spectroscope from light reflected off the surface of the verdite and the best results are seen from parts of verdite blocks and carvings which are thin enough to allow some transmission of light. Indistinct absorption lines above 640 nm and vague absorption at the blue end of the spectrum can be seen in some specimens and these results are in accord with the observations of Webster (1983 p.366).

Verdite is a deep green rock consisting essentially of finely intergrown chromian muscovite mica or fuchsite. Scattered grains of rutile are present in the Transvaal verdite and this is also a feature of the Zimbabwe rocks. The fine structure exhibited by the banding or brecciation in many examples (see Figures 1 to 4) is emphasized or brought out by the different colours of the impurities present and it was to identify these that the present study was undertaken. Two samples from the Mazoe-Concession area about thirty miles north of Harare, Zimbabwe, and two from the Transvaal were selected for sectioning and mineralogical analysis. In both localities the rocks are similar in texture and consist of grains of muscovite less than 0.1 mm across finely intergrown in a 'felted' mass (Figures 6, 7). The impurities are generally also of this grain size although some albite grains in the Transvaal rocks reach 2 mm. In thin section the banding is not nearly as sharply defined as in hand specimen, but changes in mineralogy can be seen in Figures 6, 7 and 8 where the dark grains are responsible for the dark brown areas visible in carvings such as that shown in Figure 1.

The two samples from Zimbabwe consist in detail of two mineral assemblages. The first, MI 37073, is largely muscovite with impersistent bands of rutile grains (<0.01 mm). In places there are irregular patches which are orange brown, pale brown or opaque, and these consist of mixtures of hydrous iron oxides and arseniosiderite ($Ca_3Fe_4(AsO_4)_4(OH)_6.3H_2O$). The Ca:Fe:As ratios generally lie between 2:3:3 and 3:4:4, but in some places Fe is dominant, indicating the possible presence of scorodite, and in others As is absent, indicating that goethite or limonite are present. Some grains contain up to 0.5% of Ni, Te, Cu or Bi and their presence is consistent with the occurrence of gold nearby. In these analyses Cr is below the limit of detection of 0.2 wt% oxide. Some grains consist of arseniosiderite cores and iron arsenate rims. The

FIG. 4. Close-up of banding and of irregular patches of fine-grained ruby in verdite, Zimbabwe. Red-ruby, green-chromian muscovite, brown-hydrated iron oxides, arsenates and other minerals.

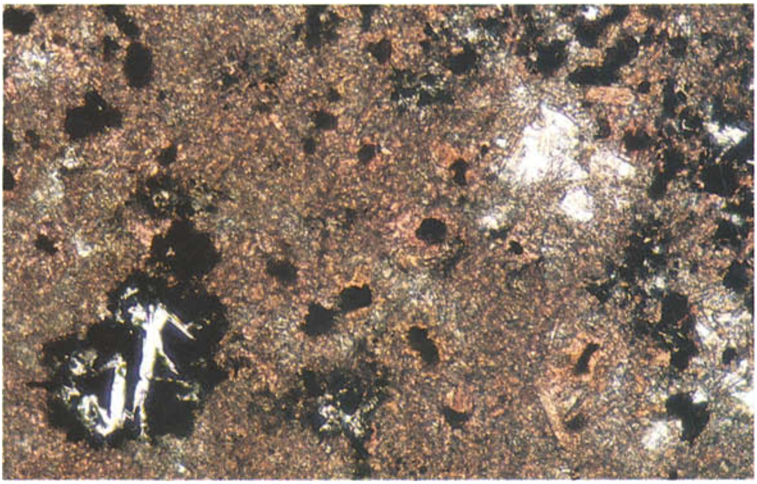

FIG. 5. Pink corundum associated with opaque rutile grains and surrounded by turbid muscovite occurs with patches of chlorite (clear) and gersdorffite (opaque) intergrown with ?andalusite (clear). Zimbabwe verdite MI 37367, field 1 mm wide, plane polarized light.

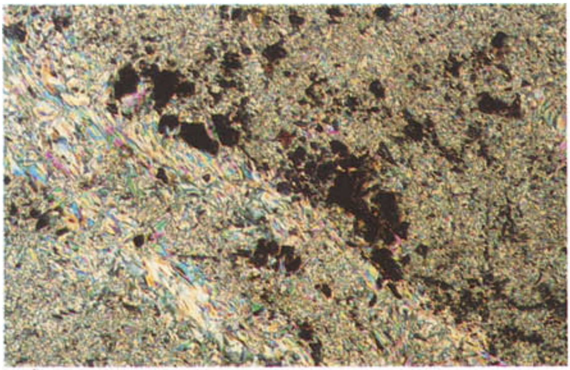

FIG. 6. Verdite from Zimbabwe. Photomicrograph showing muscovite (bright interference colours) with clusters of opaque grains (rutile) and sparse grains of golden brown arseniosiderite. MI 37073, field of view 1 mm wide, cross polarized light.

FIG. 7. Sinuous bands of tiny opaque grains of rutile rest in finely intergrown flakes of muscovite (bright interference colours). Transvaal verdite, MI 26804, field 1 mm wide, cross polarized light.

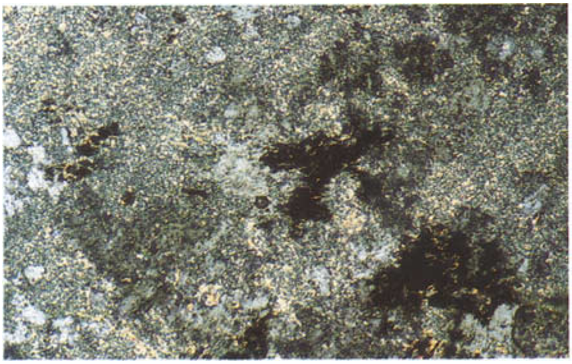

FIG. 8. Groundmass of muscovite flakes with patches of opaque rutile and albite (grey) which are responsible for the 'spotty' character of some Transvaal verdites. MI 35476, field 1 mm wide, cross polarized light.

second Zimbabwe sample is ruby verdite, MI 37367. It consists partly of a fine-grained intergrowth of muscovite, phengitic mica and chlorite with sinuous bands of tiny rutile grains, and partly of a fine-grained (<0.1 mm) intergrowth of corundum with minor quantities of chlorite, muscovite, margarite, aluminium silicate, rutile, gersdorffite and sulpharsenates (Figure 5). The patches and streaks of ruby (Figures 3, 4) consist of masses of tiny unoriented plates of corundum with contents of up to 1% SiO_2, 1% TiO_2 and 4.5% Cr_2O_3. The grains of Al_2SiO_5 are rare and small, and without x-ray crystallographic data it is not possible to be sure if they are andalusite, kyanite or sillimanite; they too contain traces of Cr_2O_3 up to 0.6%. Chlorite is the low-silica variety sheridanite, with up to 1.9% Cr_2O_3, and the calcium mica margarite contains variable amounts of MgO (up to 1.4%), K_2O (up to 1.5%) and Cr_2O_3 (up to 1.2%). The margarite is intergrown with gersdorffite (NiAsS) with minor amounts of Fe and Co. X-ray diffraction studies by Mr B. R. Young confirmed that TiO_2 is present as rutile in MI 37073 (chart DX 2978) and in MI 37367 (DX 2979). The pattern of trace Cr content in many of the verdite minerals is continued in the rutile grains some of which contain 2.5% Cr_2O_3. In the corundum-free part of the rock chromian muscovite is associated with rutile, the only dark mineral, and a second, phengitic mica. Phengite is essentially a solid solution of muscovite with Mg, Fe and Si partially replacing Al, and some grains in this rock contain up to 7.2% MgO and 1.3% FeO, although less Cr_2O_3 is present in this mica than in the Mg-free muscovite. Throughout specimens MI 37073 and MI 37367 the composition of muscovite is consistent except for Cr_2O_3, which ranges from 0.3-1.9% in the former and from 2.1-2.9% in the latter (see Table 1).

The two samples of verdite from the Transvaal, MI 26804 and MI 35476, show less mineralogical variation than the Zimbabwe specimens. Both consist largely of chromian muscovite and rutile, but whereas there is only a trace of albite feldspar in MI 26804, MI 35476 contains up to 30% (Figure 8). In the latter, the feldspar composition ranges from $Ab_{95}An_4Or_1$ to $Ab_{90}An_6Or_4$. The occurrence and composition of rutile resembles closely that in the Zimbabwe verdite with sinuous bands of tiny grains which again contain minor amounts of Cr_2O_3. In addition, however, small amounts of Ca and P were detected and the rutile may contain submicroscopic inclusions or intergrowths of apatite.

TABLE 1

Energy-dispersive electron microprobe analyses of muscovites.

Wt%	1	2	3	4
SiO_2	45.52	45.14	47.42	45.08
TiO_2	0.23	0.34	0.42	0.39
Al_2O_3	35.16	35.10	31.78	30.89
FeO	<0.2	<0.2	0.20	0.33
MgO	0.37	<0.2	1.61	1.72
Na_2O	0.91	0.68	0.59	0.43
K_2O	10.23	10.19	10.88	10.36
Cr_2O_3	1.23	2.60	1.86	4.20
Total	93.65	94.05	94.76	93.40

Notes. An accelerating voltage of 15 kV, a specimen current of 5×10^{-9} amps and an electron beam focused to about 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 %. Total iron was assigned to FeO. The low totals do not include H_2O and the possible presence of oxides of low atomic number elements. Numbers refer to specimens in the collection of the British Geological Survey, London.

1. Mean of 10 analyses of muscovite in verdite MI 37073 (SG 2.84) from near Harare, Zimbabwe. Cell dimensions: a 5.184 ± 0.002Å b 8.997 ± 0.003Å c 20.044 ±0.003Å β95 ° 45′ ± 1′.
2. Mean of 3 analyses of muscovite in ruby-verdite MI 37367 (SG 2.84) from Concession Corundum Mine, north of Harare, Zimbabwe.
3. Mean of 7 analyses of muscovite in verdite MI 26804 (SG 2.85) from Barberton, Transvaal. Cell dimensions: a 5.195 ± 0.001Å b 9.013 ± 0.002Å c 20.020 ± 0.002Å β 95 ° 47′ ± 1′.
4. Mean of 4 analyses of muscovite in verdite MI 35476 (SG 2.70) from Verdite Mine, Transvaal.

The major constituent of verdite is muscovite and the mean compositions in specimens from the two countries are given in Table 1. In the Transvaal verdites, the muscovite composition throughout each rock is relatively consistent with the largest variation shown by Cr_2O_3 (columns 3 and 4). It ranges from 1.4-2.7% in MI 26804 and from 1.2-6.8% in MI 35476. The muscovites in the Zimbabwe verdites are richer in Al_2O_3 and poorer in MgO and Cr_2O_3 than those from the Transvaal, but the differences are very slight and should not be considered significant on the basis of only two samples from each country. Muscovites in the verdites from both countries are well crystallized and x-ray powder diffraction data were obtained from diffractometer charts using Cu Kα radiation at room temperature (22 °C) and a scanning speed of 1/8 °2Θ/min, using silicon (a = 5.43088Å at 25 °C) as an internal standard. The data were refined using the computer program of Appleman and Evans (1973).

The analyses of the muscovite and rutile and the textures of the rocks suggest that the Zimbabwe and Transvaal verdites are essentially the same. However, in addition to the colour, the beauty of the stone also lies in its banded and brecciated structure, and this is emphasized by the different minerals associated with the muscovite and rutile. Arsenic-bearing minerals, ruby and aluminous silicates are responsible for a whole range of colours in Zimbabwe verdite. Some may have resulted from metamorphism of a banded sedimentary sequence of clay or shaly rock, perhaps tuffaceous with variable contents of heavy minerals, and others, such as the arsenates, may be the result of metasomatic or hydrothermal activity. Ferguson and Wilson (1937) have described fuchsite rocks and andalusite corundum granulites from the area around Concession and they consider them to be part of the largely volcanic Greenstone series of the Basement Schists, which are Precambrian in age. The corundum granulites probably arose from thermal metamorphism of an aluminous sedimentary layer interbanded with the volcanics but they consider (op. cit., p.32) the origin of the fuchsite rock to be very obscure. The origin of the Cr-mica rocks in other parts of the world is likewise not well understood and a complex history of Cr-mica schists of the Erris Complex in Ireland has recently been described by Max *et al.* (1983). They conclude that a wide range of rock types (ultrabasic to acid) had been dismembered and recombined during two periods of metamorphism, and that the Cr-mica grew at a late stage under the influence of hydrothermal fluids. According to Heinrich (1965) Cr-muscovite is found both in medium grade metamorphic rocks (schists and quartzites) in which there is no evidence of metasomatism, and in hydrothermal veins and replacement deposits. Whitmore *et al.* (1946) outline a three-fold classification based on associated minerals in low, medium or high-grade metamorphic environments, and comment on the association of Cr-muscovite with ruby corundum and kyanite in NE. Transvaal (op. cit., p.18). However, phengitic mica, which occurs in the

Concession ruby-verdite, is typical of low grades of metamorphism (prehnite-pumpellyite to low chlorite zone of the greenschist facies) and may well have developed as a result of hydrothermal activity. It is evident that Cr-muscovites and Cr-phengites are typically associated with complex metamorphic terrains, and in order to determine the origin of the Zimbabwe verdites the detailed geology of the surrounding rocks will also have to be known.

ACKNOWLEDGEMENTS

We would like to thank Mr B. R. Young for the x-ray identification of rutile and for his detailed work on the Cr-muscovite, Dr M. T. Styles for helpful advice concerning the microprobe analyses, Mr D. M. Taskis, of NERC Computing Service, for advising on the use of the Appleman and Evans program, and to him and Mr R. W. Sanderson for its implementation on the Honeywell DPS 300 computer. Roy Guthrie, Director of the Shona Gallery, Harare, supplied numerous samples of verdite for examination and photography. The paper is published with the permission of the Director, British Geological Survey (NERC).

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UNUSUAL EPR PROPERTIES OF MIKU EMERALDS

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INTRODUCTION

An unusual pleochroism was recently found by Schmetzer and Bank (1981) in emeralds from Miku (Zambia). These dark green emeralds show a pleochroism || *c* blue and ⊥ *c* yellowish-green, and this phenomenon was explained as due to 'a coincidence of an emerald and aquamarine component in the same individual stone'. The microprobe analysis revealed a high iron content, while chromium and vanadium were present as trace elements only. Schmetzer and Bank's (1981) suggestions imply that the iron atoms are replacing in solid solution the octahedral and tetrahedral cations in the beryl structure.

In order to clarify this point we have performed EPR (Electron Paramagnetic Resonance) investigations on 12 emeralds from Miku. The EPR is a non-destructive technique* and gives useful and sensitive indications on the paramagnetic impurities occurring in gemstones, the number of the signals and their position depending on the impurity and the type of the crystal.

RESULTS AND DISCUSSION

EPR measurements were performed using a Varian E-9 spectrometer operating at x-band frequency and equipped with a static magnetic field up to 1.6 tesla. In our apparatus the changing of the sample is very rapid, and we can study single crystals ranging from 1 mm^3 to 1 cm^3. The EPR spectra were recorded as a function of the angle between the applied magnetic field $\vec{H}$ and the hexagonal *c* axis.

Chromium and iron are usually found as impurities in both natural and synthetic emeralds (Hutton and Barrington, 1977), and

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*See D. R. Hutton (1979), Magnetic Resonance—a Non-destructive Probe of Gemstones, *J.Gemm.*, **XVI**(6), 372-85.—Ed.

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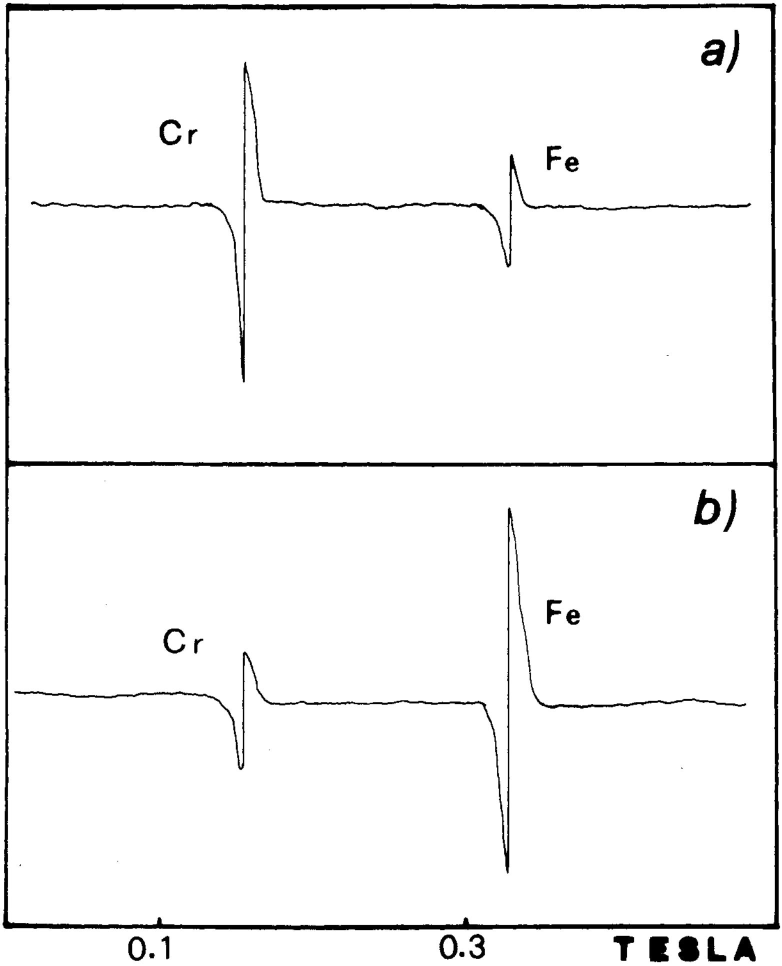

FIG. 1 EPR spectra of (a) synthetic emerald Gilson N; (b) emerald from the Urals (U.S.S.R.). $\vec{H} \perp c$ axis.

they can be easily identified performing EPR experiments with $\vec{H} \perp c$. In Figure 1 we record the EPR spectra of a Gilson N synthetic emerald and a natural emerald from the Urals (U.S.S.R.). These spectra are commonly found in synthetic as well as natural emeralds (Viticoli *et al.,* 1984), indicating that chromium and iron are present as trivalent ions replacing the Al^{3+} ions in the octahedral sites of the beryl structure. The intensity of the signals is directly related to the concentration of the impurities, and the linewidths are of the order of 3×10^{-3} tesla.

Miku emeralds show instead a very different EPR spectrum (Figure 2) : the Cr^{3+} and Fe^{3+} signals appear as very narrow bands superimposed on a very broad absorption with a linewidth of 1.8×10^{-1} tesla.

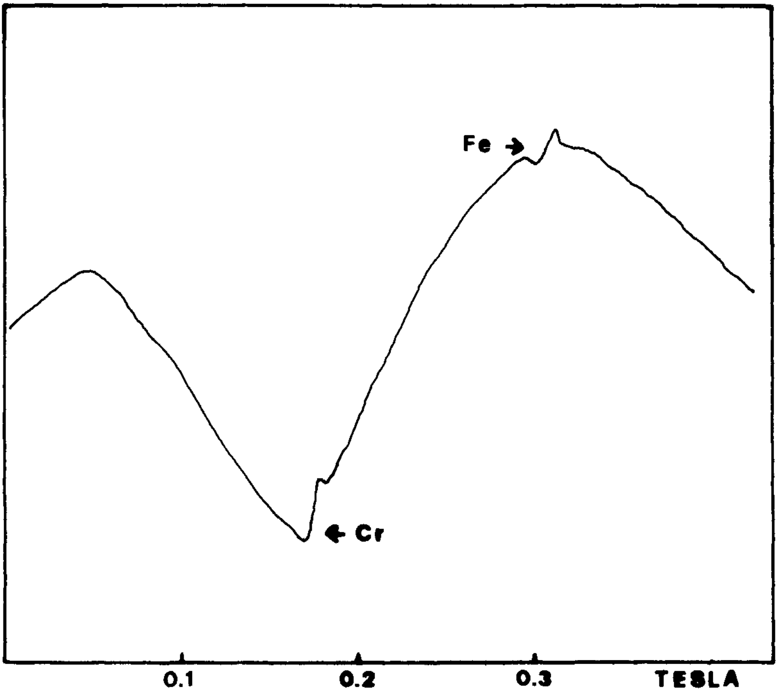

FIG. 2 EPR spectrum of Miku emerald ($\vec{H} \perp c$ axis).

The Fe^{3+} and Cr^{3+} signals are comparable in intensity, suggesting that the iron atoms present in the octahedral sites of the beryl are a small fraction of the total iron content found by the microprobe analysis. Therefore we suggest that the broad EPR signal originates from the presence, in these emeralds, of a magnetic concentrated compound of iron. A more complete analysis of the optical spectrum (350-2000 nm) could help to identify this compound and its possible effects on the visible spectrum of Miku emeralds.

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Viticoli, S., Gastaldi, L., Flamini, A., & Grubessi, O. (1984) Optical absorption and EPR investigations on natural and synthetic emeralds. *La Gemmologia*, in press.

[*Manuscript received 29th March, 1983.*]

A NEW LAMP USING STANDARD ILLUMINANTS A, C AND D 65 FOR COLOUR-GRADING OF GEM STONES

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1. THE E.Ö.G.G. STANDARD LAMP-UNIT

Colour measurements of gemstones should provide data based on visual judgements. They form the 'colour'-basis when grading coloured stones. Gemmologists are used to making visual estimations of colour of gemstones by comparison under variable conditions. What they find in this way are arbitrary values based on personal criteria and different conditions of tests and judgement. With the boom in the diamond and coloured stone markets accurate and more reliable systems for colour-measurements were asked for and seem now to be in their developmental states. Most of them are based on visual estimations, only rarely on the

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tristimulus method or photo-electric measurements. None uses standard colour charts, which for years have widely been accepted in industry for visual colour matching.(1,2,3,4,5) There does not exist a world-wide agreement on the use of a standardized light-source. Gemmologists still prefer to work with fluorescent lamps with or without built-in colour-filters. But these lamps show large deviations of radiance from CIE(1) standard values. Moreover, there are marked differences in colour-temperatures with various types.

In 1965 the standard light-source D 65 was introduced by the CIE.(1,3) This light-source is, nowadays, available in most commercial, though expensive, photometers, but mostly through the use of built-in computers. Gemmologists and gemstone dealers would possibly need less sophisticated instruments. It was therefore a most asked-for prerequisite to build a modern standard light-source with standard illuminants D 65 and C tailor-made for the colour-grading of gemstones of any kind. This aim was achieved through a special research program of the E.Ö.G.G.*

This lamp-unit houses a tungsten filament OSRAM Wi 410 light-source for standard light D 65. The first one includes a CIE-based liquid filter system.(1,3,8) Without these filters the tungsten lamp produces standard light A. The second one makes use of a specially E.Ö.G.G.-developed solid filter system. There are two compartments for visual colour-matching. The interior of both compartments is covered with barium sulphate white (DIN 6164). There are exchangeable stone-holders, one for diamond-grading and others for visual colour-matching of coloured stones of different carat weights. The compartments and stone-holders are of such sizes that practically any cut stone can be visually compared with from two to four chips from the DIN colour-chart. With rotatable stone-holders the conditions of 45/0° for visual colour-matching as recommended by the DIN 5033(3,8) are easily fulfilled. The stone-holders facilitate colour-grading of diamonds by means of master-stones, with both standard illuminants C and D 65, without resetting the stones.

Figure 1 shows the lamp with the standard illuminant D 65 on the left compartment and the standard illuminant C on the right.

Figure 2 gives a closer view of the interior of one compartment with coloured stone and chips.

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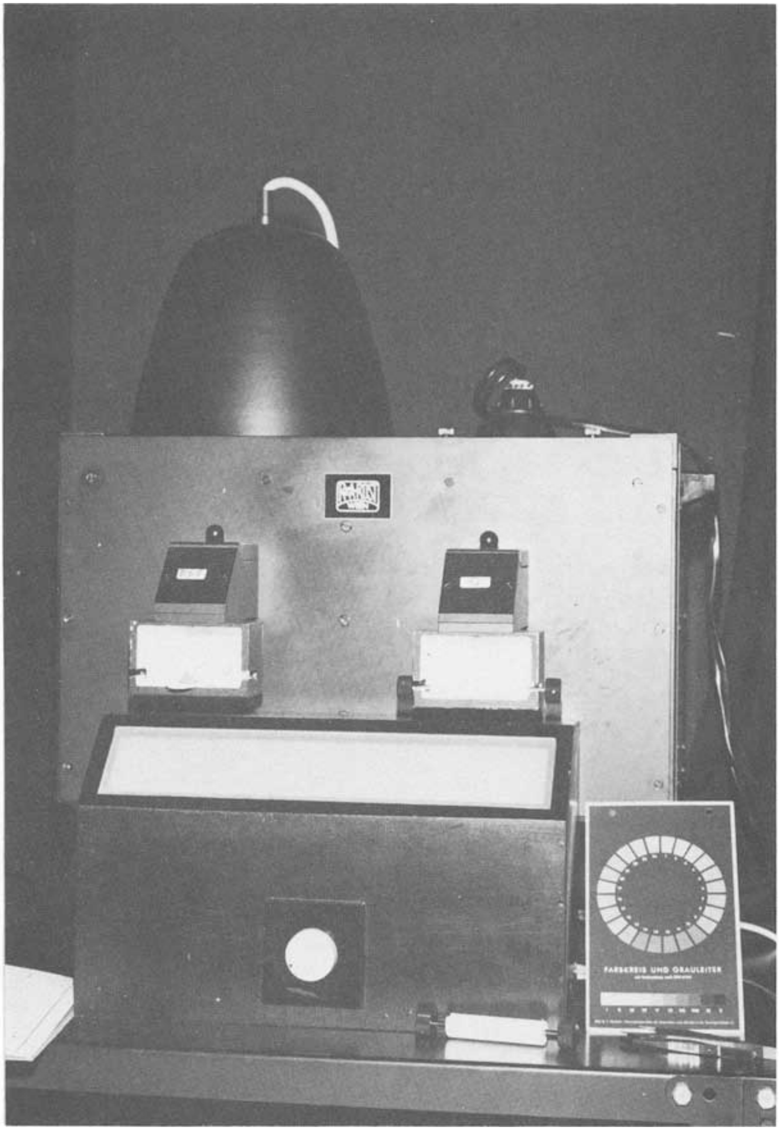

FIG. 1. E.Ö.G.G. grading lamp with standard illuminants A, C and D 65, ready for use. In the left D 65 compartment a large fire-opal rests on a plate. Two forms of rotatable stone-holder are shown on the right side, one in the C-compartment, the other below. In front of the lamp unit there is a long fluorescent lamp fitted with a dimmer control. This lamp facilitates the rapid accommodation of the eyes prior to any colour-matching test.

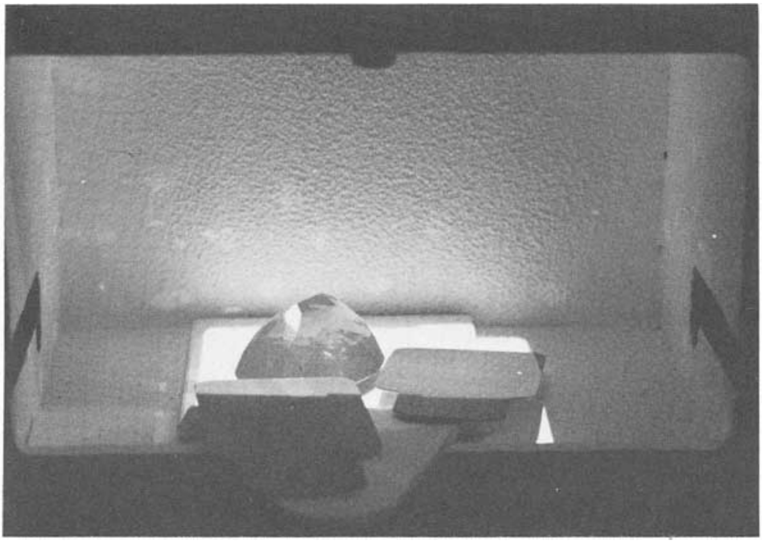

FIG.2. The interior of the left D 65-compartment with stone and glossy colour-chips. Oblique trays are used with other forms and sizes of cut stones; thus conditions for 45/0°-angles for incident light/visual matching according to DIN 5033, part 7, are easily met with.

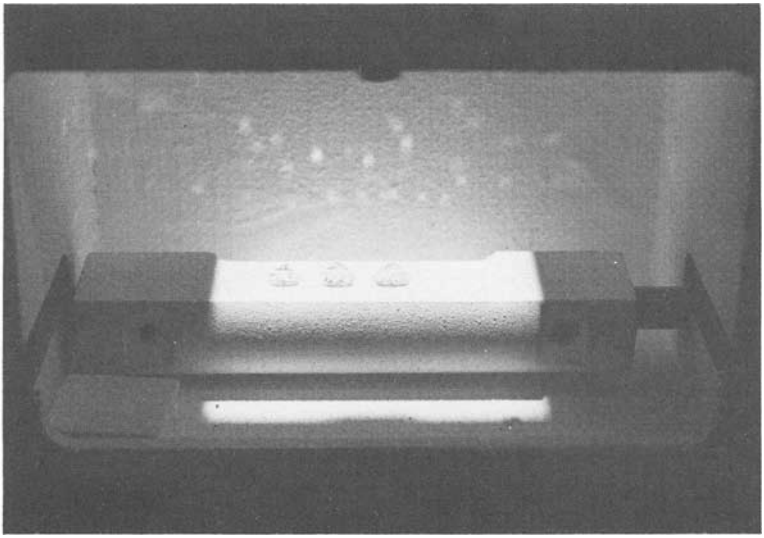

FIG. 3. The interior of the right C-compartment with rotatable stone holder for colour-grading of diamonds using master stones.

Figure 3 demonstrates how the rotatable stone-holder is used for colour-grading of diamonds by means of master-stones.

The colour-temperatures of the standard illuminant C and D 65 of the E.Ö.G.G. grading lamp have been carefully measured by the Bundesanstalt für Eich und Vermessungswesen, Vienna, using the liquid filters according to DIN 5033, part 7, page 2, or the specially designed conversion filter to produce standard illuminant D 65. The x, y chromaticity co-ordinates of both standard illuminants C and D 65 are given in Table 1.

TABLE 1

x, y chromaticity co-ordinates of the standard illuminants C and D 65 of the E.Ö.G.G. grading lamp

illuminant and filter	x, y chromaticity co-ordinates		theoretical values of chromaticity co-ordinates	
'D 65' Osram XBO 150 W/1 + special filter combination of E.Ö.G.G.	0.313	0.331	0.3127	0.3290
same lamp + special filter combination + heat-shield	0.316	0.345	—	—
'C' Osram Wi41/1 + liquid filters	0.310	0.316	0.3101	0.3162

There exist two sets of the DIN colour-charts. The older one uses non-glossy chips for standard illuminant C.(2) The new one contains glossy chips to be used with standard illuminant D 65. Normally, for a trained observer to judge intermediate values, four chips of the chart are sufficient for visual colour-matching. The

Pflanzenfarbenatlas, by Professor Biesalski, used already by Rösch,(9) proved to be a valuable additional means for colour-matching of gemstones. It contains those colour-chips based on DIN 6164 for illuminant C of high saturation values, which in the older DIN colour-chart have been omitted. The psychologically well balanced System of the DIN colour-chart based on hue (Farbton T), saturation (Sättigung S, chroma) and relative brightness (Dunkelstufe D, value V) can be tranformed by means of special graphic charts or through specially programmed computers into CIE (x, y) chromaticity co-ordinates.(6,7) It is also possible to calculate the Munsell notation or renotation values for hue, chroma and value from the measured T-, S- and D-values.

2. VISUAL COLOUR-MATCHING OF SOME TURQUOISES AND FIRE OPALS

Using the chips of the DIN 6164 colour-chart, fourteen observers were chosen to estimate the colour of nine turquoises. Each observer was familiar with handling gemstones and had passed medical tests for colour deficiences. The T-, S- and D-values found in these tests were statistically treated and tranformed into CIE x, y chromaticity co-ordinates. The loci of these co-ordinates are reproduced in Figure 4. It can been seen that the loci of the turquoises are concentrated within a small rectangular field starting at the lower part of the colour-triangle in the blue region and extending in an upward direction to colours with less saturation and a greenish tint. The 95% confidence-limits of the median-values of the calculated chromaticity co-ordinates are marked by the length of the horizontal and vertical bars.

Likewise the chromaticity co-ordinates of some fire opals were calculated from visual colour-matching using this time DIN colour chips for both illuminants, source C and D 65. The choice of fire opals was a necessity because of the lack of some of the new glossy chips of the DIN colour-chart for standard illuminant D 65 at the time of the experiments. For the 'opal-tests' twenty-eight observers had to make their independent estimations on seven fire opals. The result of their visual colour-matching tests are presented in Figures 4 and 5 for illuminant C and D 65 respectively with the bars of the 95% confidence-limits of the median-values. It can be seen that with two standard illuminants C and D 65 slightly different but otherwise coherent results were gained by the same twenty-eight

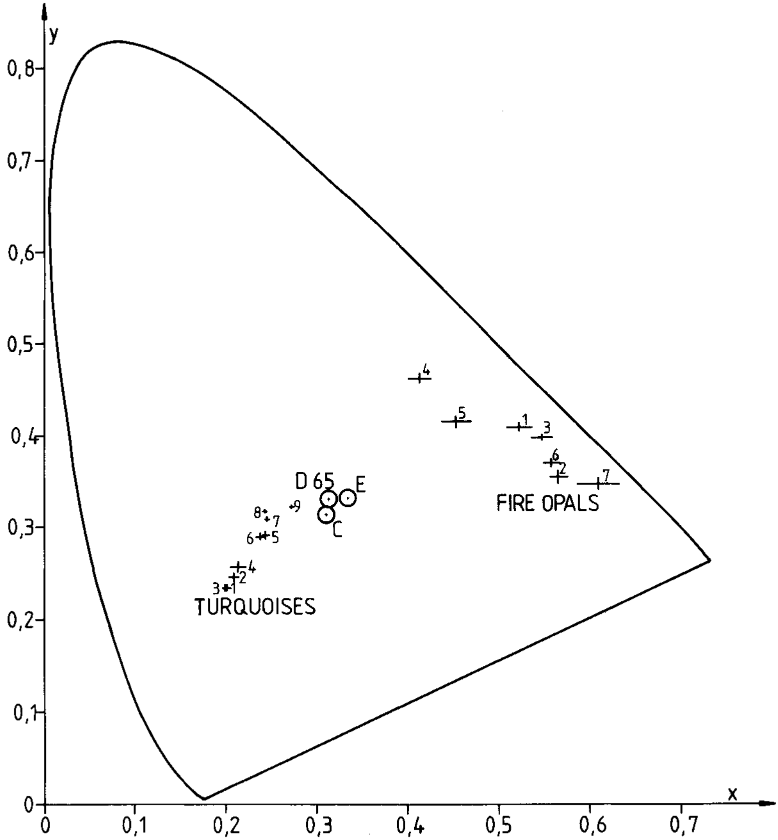

FIG. 4. CIE (x, y) chromaticity co-ordinates of turquoises and fire opals with standard illuminant C. Co-ordinates of standard illuminants C and D 65 together with centre of gravity E of the colour-triangle presented as circle. Horizontal and vertical bars = 95% confidence-limits of median-values.

observers. From the loci of the chromaticity co-ordinates of both figures it can be deduced that the fire opals used were of high colour-quality concerning the close proximity of their saturation values to the spectrum locus of the colour-triangle in the yellow range of colours.

3. THE COLOUR-GRADING OF DIAMONDS

In spite of the agreements reached on grading of diamonds by means of master-stones, no universally accepted standard illuminant has been proposed by various committees. CIBJO

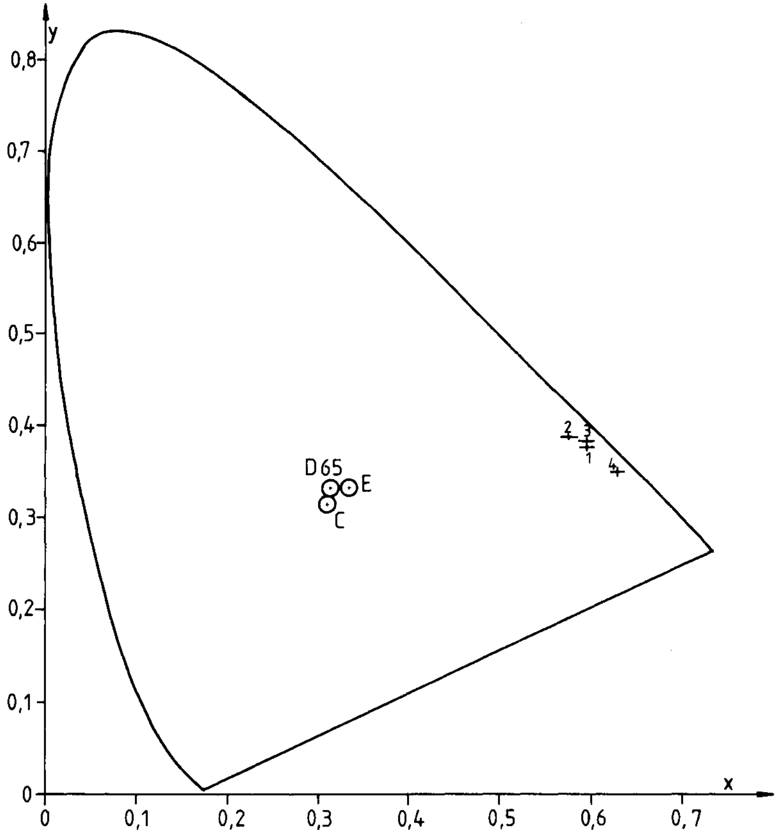

FIG. 5. CIE (x, y) chromaticity co-ordinates of four fire opals with standard illuminant D 65, number and stones identical with those of Figure 4. Horizontal and vertical bars = 95% confidence-limits of median-values.

specifies a 5000 K colour temperature, the IDS rules recommend D 65 as a standard illuminant. This means that nowadays fluorescent lamps and non-standard illuminants as well as standard illuminants C and D 65 can be used.

In order to test the newly developed E.Ö.G.G. standard lamp-unit for diamond-grading four different types of lamp were chosen, whose colour temperatures and chromaticity co-ordinates are given in Table 2. The lamps A and B were separate units not mounted in the E.Ö.G.G. grading lamp unit.

TABLE 2

Colour temperatures and x, y chromaticity co-ordinates of the four illuminants used in the colour-grading tests of brilliant-cut diamonds

illuminant	chromaticity co-ordinates x	y	colour-temperature (K)
A	0.376	0.388	4230
B	0.322	0.346	5950
D 65	0.313	0.331	6504
C	0.310	0.316	2856*

*colour-temperature of illuminant C without CIE liquid filter combination.

The two fluorescent lamp-units were of commercially available types. They are designated by the capital letters A and B. Thirty-seven observers participated in this test, the results of which were subjected to a rigorous statistical treatment. These tests were made with ten different diamonds, which were comparison graded against a set of master stones (CIBJO), and Table 3 contains the results of these tests. It can be seen that with the new lamp-unit rather consistent results could be achieved.

TABLE 3

Results of colour-grading of brilliant-cut diamonds by means of four different illuminants (GIA nomenclature, 37 observers)

type of lamp unit and illuminant		weight of cut diamonds in metric carats									
		0.590	0.478	0.475	0.474	0.588	0.522	0.612	0.708	0.745	0.752
E.Ö.G.G. grading lamp unit	standard illuminant D 65	G+	I	I−	H	E+	G	H−	E−	G+	F+
	standard illuminant C	G+	I−	I−	H	E+	G	H−	E−	G	F
fluorescent lamp unit ‘A’		F−	I+	J	H−	D−	G−	I+	E−	G−	F−
fluorescent lamp unit ‘B’		F	I	J	H−	D−	G−	H−	E	G	F

Some observers found it difficult to use the illuminant D 65 for colour-grading of diamonds, giving preference to the fluorescent lamps A or B or standard illuminant C, which are definitely of lower colour-temperatures. This implies that the higher content of UV light of the standard illuminant D 65 caused some inconvenience with 'white stones'.

The data given in Table 3 makes it obvious—and this is generally felt among many experienced diamond-graders—that the recently introduced subdivision of colour-grades D to K with signs of + or − seems to be of no practical value. For it is now proved that the variances of statistics use are consistently much greater than the calculated confidence-limits. These findings are independent of the colour-grades of the tested diamonds and of the type of illuminant used.

The result of these colour matching tests is the scientifically based confirmation of the opinion of many colour-graders—who have well founded backgrounds in colour-metrics—that first of all a standard illuminant must be found and accepted on a world-wide basis, together with a standardization of the background-conditions of illumination (barium sulphate DIN 6164 in these tests!) if any further improvement in colour-grading of diamonds is to be achieved. The same holds true under even more severe conditions of a standardized procedure of colour-grading of coloured stones.

This work was financially supported by Forschungsförderungs-fond für die gewerbliche Wirtschaft, Vienna, to whom we express our gratitude. We are indebted to Messrs R. and A. Rost, Vienna, for their assistance in building the prototype of E.Ö.G.G. lamp. To the thirty-eight observers who participated in the various colour-matching tests cordial words of thanks are expressed.

4. CONCLUSIONS

A new standard two-compartment lamp unit has been developed using standard illuminants C and D 65 (which can be easily extended to illuminant A) specially designed for colour-grading of gemstones. Visual colour-matching can be carried out by means of master-stones with special stone holders, or by comparison with colour-chips, preferably standardized colour-chips according to DIN 5033, making use of the DIN 6164 colour-chart. Stones and chips rest on plates or rotatable holders painted with barium sulphate white according to DIN 6164, thus any influence of background-colours is rigorously eliminated. Stones need not be reset when changing from one to the other compartment. The results of the visual colour-matching tests can be expressed in T:S:D values (hue:chroma or saturation:relative brightness). These values can be transformed into x, y chromaticity co-ordinates either by use of special nomograms or computer calculations. Conversion into respective Munsell renotation values is possible. Some colour-matching results gained with fire opals and turquoises from up to twenty-eight observers are quoted. The E.Ö.G.G. grading lamp unit can also be used for colour-grading of diamonds by means of master stones. Tests with thirty-seven observers have shown that the subdivision of the GIA colour grades D-K with + or − signs is not justified on statistical grounds.

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GEMMOLOGICAL ABSTRACTS

ANDERSON (J. E.). *Clinohumite, the newest gem.* Lapidary J., **37**, 7, 984-7, 3 figs in colour, 1983.

Clinohumite, an orange yellow member of the humite group of minerals, has been found in the Pamirs of the U.S.S.R. and has appeared on the market both as facetable crystals and faceted stones. It is a member of the monoclinic crystal system with hardness over 6, SG 3.2-3.3 and RI 1.631-1.688. M.O'D.

BANK (H.). (a) *Seltene Edelsteine: farbloser Yugawaralith aus Indien, rötlicher Friedelit aus USA und rötlicher Eudialyt aus Schweden.* (Rare gemstones: colourless yugawaralite from India, reddish friedelite from U.S.A. and reddish eudialite from Sweden.) Z.Dt.Gemmol.Ges., **32**, 2/3, 138-40, 1983; (b) *Über Gahnospinelle und Gahnite.* (About gahnospinels and gahnites.) Id., 141-2, 1983; (c) *Farbloser bis gelbicher Hydroxylherderit, ergänzende Daten.* (Colourless to yellowish hydroxyl-herderite, additional data.) Id., 143-4, 1983.

(a) Three rare minerals, cut as gemstones are described: (i) colourless yagawaralite from India, SG 2.21, RI 1.590-1.597, monoclinic and a tekto-silicate; (ii) reddish friedelite from U.S.A., probably from the Hotashell mine where transparent rhodochrosite is found. Colour caused by manganese. RI 1.659-1.627, SG 3.09; (iii) reddish eudialite from Sweden is a ring silicate and trigonal, RI 1.593-1.597, DR 0.004, hardness 5-6 on Mohs's scale, SG 2.88. (b) Mixed crystals of spinel and gahnite were called gahnospinels, RI between 1.796 and 1.803. Mentioned also are a green Brazilian gahnite with RI 1.792 and gahnospinels showing asterism. The gahnites had SG 4.60. (c) The hydroxyl-herderite from Brazil was found to have RI 1.610-1.645 and SG 3.08. E.S.

BANK (H.). *Varieties of beryl found in Madagascar.* Goldschmiedezeitung, **81**, 12, 77, 1983.

The types of beryl found in Madagascar are listed. An emerald with very high RI has recently been found at the Ankadilalana mine in the south-east of the island. M.O'D.

BLACK (P.). *Jade.* Australian Gem & Treasure Hunter, Part 1, 85, 8-10, 3 figs, 1983; Part 2, 86, 25-6, 6 figs, 1983.

The jade minerals and their possible imitations are described gemmologically. Part 2 describes modern mining methods. M.O'D.

BOSSHART (G.). *Cobalt glass as a lapis lazuli imitation.* Gems & Gemology, **XIX**, 4, 228-31, 4 figs (2 in colour), 1983.

A moulded bead necklace offered as 'blue quartz from India' resembled fine lapis lazuli but was proved by absorption spectra and other tests to be a non-transparent cobalt glass. White inclusions of low-cristoballite gave necessary colour irregularities. Dendritic and radial inclusions were seen, completely different from lapis lazuli structure. No pyrite inclusions or bubbles or swirls were present. Macroscopic appearance was confusing. R.K.M.

BRACEWELL (H.). *Diamond in Western Australia.* Wahroongai News, **17**, 10, 9-16, 2 maps, 1983.

A summary and history of the discovery of diamonds by the Ashton and Argyle Mines ventures. Many diamantiferous kimberlite pipes have been found, as well as a number of alluvial deposits. The large pipe, known as AK-1, is expected to come into production in 1985. Sampling so far carried out seems to indicate high productivity, with about 5% of gem quality. R.K.M.

BRACEWELL (H.). *The goldfields of W.A. and the emerald mine.* Wahroongai News, **17**, 8, 20-22, 1983.

Round Australia trip reaches Coolgardie and Kalgoorlie, finding citrine and prase among relics of the gold-mining past. Then on to Menzies and an emerald mine. Areas now producing nickel. Leonora, Gwalia and Kookynie and on to Yundamindera, where chrysoprase, apatite and jasper were sought and fire opal found. R.K.M.

BROWN (G.). *The assessment of gemstone colours: a survey of potential problems.* Aust. Gemmol., **15**, 3, 81-9, 15 figs (13 in colour), 1983.

A very full summary of the problems and possibilities of accurate colour evaluation of gems, assessing available systems, aids, and possible problems arising from sight defects. Paper tends to emphasize the complexities without offering answers. R.K.M.

BROWN (G.). *Direct x-radiography of pearls.* Aust. Gemmol., **15**, 4, 105-21, 36 figs (30 radiographs), 1983.

A very well illustrated paper on the determination of pearls by direct x-rays, which indicates requirements in technique to obtain usefully diagnostic negatives. Advocates the use of dental x-ray apparatus and film. R.K.M.

BROWN (G.). *Western Australian tiger iron.* Wahroongai News, **17**, 8, 11-2, 1 map, 1983.

An ornamental rock, golden crocidolite interfoliated with red, brown or black jaspilite (haematite-rich jasper) found near Mt Goldsworthy, W.A. R.K.M.

BUCHERT (J.), ALFANO (R. R.). *Emerald—a new gem laser material.* Laser Focus/Electro-optics, **19**, 9, 117-23, 4 figs, 1983.

Emerald as a laser medium has been found to have an emission cross section and gain characteristics approximately twice those of alexandrite and it is possible that they may exceed those of alexandrite by as much as four times. Emerald appears to have the widest spectral band width of any known laser material in which laser action has been achieved. It may be possible for sub-picosecond pulses to be generated. It can also work at high temperatures, conditions in which the inversion population is increased above the ground state. Compared to alexandrite and ruby, emerald has a weaker crystal field to act on energy levels of chromium ions; higher gain permits faster operation and the generation of very short high-intensity pulses. Material used experimentally has been grown hydrothermally. M.O'D.

Cassedanne (J.). *Note sur les agates brésiliennes à contours géometriques.* (Note on Brazilian agate with geometric shapes.) Revue de Gemmologie, 77, 8-13, 6 figs, 1983.

The material in question is found at Sitio Garguelo in the extreme west of the state of Paraiba, about 375 km south of Fortaleza. The agates are angular with sections of clear and dark chalcedony, with some quartz, and the centres appear to be hollow. Large specimens may reach nearly 1 m in length; in cross-section they show from three to five faces. Some speculations on origin are given. M.O'D.

Clocchiatti (R.), Massare (D.), Jehanno (C.). *Origine hydrothermale des olivines gemmes de l'ile de Zabargad (St Johns) Mer Rouge par l'étude de leurs inclusions.* (Hydrothermal origin of Zabargad (Red Sea) peridot proved by studying the inclusions.) Bulletin Minèralogique, 104, 354-60, 5 figs, 1981.

A study of the inclusions shown by St John's Island peridot proves the hydrothermal origin of the mineral. Circulations of hypersaline fluids with abundant volatiles and a low pressure caused the major elements in the peridotite to mobilize. M.O'D.

Collins (A. T.). *Excited states if the H3 vibronic centre in diamond.* J. Physics C: solid state physics, **16**, 6691-4, 3 figs, 1983.

The H3 vibronic centre in diamond with a zero-phonon line at 2.463 eV has a series of excited states giving absorption lines between 3.2 and 3.6 eV. The transition from the excited regions to the ground state does not give luminescence, but the centre relaxes to the lowest excited level and the H3 luminescence band is produced by transition from this level to the ground state. M.O'D.

de Goutiere (A.). *Unusual amethyst inclusion.* (letter) Gems & Gemology, **XIX**, 3, 170, 1 fig. in colour, 1983.

Illustrates brush-like tufts of cacoxenite in amethyst. R.K.M.

Dillon (S.), ed. *Gem News.* Gems & Gemology, **XIX**, 3, 185-7, 1 fig. in colour, 1983.

Gives diamond news from Australia, Belgium, Israel, Thailand, United States (diamonds have been found on border between Colorado and Wyoming) and Zaire. News of amethyst from Para, Brazil; blue chalcedony from Namibia; Pacific coral from deep waters; a new source of Californite idocrase and a reduction in malachite exports from Zambia and Zaire. Synthetic cat's-eye chrysoberyl from Japan, and C-OX a new synthetic from Russia, said to be similar to cubic zirconia, are reported.

R.K.M.

DUIJVESTIJN (M. J.), VAN DER LUGT (C.), SMIDT (J.), WIND (R. A.). *^{13}C NMR spectroscopy in diamonds using dynamic nuclear polarization.* Chemical Physics Letters, **102,** 1, 25-8, 2 figs, 1983.

Unpaired electrons associated with nitrogen impurities can be used to enhance the ^{13}C NMR signal. ^{13}C NMR spectra of three natural and two synthetic diamonds are shown. The magnitude of the signal gives information on the number of paramagnetic impurities and the width of the lines in the signal gives information on the number of ferromagnetic impurities. It is possible that all synthetic diamonds will show a characteristic broadening of the ESR spectrum due to ferromagnetic impurities. M.O'D

DUYK (F.). *Lacunes cristallines dans un saphir.* (Crystalline voids in a sapphire.) Revue de Gemmologie, 77, 14-15, 9 figs, 1983.

A sapphire cabochon of 51 ct and appearing from its colour to be from Sri Lanka showed two voids with crystalline shape. One was about three-quarters filled with liquid and a small black crystal was also present. The smaller of the two voids contained non-miscible liquids. M.O'D.

FRENZEL (G.), STÄHLE (V.), BANK (F. H.). *Granat-Glas-Dublette als Smaragd-Imitation in einem alten Fingerring.* (Garnet-glass doublet as emerald imitation in an antique ring.) Z.Dt.Gemmol.Ges., **32,** 2/3, 92-8, 6 figs (3 in colour), 2 tables, bibl., 1983.

The metal of the ring circa 1830 consisted of gold, silver and copper, the hoop divided at the shoulder. The bezel is formed by a cross of four green stones (0.7 ct total) with a small 'pearl' at the centre which was wax-filled glass. The four green stones were almandine-topped with and without rutile needles fused to the base of potassium-silicate glass high in lead oxide with low softening temperatures. The green colour in the glass was produced by small addition of CuO and Cr_2O_3. E.S.

FRYER (C.), ed., CROWNINGSHIELD (R.), HURWIT (K. N.), KANE (R. E.). *Gem Trade Lab Notes.* Gems & Gemology, **XIX,** 3, 171-6, 18 figs in colour, 1983

An alexandrite cat's-eye of 32.69 carats is illustrated in incandescent and in fluorescent light, a lovely stone! Cubic zirconia, laser 'drilled' to pass as diamond; a pavé-set diamond ring showed extraordinary facet-edge wear; 'fancy' diamonds were found to have been 'painted' (with vitreous enamel?) on pavilion only. Diaspore, a rare aluminium hydroxide gem, SG 3.35, RI 1.702-1.750, biaxial +, identified and illustrated. An emerald exhibited a spiral helical inclusion parallel to *c* axis. A new lapis imitation, differing from natural lapis and from Gilson imitation, was found and illustrated. [Pyrite inclusions were simple in outline.] New and better Gilson synthetic black opals described and illustrated; all contained gas bubbles, short UV gave yellowish-green chalky fluorescence.

Cultured bouton pearls had an unusual radial structure on centre flat base. An Oriental carved stone had approximate RI 1.57, poor polish, and estimated SG 2.70, H about 3; identified as pinite by x-ray powder diffraction, a massive impure form of muscovite mica. A tanzanite (purple zoisite) with rounded facet edges described and illustrated; suggested that this is due to use of a polishing buff on the mount after stone was set. R.K.M.

FRYER (C.), ed., CROWNINGSHIELD (R.), HURWIT (K. N.), KANE (R. E.). *Gem Trade Lab Notes.* Gems & Gemology, **XIX**, 4, 232-7, 22 figs in colour, 1983.

Sapphire with thin colour zone on one surface was thought to be heat-treated, not diffusion coloured; a 2.55 carat fine ruby had been badly fractured by heat treatment; C-Ox is trade name for green and blue forms of cubic zirconia, both stones having strong and characteristic absorption spectra; all diamonds in a brooch fluoresced under long UV; a 4 carat diamond had pronounced fern-like white dendritic inclusions; a carved yellow/black, grey/green jade-like ornament was found to be mainly serpentine; a sawn jade boulder was maw-sit-sit on one side and chloromelanite on the other; new Inamori synthetics are described; three-quarter blister pearls were found with bead completely enclosed but visible through thin back; a ring pearl showed very marked erosion by body acids around each claw of the setting.

Reddish-brown quartz is thought to be heat-treated natural stone; an early 'Geneva' synthetic ruby is described; recently most yellow sapphires tested in New York Lab owed colour to Thai heat-treatment; a group of natural yellows are also discussed; rare cat's-eye zircon is also described. All are illustrated. R.K.M.

GRAY (F. L.). *Engraved gems: a historical perspective.* Gems & Gemology, **XIX**, 4, 191-201, 12 figs, 8 in colour, 1983.

An account of engraved gems from Egyptian times to the present day, when ultrasonic drills are being used to mass-produce cameos and intaglios, thus removing skill from this ancient art. R.K.M.

GÜBELIN (E.). *Black jade from Cowell.* (Letter). Aust. Gemmol., **15**, 3, 79, 1983.

Analyses of black nephrite show that colour is due to high content of FeO, about twice that found in green nephrite. R.K.M.

GÜBELIN (E.). *Marques de distinction des nouveaux rubis synthétiques.* (Distinctive marks shown by some new synthetic rubies.) Revue de Gemmologie, 76, 9-16, 42 figs (41 in colour), 1983.

Details of characteristic inclusions shown by Chatham, Kashan and Knischka rubies are illustrated and discussed. M.O'D.

GÜBELIN (E.). *Rosa topas aus Pakistan.* (Rose topaz from Pakistan.) Lapis, **9**, 1, 23-8, 17 figs in colour, 1984.

A rose-coloured topaz of gem quality is reported from the area of Katlang, north-east of Peshawar, Pakistan. Chemical composition was SiO_2 = 34.34%; Al_2O_3 = 48.13%; Cr_2O_3 = 0.03%; V_2O_3 = up to 0.01%; TiO_2 = up to 0.01%; FeO = up to 0.02%; MgO = up to 0.01%; MnO = up to 0.01%; F = 14.75%; H_2O = 3.01%. RI was 1.629-1.642, DR 0.009-0.011, SG 3.515-3.53. Pleochroic colours were yellow, purple and lilac to violet. An emmission line of some strength is at 682 nm, and there is a faint dark-red luminescence under LWUV. Some colourless and brown stones are also found in the area. Crystals are well-developed and contain two-phase inclusions and parallel needle-like growths. M.O'D.

GUNAWARDENE (M.), MERTENS (R.). *Untersuchungen der neuen Opal-Imitation von Gilson.* (Examination of the new opal imitation by Gilson.) Z.Dt.Gemmol.Ges., **32,** 2/3, 119-25, 8 figs (6 in colour), 1 graph, 1 table, bibl., 1983.

An English version of this article was published in *J.Gemm.,* 1984, **XIX,** 1, 43-53. E.S.

HALL (J.). *Colored gemstones.* Lapidary J., **37,** 7, 978-82, 6 figs in colour, 1983.

A general guide to the coloured stone trade but with some fine coloured pictures. M.O'D.

HÄNNI (H. A.). *Comparaison chimique des émeraudes naturelles et synthétiques.* (Chemical comparisons between natural and synthetic emeralds.) Revue de Gemmologie, 76, 6-8, 1 fig, 1983.

The relative content of secondary elements in the natural and artificial varieties of emerald are discussed and shown in graph form. M.O'D.

HÄNNI (H. A.). *Weitere Untersuchungen an einigen farbwechselnden Edelsteinen.* (Further examination of several gemstones which show colour changes.) Z.Dt.Gemmol.Ges., **32,** 2/3, 99-106, 3 tables, 1 graph, bibl., 1983.

Four colour-changing gemstones were investigated. The material responsible for the colour change was found to be Cr^{2+} in the case of kyanite and diaspore and V^{3+} in pyrope and grossularite-rich spessartites and corundums. In strongly pleochroic specimens certain absorption features are present in one direction only. Colour changes also occur which are different from alexandrite effect, especially in a described garnet. It is questioned therefore whether the effect is to be called alexandrite effect generally. E.S.

HAUNER (U.). *Bayerischer Saphir.* (Bavarian sapphire.) Lapis, **8,** 11, 19-20, 3 figs (2 in colour), 1983.

Blue sapphire not of gem quality has been found in the pegmatite in the Schwarzeck area of Bavaria. M.O'D.

JENKINS (A.). *The Lightning Ridge opal fields.* Part 1. Australian Gem & Treasure Hunter, 85, 29, 2 figs, 1983.

The author arrived on the field in 1969 and begins his account with details of the methods of opal recovery in use at that time. M.O'D.

JEYNES (C.). *A proposed diamond polishing process.* Phil. Mag., A. **48,** 2, 169-97, 15 figs, 1983.

A polishing method for diamond based on a brittle wear-chip mechanism with two stages is described. The size of the chips is determined by cracking in the elastic stress field behind the polishing grains. This field is not considered to be qualitatively changed by plastic deformation. In the second stage the wear chips may be released by a variety of other mechanisms. Plastic deformation may encourage their release. The effects of different grain sizes are discussed. M.O'D.

KANE (R. E.). *The Ramaura synthetic ruby.* Gems & Gemology, **XIX**, 3, 130-48, 26 figs (21 in colour), 1983.

Another new flux synthetic to confuse the gem dealer. This one is 'seed-less', nucleation obtained by slowly cooling the melt. Less inclusions than in 'seeded' growth. Manufacturer says that he is including a characteristic fluorescence under UV to aid recognition. This was not detected in most stones examined. Gemmological properties overlap those for natural stones. Inclusions: no platinum flakes; fractures, healed cracks and various inclusions of orange-yellow and white flux were seen, straight line growth patterns. A considerable variety of such features is illustrated. Any clean ruby must be suspect. R.K.M.

KELLER (P. C.). *The rubies of Mogok: a review of the Mogok stone tract.* Gems & Gemology, **XIX**, 4, 209-19, 11 figs in colour, 1983.

An excellent account of the geology and mining methods of the tract, and of the gemmology of its stones. R.K.M.

KOIVULA (J. I.). *Induced fingerprints.* Gems & Gemology, **XIX**, 4, 220-7, 11 figs in colour, 1983.

Since 1980 heat-induced healed-crack fingerprints have been found in some Verneuil synthetic corundums. The author has successfully reproduced such inclusions in clean synthetic material and their artificial formation is explained in detail. It is suggested that they are induced to up-date cheap Verneuil stones to look like the more expensive flux synthetics. Synthetic corundum slabs were quench-crackled and then placed in a Chatham flux-growth environment for 42 days, causing cracks to heal to give fingerprint-type inclusions. Other stones were subjected to heat alone, but did not heal in this way. A further attempt to induce chemical dendrites was successful, but the fingerprints were not natural-looking. It is thought that such healed cracks occur accidentally when the Thais heat the stones to reduce the visible curved zoning.

Recognition is a problem and depends on basic clues of curved zoning, bubbles, UV transparency beneath the false appearance conferred by the fingerprints. Czochralski pulled crystals can be essentially flawless, so fingerprint inclusions in any otherwise flawless stone must be treated with suspicion. Straight and sharply angled growth or colour zoning and recognized natural included crystals will be further important clues to the natural stone. Induced fingerprints *must* be disclosed. However, Koivula envisages a time when it may be possible to repair a cracked or broken natural stone using one of the techniques described. An important paper!
R.K.M.

KOIVULA (J. I.), ed. *Gem news.* Gems & Gemology, **XIX**, 4, 246-7, 1983.

Australian Ashton Joint Venture has sold its first 200 000 carats of rough for about US$9.50 per carat; C.S.O. starts a quarterly journal; improvement in diamond market expected; Japan cancels duty on diamonds; in 1982 Laurence Graff bought a 278 triangular diamond in West Africa. It cut three stones, including one of 70.03 carats claimed to be the world's largest heart-shaped diamond. India is banning export of rough gems; opal production in Australia fell by estimated 60% last year, driving prices on all grades up; Yogo Gulch sapphire deposit, Montana, plans to go into full production; in Sri Lanka, Swedish gemmologist Olle Fjordgren has found a first blue zoisite in Rakwana material; information on C-Ox is given; scientists at Marwell,* Oxon, said to have grown diamond on diamond, using high-energy particle accelerator. Carbon atoms fired into diamond crystal and incorporated in structure by annealing at 800 °C. Theoretically claimed to be a possible growth method for large synthetic diamonds. R.K.M.

KOMOTAUER (S. K. K.). *Turmalin.* (Tourmaline.) Mineralien Magazin, **7**, 11, 488-98, 16 figs (13 in colour), 1983.

A beautifully illustrated though simple description of the tourmaline family of gemstones. A short bibliography is included. M.O'D.

LAGACHE (H.). *Méthode de reconnaissance des substituts du diamant de taille 'brillant'.* (How to recognize brilliant-cut diamond substitutes.) Revue de Gemmologie, 76, 18-20, 4 figs, 1983.

Simple methods of distinguishing diamond from its substitutes are given for cut stones. M.O'D.

LEBEDEV (A. S.), ILYIN (A. G.), KLYAKHIN (V. A.). *Variétés de béryl 'gemme' hydrothermal.* (Varieties of beryl gemstones made hydrothermally.) Revue de Gemmologie, 76, 4-5, 5 figs, 1983.

Extract from an uncited paper giving details of the manufacture of various types of beryl by the hydrothermal method. M.O'D.

LESTOCK (J.). *Dinosaur bone agate.* (Letter) Gems & Gemology, **XIX**, 3, 169, 1 fig. in colour, 1983.

Describes and illustrates this unusual material. R.K.M.

LIND (T.), SCHMETZER (K.), BANK (H.). *The identification of turquoise by infrared spectroscopy and x-ray powder diffraction.* Gems & Gemology, **XIX**, 3, 164-8, 1 fig, 1983.

Most turquoise products other than some paraffin-impregnated natural turquoise can be identified by x-ray diffraction and infrared spectroscopy. R.K.M.

LIND (Th.), SCHMETZER (K.), BANK (H.). *Untersuchungsmethoden zur Unterscheidung von natürlichen und synthetischen Amethysten.* (Methods of differentiating between natural and synthetic amethysts.) Z.Dt.Gemmol.Ges., **32**, 2/3, 126-37, 24 figs, bibl., 1983.

The efficiency of several experimental methods for differentiating between natural and synthetic amethysts is discussed. Under the microscope the natural stone shows polysynthetic twin lamellae, mono- and bi-phase inclusions, negative crystals; sometimes one can see residues of the seed in the synthetic product. By repolishing, 'fingerprints' may be produced on a facet of the natural cut stone. Infrared investigation can help. Investigation is suggested to be as follows: (1) conoscopy (uninterrupted cross can be seen in the natural product); (2) (a) microscopy, (b) repolishing and (c) infrared spectroscopy. E.S.

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*sic: obviously should be Harwell.—Ed.

LOOK (G.), SUSSIECK-FORNEFELD (C.). *Sri Lanka.* Magma, **1**, 1, 20-5, 8 figs (6 in colour), 1983.

General well-illustrated introduction to the gemstones of Sri Lanka with a note on treated stones. M.O'D.

MCLEOD (N.). *Mt Surprise topaz field.* Australian Gem & Treasure Hunter, 84, 22-5, 5 figs (4 in colour), 1983.

Details of the material available in the field (topaz, beryl) are given with notes for the guidance of amateur prospectors. M.O'D.

MARTIROSYAN (R. M.), MANVELYAN (M. O.), MNATSAKANYAN (G. A.). *Width of an ESR line of Cr^{3+} ions in emerald.* Soviet Physics: Solid State, **25**, 5, 904-5, 2 figs, 1983.

An investigation of the line profile and line width of the $3 \leftrightarrow 4$ $(-\frac{1}{2} \leftrightarrow \frac{1}{2})$ intradoublet transition was carried out at a frequency of 9.2 GHz. Concentration dependence of the line width was non-linear; this may have been due to errors in the estimation of the Cr content of the sample or to accidental impurities. Internal stresses may contribute to inhomogeneous broadening of the line profile. M.O'D.

MASCHMEYER (D.), LEHMANN (G.) *New hole centers in natural quartz.* Physics and Chemistry of Minerals, **10**, 2, 84-8, 1 fig., 1983.

Five new hole centres were detected in natural citrines. They were analysed by electron paramagnetic resonance. Another hole was detected in rose quartz, the cause of the coloration being radiation defects. Characteristic patterns caused by the proximity of a neighbouring aluminium impurity were resolved in the spectra of three of the centres. M.O'D.

MELBY (J. H.), TAYLOR (A. M.). *Phenakite, a lucky find in Colorado.* Lapidary J., **37**, 9, 1276-82, 17 figs (10 in colour), 1983.

Phenakite crystals have been found on Mt Antero, in the Collegiate Range about 135 miles south-west of Denver. Crystals occur in a quartz-feldspar pegmatite and are associated with smoky quartz. M.O'D.

NASSAU (K.). *The current status of gemstone treatment.* Lapidary J., **37**, 8, 1124-34, 17 figs in colour, 1983.

Techniques for altering the colour of gemstones are reviewed and assessed. Some remarks on whether or not treatment should be disclosed are given. M.O'D.

NORWOOD (V. G. C.). *Recognizing flaws in gemstone rough.* Lapidary J., **37**, 7, 1084, 1983.

For immersion purposes the writer recommends glycerine for materials with a low refractive index. Dulite, a proprietary product of ICI, is recommended for higher index materials, with the proviso that it is caustic and care needs to be taken. M.O'D.

O'DONOGHUE (M.). *The dealer looks at gemstones—8.* Gems, **14**, 6, 24, 1982.

The factors influencing the price and nature of pearl are discussed with special reference to size, weight and trade practices. (Author's abstract.) M.O'D.

READ (P. G.). *A computer program for gem identification.* Gems & Gemology, **XIX,** 3, 157-63, 14 figs, 1983.

A further account of the Gem Data Bank computer program devised by this writer, using floppy disk storage. R.K.M.

RINGSRUD (R.). *The oil treatment of emeralds in Bogota, Colombia.* Gems & Gemology, **XIX,** 3, 149-56, 8 figs in colour, 1983.

Cut emeralds boiled in alcohol to remove oil used on rough. Treated with HCl and HNO_3 acids. Acid boiled out. Then stones immersed in hot oil. Cedar-wood oil is most favoured. Various methods of detecting oiling are suggested. Use of green oil to improve colour is not favoured. R.K.M.

ROEMER (U.). *Achate.* (Agate.) Goldschmiede und Uhrmacher Jahrbuch, (1984), 88-91, 1984.

A brief review of the agate group of the quartz family. M.O'D.

ROEMER (U.). *Edelsteinvorkommen in der Tschechoslowakei.* (Gemstone occurrences in Czechoslovakia.) Goldschmiede und Uhrmacher Jahrbuch, 84-6, 1984.

Most gemstones found in Czechoslovakia belong to the quartz family, though some tourmaline and chrysoberyl occur in small quantities. M.O'D.

ROUCAN (J.-P.). *Trois nouvelles pierres ornamentales violettes, charoite, sogdianite et sugilite.* (Three new violet ornamental stones, charoite, sogdianite and sugilite.) Le Monde et les Minéraux, 58, 12-14, 3 figs in colour, 1983.

Three fairly newly described minerals with ornamental application are briefly reviewed. M.O'D.

RUPASINGHE (M. S.), BANERJEE (A.), PENSE (J.), DISSANAYKE (C. B.). *The geochemistry of beryllium and fluorine in the gem fields of Sri Lanka.* Mineralium Deposita, 19, 86-93, 3 figs, 1983.

Beryllium is found in a range of 1-13 parts per million in Sri Lankan gem sediments. Fluorine is found in the range of 400-2000 ppm and the F/Be ratios for all areas examined give a range of 54-441. The distribution of Be in the sediments is irregular. M.O'D.

SANDERS (J. V.). *Crystal Opal* (Letter to the Editor). Aust. Gemmol., **15,** 4, 129, 1983.

Writer answers my oft repeated query about the term 'crystal opal'. From his description of the material it seems apparent that this Australian term is synonymous with our 'water opal'—a colourless, transparent body with a rich play of colour. The Editor asks for the earliest published use of the term. I would expect it to date from the first discovery of this type of material in Australia. I am obliged to Dr Sanders for clarifying this matter. R.K.M.

SANDERS (J. V.). *A proposal for the classification of opals.* Aust. Gemmol., **15,** 3, 75-8, 2 figs, 1983.

A more scientific approach than that of Sherman (G.)* and suggested

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*See SHERMAN (G.) below.—Ed.

classification is more logical. Recognizes that play of colour is due to diffraction, or interference. R.K.M.

SATO (K.), SUNAGAWA (I.). *Quantitative evaluation of colour in diamonds (by spectrographic method.* A summary by SANDERS (J. V.). Aust. Gemmol., **15**, 3, 91-2, 1983.

Team used a spectrophotometer/computer link-up to off-set the effect of stone size on apparent colour in Cape diamonds. Scientific approach allows yellow factor to be assessed regardless of stone size and of a greying factor which masks some colour. UV filter is used to eliminate fluorescent effects. Sanders points out that the actual appearance of a stone to the eye is the factor on which value is based, and the subjective, non-scientific approach must be adopted. R.K.M.

SAXENA (M. P.). *Gemstones of Pamirs.* Gem World, **10**, 4, 26, 1983.

A bright green marble, fresh deposits of lazurite and a patterned onyx have been recently discovered in the Pamirs. Some notes on the production of amethyst by the hydrothermal method are given. M.O'D.

SCHMETZER (K.). *Eine Untersuchung der opalisierenden Syntheseprodukte von Gilson.* (An investigation of the opalescent synthetic product of Gilson.) Z.Dt.Gemmol.Ges., **32**, 2/3, 107-18, 10 figs (6 in colour), 2 graphs, 1 table, bibl., 1983.

An English version of this article was published in *J.Gemm.,* 1984, **XIX**, 1, 27-42. E.S.

SCHMETZER (K.), BANK (H.). *Untersuchung eines Skapoliths mit Katzenaugeneffekt aus Sri Lanka.* (Examination of a scapolite with cat's-eye effect from Sri Lanka.) Z.Dt.Gemmol.Ges., **32**, 2/3, 86-9, 3 figs in colour, bibl., 1983.

The scapolite from Sri Lanka showed intensive chatoyancy. RI $n_o = 1.583$, n_e 1.553. Microprobe analysis established a meionite content of 69%. Chatoyancy was caused by needle-like inclusions with orientation parallel to the *c*-axis of the scapolite host crystals; the needles were found to be pyrrhotite. E.S.

SCHMETZER (K.), LIND (Th.), BANK (H.). *Stabilisierter Coeruleit.* (Stabilized ceruleite.) Z.Dt.Gemmol.Ges., **32**, 2/3, 90-1, bibl., 1983.

An English version of this article was published in *J.Gemm.,* 1983, **XVIII**, 8, 734-5. E.S.

SCHMID (F.), KHATTAK (C. P.). *Large crystal sapphire optics.* Laser Focus/Electro-optics, **19**, 9, 147-52, 6 figs, 1983.

Large sapphire boules which are free from light scattering have been grown by the heat exchanger method. Diameters of up to 8 inches have been routinely achieved. M.O'D.

SEEHERR (H.). *Heilendes Gestein.* (Healing stone.) Goldschmiede und Uhrmacher Jahrbuch, (1984), 51-65, 1 fig, 1984.

An account of the therapeutic value placed on gemstones at various times. M.O'D.

SHERMAN (G.). *Certification of opal.* Aust. Gemmol., **15**,3, 71-4, 1983.

Explains need for, and evolution of, the appraisal and identification certificate of opal. Author says this is not a valuation, [although 'appraisal' means 'to put a value on',] and seeks to justify the term 'crystal opal'. He still does not define it.*

R.K.M.

SNOW (J.), BROWN (G.). *The Kyowa GR1 gemmological refractometer.* Aust. Gemmol., **15**, 4, 130-2, 2 figs, 1983.

A report on a new Japanese refractometer which seems to be essentially similar to most other makes, but which includes a scale adjustment screw which is said to make for far greater accuracy. A diagram of the lay-out of major optical components fails to show the light path and leaves one wondering whether two additional prisms, fore and aft of the high RI prism, are correctly depicted. R.K.M.

STOCKTON (C. M.), MANSON (D. V.). *Gem andradite garnets.* Gems & Gemology. **XIX**, 4, 202-8, 7 figs (2 in colour), 1983.

A careful study of the garnet subspecies generally known as demantoid. A range of twenty-one stones was tested, and RI 1.880 to 1.883, SG 3.80 to 3.88 were recorded. These did not include the highly prized, rare vivid green. Detailed electron-microprobe chemical analyses underlined the unusually constant composition of the variety. Colour did not directly relate to the small amount of Cr_2O_3 that was found. Manganese and titanium, also in minute amounts, may influence colour. Authors suggest that cutters deliberately orient stones to include characteristic byssolite fibres under the table facet. [From observation of rough I would say that these usually radiate from the centre of the crystal and the cutter has little choice if size and colour are to be maintained.] R.K.M.

STRIPP (D. M). *Exceptional gem trio unveiled at American Museum of Natural History.* Lapidary J., **37**, 9, 1284-91, 8 figs, 1983.

The three stones quoted were loaned to the Museum and are a carved emerald of 217.80 ct (the Mogul); a 667.14 ct emerald crystal and a 15.97 ct cut Burma ruby.

M.O'D.

TAYLOR (A. M.). *A new synthetic emerald* (Letter to the Editor). Aust. Gemmol., **15**, 3, 79-80.

Underlines difficulties in producing vanadium-doped green beryl and questions whether the new synthetic reported by G. A. Tombs (Aust. Gemmol., **15**, 1)† originated there or elsewhere. Dr Taylor points out that V^{3+} doping of emerald is comparatively easy in hydrothermal growth, but much less so in flux melts, which oxidize the dopant to V^{5+}. They can be distinguished by the liquid in the two-phase inclusions. In flux-melt stones this is, in fact, a solid glass of higher RI than the host emerald. In hydrothermal stones, natural or synthetic, it is salt water, with an RI well below that of the host beryl, [and the gas bubble will be mobile]. R.K.M.

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*See SANDERS (J.V.) *Crystal opal.* (Letter to the Editor). above.—Ed.

†See *J. Gemm., 1983* **XVIII** (7), 661.—Ed.

THOMPSON (D.). *Sapphires in New South Wales.* Australian Gem & Treasure Hunter, 83, 28-30, 6 figs, 1983.

Describes sapphire production in New South Wales with particular reference to the New England area which includes Inverell. M.O'D.

TOMBS (G.). *Diamond grading system foundations and comparisons.* Aust. Gemmol., **15**, 4, 124-7, 1983.

Compares different grading scales and nomenclature, explaining difficulties and suggesting some solutions. R.K.M.

VOCHTEN (R. F.). *Blaugrüner Apatit von Gravelotte, Ost-Transvaal, Südafrika.* (Blue-green apatite from Gravelotte, East Transvaal, South Africa.) Z.Dt.Gemmol.Ges., **32**, 2/3, 83-5, 2 graphs, 1 table, 1983.

Gravelotte is an emerald mine yielding also some cubic pyrites crystals and apatite, which is bluish-green and of cuttable quality. The crystals are hexagonal and have been identified as fluoro-hydroxyl-apatites. An irreversible colour change takes place with increasing temperature. E.S.

ZEITNER (J. C.). *A review of green gems.* Lapidary J., **37**, 9, 1252-62, 13 figs, 1983.

A review giving considerable historical detail pertaining to green gemstones. M.O'D.

Thailand, jeweller of the world. (Department of Commercial Relations, Ministry of Commerce, Thailand.) Gem World, **10**, 4, 21-5, 3 figs, 1983.

A brief history of the gem trade in Thailand. M.O'D.

BOOK REVIEWS

BINNEWEIS (B.). *Steinschleifen.* (Stone cutting.) Kosmos Verlag, Stuttgart, 1979. pp.95. Illus. in colour. Price on application.

A beautifully-produced and comprehensive guide to cutting with all the stages clearly described. Photographs are by Samuel Rothenberg. This is the best guide I have seen to cover a small compass and still get in everything that is needed. Naturally a great number of gem species are not described—for that one must turn to the much larger productions of Sinkankas and Vargas. Even for non-German speakers, this would still be worth buying. M.O'D.

FUHRMANN (R. J.). *Granat.* (Garnet.) Rühle-Diebener-Verlag, Stuttgart, 1983. pp.113. Illus. in black-and-white and in colour. Price on application.

This book contains less information than the number of pages might suggest, since the print is unusually large and the illustrations plentiful, though of indifferent quality. The aim is to review the garnet family of minerals from the point of view of the amateur jewellery maker. Though illustrations of crystals and occurrences are provided, they are not described. There is no index or bibliography. M.O'D.

GODONIKOV (A. A.). *Mineralogiya.* (Mineralogy) [In Russian.] Nedra, Moscow, 1983. pp. 646. Illus. in black-and-white. R3.50.

A well produced introductory textbook in which structural diagrams make a welcome appearance. Drawings and reproductions are of good quality and there is a bibliography. M.O'D.

HINKS (P.). *Twentieth century British jewellery, 1900-1980.* Faber & Faber, London, 1983. pp.192. Illus. in black-and-white and in colour. £27.50.

This is a first-class book and quite magnificently illustrated. The author gives just enough of the historical and social trends of the century to place its jewellery in the appropriate context, and for this reason the chronological order followed in the text is to be preferred to any other. Within each period more attention is paid to detail of ornament than to methods of manufacture, but there are already many satisfactory books on technique. There are many illustrations in the text and a short bibliography. Any student of jewellery will find this book essential, though not cheap. M.O'D.

UNTRACHT (O.). *Jewelry concepts and technology.* Hale, London, 1982. pp. xxiii, 840. Illus. in black-and-white and in colour. £25.

This very comprehensive book is so large that a lectern would be needed to accommodate it comfortably. At the price it is very good value, since so much of the jewellery manufacturer's art is contained in it. After an introductory chapter discussing the reasons for jewellery, speculation is abandoned in favour of details of workshop design and operation, metals, basic techniques, the forming of sheet metals and the drawing of wire and its uses. All these parts are well illustrated in the text, with some colour work which is not of top quality but serves adequately in a book of this price. After a section on tubing the book turns to ornament and fabrication, the use of various gemstones and coloured metals and coating techniques. The final sections contain tables, a glossary and a good bibliography. Altogether a very good buy. M.O'D.

VLEESCHDRAGER (E.). *Dureté 10: le diamant.* (Hardness 10: the diamond.) Gaston Lachurié, Paris, 1983. pp. 301. Illus. in black-and-white. Fr 210.

This is a complete survey of diamond from its mining to its final end in jewellery. The journey takes in the customary stops; characteristics of diamond crystals, properties, cutting (a large and well constructed section) and grading (also well constructed). There is an extensive glossary, quite a good bibliography and an index. For readers whose main language is French, this represents a good bargain at the price. M.O'D.

ASSOCIATION NOTICES

OBITUARY

BASIL WILLIAM ANDERSON—PIONEER GEMMOLOGIST (1901-1984)

The death on 24th February, 1984 of Basil William Anderson, a Vice-President of the Gemmological Association of Great Britain and a Fellow of King's College, London, one of the world's leading gemmologists for nearly sixty years, must inevitably mark the end of an era. Perhaps the greatest of the pioneers of this specialized science, it would be difficult to over-estimate the importance of his many contributions to trade integrity and to the greater understanding of the gems upon which it largely depends.

An immensely popular, generous-hearted and friendly man, Basil Anderson was held in high esteem and in very real affection by all members of the British gem trade who knew him, in the world-wide field of gemmology and by his many personal friends. Guide, mentor and friend to so many, his passing leaves a very deep sense of personal loss. It will not be easy to reconcile the fact that such a fount of gemmological wisdom is no longer with us.

Born in South London on 3rd July 1901, Basil was the grandson of Frederick Field, F.R.S., a chemist and mineralogist of considerable standing. His mother, to whom largely he owed his interest in minerals and a life-long appreciation and love of nature and the countryside, was herself an acknowledged authority on the essayist Charles Lamb and engendered in the young boy an interest in English literature which was to be reflected in the lucidity of his lectures and writings later in life. In a very recent letter he mentioned the delights of frequent visits as a young boy, with his mother, to the Natural History Museum, and the enormous treat of having tea afterwards 'at the very good ABC in South Ken. Station arcade.' Simple pleasures which helped to shape the man.

We know little of his father beyond the fact that a serious illness had at some time deprived him of the power of speech. His son was known to have been adept at reading sign language.

FIG. 1. Basil and Barbara Anderson, 1974.*

FIG. 2. B. W. A., 1983.

*Earlier photographs of B. W. A. may be found in *J.Gemm.*, 1975, XIV(6) on p.259 and 1983, XVIII(7) on pp.599, 600 and 601.—Ed.

B. W. was educated at Sedbergh School in a rugged region of Yorkshire, close to the Lake District. Here he excelled in fell-running, an up-and-down hill sport requiring exceptional stamina. Then on to King's College, London, obtaining there an Honours Degree in Chemistry, with Geology as his subsidiary subject, and gaining considerable repute in athletics and games *en passant.*

His entry into the gem trade was not planned, and like my own, was a result of the circumstances of the day.

In the early 1920s Japanese cultured pearls were marketed secretly by them as natural pearls and very soon were seriously contaminating the Bombay 'bunches', the normal source of matched and drilled pearls intended for western markets. The appropriate committee of the London Chamber of Commerce saw that a laboratory capable of testing and certifying pearls as natural, or as cultured, was an immediate need. W. T. Gordon, Professor of Geology at King's, was already concerned with a certain amount of gem identification for the Hatton Garden trade and, when approached, recommended B. W. Anderson as a suitably qualified scientific expert. Thus in 1925, Basil, then 24, became a full-time professional gemmologist responsible for organizing the World's first independent gemmological laboratory.

He has written and talked many times on those early days when he was thrust in 'at the deep end' with little knowledge of pearls and even less of methods of testing them. The pearl trade was in a chaotic state with leading dealers holding vast stocks which might or might not be natural pearls, and with more adulterated bunches coming in all the time. At first assisted only by a rather unhelpful commissionaire and equipped with nothing more than a lucidoscope (a powerful water-cooled lamp) and a telephone, he was helped enormously six months later when a hazardous trip by air to Paris led to the purchase of one of the recently improved endoscopes which allowed drilled pearls to be sorted laboriously one by one, but with 100% accuracy.

A very good chemical balance, a mineralogical microscope, a Tully table refractometer and a dichroscope were added to the laboratory equipment, often at B. W.'s personal expense. But these were to be little used at this stage, for the work for the first five years was almost entirely with pearls. The most valuable acquisition at this time was undoubtedly the late Mr C. J. Payne, an honours geologist, again from King's College, who joined the laboratory at the end of 1928, beginning a most important partnership with Anderson which was to last, interrupted only by the war, until Payne's retirement in 1970. In 1928 B. W. had himself tested over 49,000 individual pearls.

A move to larger premises in 1929 allowed him to have x-ray apparatus installed, which made it possible at last to test undrilled and half-drilled pearls by means of Laue diffraction patterns.

The world depression, which was to become known as 'the Slump', hit this country towards the end of 1929, and the deluge of pearl testing slowed to a trickle. The two young men, with time on their hands, turned their attention to other gems and to possible lines of research, while relaxing each lunchtime by solving *The Times* crossword puzzle which became a daily obsession with them both.

With a refractometer which was capable of reading up to 1.86 they quickly realized that much of its potential was being lost owing to the fact that the optically densest contact fluid, methylene iodide saturated with sulphur, had an RI of only 1.785. So the search was on for a 'higher' liquid.

Many combinations were tried, with near disaster as the end product of some, when they resulted in corrosive, highly noxious, or even explosive mixtures. Eventually three liquids were found:

1. Methylene iodide + sulphur + tetra-iodo-ethylene, RI 1.81.
2. Selenium bromide, RI 2.00.
3. Phenyldi-iodo-arsine, RI 1.85.

The 1.81 was comparatively innocuous and suitable. This became the standard refractometer liquid and was at one time sold as 'andersonol', until B. W. protested. The other two were corrosive and attacked the dense glass of the instrument, but might be useful if some other test surface could be used. A fourth liquid, West's solution, consisted almost entirely of yellow phosphorous and, on occasion, would explode spontaneously in air with near disastrous results.

That research inspired the designing of the blende and the diamond refractometers and, much later, the spinel version. These were made by Rayners, to the requirements of Anderson, and the use of truncated prisms in place of the more expensive dense glass hemispheres led eventually to the use of similar prisms in the Rayner standard instrument.

Now the crude beryloscope test for emeralds attracted Anderson's attention and experiments with photographic filters produced the more transparent and better Chelsea emerald filter.

Basil Anderson next turned his attention to the neglected subject of absorption spectroscopy and, assisted by Payne, pioneered its use in the identification of gems, the results of the research eventually appearing in a series of forty papers in the *Gemmologist* in the 1950s. This spectroscopic technique became standard in British gemmology long before it was adopted by other countries.

In 1933 B. W. Anderson was appointed lecturer to the 'Mineralogy for Jewellers' classes at Chelsea Polytechnic. I had attended his lectures at the Royal Society of Arts in 1932 and was now to study under his guidance in my Diploma year. His enthusiasm for the subject was infectious and that class blossomed remarkably. The following year's examinations produced nine passes with distinction, including such well-known names as Robert Webster, A. Ross Popley, Norman Harper and others, and out of 21 entries not one student failed to pass. I became Anderson's 'first Tully Medallist.'

In the late nineteen-thirties Basil Anderson made a very considerable contribution to the parent science of mineralogy. Having found a big discrepancy between the published specific gravity for lapis lazuli and that which he had actually determined himself by careful hydrostatic weighing, he embarked upon another period of intense activity during which the laboratory checked and rechecked some five hundred specimens of lapis, and then went on to determine exhaustively the physical constants of all known gem minerals in their cuttable qualities. In the course of this work gahno-spinel was found and named, and the first Sri Lankan kornerupine was discovered. The new figures, together with the several new techniques introduced by Anderson and Payne, were incorporated in the 1940 edition of the standard textbook, *Gemstones,* which was being re-written by the author, Dr G. F. Herbert Smith. The importance of the Anderson-Payne contribution can be assessed if the corrected constants of that edition are compared with those of the 1930 edition.

War came, and James Payne, a Territorial Army volunteer, was called up. Basil Anderson, then 38, volunteered for the Auxiliary Fire Service. His memories of those years are summarized by a passage from the last letter I received from him on about 10th February:

'*Very* peculiar days, those, with opportunities to do things impossible in a steady job and married life situation. To be in charge of a N.F.S. crew on night duty at St Paul's, for instance, and walk around the Whispering Gallery in complete darkness with only a single neon bulb on the altar steps to help give one orientation—and to see incendiary bombs bouncing off the dome and on to some of the flat roofs—each bigger than a tennis court—and "see to them" as best one could. And to go to a lunch-time concert given by Myra Hess in the National Gallery and soak up all the pleasure one could from the *one* fine painting available to the public eye at that time:- Renoir's "Les Parapluies" has had a special place in my affections ever since.'

Shortly after the end of the war the Laboratory secured the valuable services of Robert Webster and Alec Farn, thus completing a quartet which, headed by B. W. A. was to work in remarkable harmony for the next twenty-five years.

1945 had seen the finding of the rare gem which was eventually to be known as taaffeite, after Count Taaffe who discovered it. Basil recognized this as a possibly new mineral and initiated a prolonged investigation which culminated in confirmation, although not in completely accurate chemical composition, five years later. Painite was another new mineral, possibly the rarest of them all, with which he was closely concerned. Ekanite (1953) was found first as an asteriated dark green cabochon and hopefully greeted as 'New mineral' by the late F. L. D. Ekanayake. Anderson at first thought it was a natural glass, but instigated a very full investigation which showed it to be indeed new and also a metamict, thus joining Sri Lankan green zircon in a most exclusive mineral category.

The 'crossed filter' test for the red fluorescence of chromium was yet another Anderson innovation, using a flask of copper sulphate solution to filter out the red end of the spectrum and a red filter to eliminate the resultant blue light. A simple but quite inspired idea which provided a most beautiful demonstration of the brilliant red fluorescence. He also investigated immersion contact photography and established it as an additional method of assessing relative RI. Further work gave a bonus when it was realized that synthetic stones, being iron free, were, in general, more transparent to short ultraviolet light than were natural stones.

B. W. Anderson retired from teaching in 1966, and from the Laboratory in 1972 when, to the surprise of almost everyone apart from B. W. himself, he reached the age of 70. He had been an examiner to the Gemmological Association since 1951, and was to remain as principal examiner right up to the end of his life. In his 46 years as Director of the Laboratory he had kept personal notes on every test. These provided him with some of the material for his book, first published in 1942 under the title *Gem Testing for Jewellers* and then, in post-war reprints, to be called quite simply *Gem Testing,* going on eventually in many successful editions to the 9th in 1980, of what is now recognized as one of the most valuable and certainly the most lucid of all English textbooks on the subject. A second book *Gemstones for Everyman* appeared in 1976, and was intended to appeal to the wider public, but was rather overshadowed by the phenomenal success of *Gem Testing.*

In 1982, despite serious eye problems, Anderson undertook a very necessary revision of the 4th edition of Robert Webster's vast work, *Gems,* with the comment that he regarded this as a memorial to an old and valued colleague. The eye trouble was eventually corrected by surgery in two skilful operations. It was completely in character that, the day after the second of these, he should write a long letter to me with a description of the 'ordeal' and amusing comments on his hospital experiences. His sense of humour was still intact.

About 1934 Basil Anderson had moved to the village of Ditchling, by the Sussex Downs, where he was able to take a keen interest in local matters and to join in amateur dramatics in a rural environment which was entirely to his liking. Sadly, this ideal existence was interrupted by the long illness and death of his first wife, Irene ('Frinton'). He had a holiday home near Hartland in North Devon and now spent part of each summer down there.

In the late 1950s he married Barbara, who was to care for him so wonderfully for his remaining years. He once told me that this was by far the happiest thing he ever did.

On retirement they went to live permanently at Hartland, but total retirement was not for him. He had loved his work and now, as is often the case, was to work in some respects even harder than before. The 1970s were years of considerable change with many new synthetic gems and as many methods of dealing with them, and Anderson kept fully informed on these developments, attending international conferences and maintaining contact with his many friends in the gemmological field both at home and overseas. Eventually the changes of that period were incorporated in the largely re-written 9th edition of *Gem Testing* and in the 4th edition of *Gems*. By now the first of these had been translated into many languages and was to appear in Japanese in the coming year.

In 1977 Basil Anderson was made a Fellow of King's College in recognition of his great services to gemmological science. This, the highest award within the gift of the College, was well deserved. More recently Professor Dr Hermann Bank, of Idar-Oberstein, inaugurated an Anderson/Bank Prize and an Anderson Medal as awards in the Gemmological Association's examinations, in honour of Basil Anderson's eightieth birthday.

With all this self-imposed work-load Basil still found time to take his two lively dogs for long daily walks through the Devon countryside, enjoying the while the wild-life and flowers of moorland and valley. His delight in country life was often reflected in verse, pleasing little poems which gave glimpses of his inner thoughts in an environment which gave him enormous pleasure.

For the most part he had enjoyed good health, apart from back problems which stemmed almost certainly from a fall whilst fruit-picking. To me he seemed younger than his years, physically and intellectually, and his very considerable mental powers were in no way impaired by age. The end came suddenly and, mercifully, without suffering. He had led a good and happy life, wisely and with thought for his fellow men. He had enhanced his profession immeasurably by the keenness and brilliance of his enquiring mind. I, for one, am proud to have had the privilege of knowing him and to have called him friend.

Basil leaves his dear wife Barbara, who took such great care of him for nearly 25 years. On behalf of the gemmological world I can only express our great sympathy to her on the passing of a great and kindly man.

I have mentioned the last letter I had from Basil, a long one of six closely written pages, crammed with nostalgia and reminiscence, which ended differently from any other I had received from him before. While Basil himself would be the first to insist that his words had no hidden meaning, for he had no more premonition of death than any other vigorous, healthy and contented man of his age, the subsequent event gives them significance and, since they happen to be appropriate to his many other friends, I share them now. The letter ended:

'At last I bid you farewell
and thank you for listening!
Your friend,
B. W.'

For me at least it has been a pleasure and privilege to 'listen' for more than fifty years.

R. Keith Mitchell

B. W. Anderson—an Appreciation

It would be accurate, but perhaps a little too apt, to describe B. W. Anderson as a man of vision, yet this is precisely what he was. We, as gemmologists, will regard and remember him as Great Britain's greatest gemmologist. In this appreciation of Basil Anderson I would like to portray the man I knew in turn as lecturer, colleague and friend. I would like to tell people about the other facets reflecting the character and personality of a man popularly known and renowned as a scientist, yet who had a wealth of interests totally divorced from the gemmological field one usually associates with Basil William Anderson, gemmologist extraordinary. Others, great friends of Basil Anderson, will write upon his great gemmological achievements. I like to think of him as a man who loved the correct use of words, someone who wrote with fluency and a style which captivated.

Who else but Anderson could on the very first page of *Gemstones for Everyman,* in the opening chapter, 'What exactly *is* a gemstone?', write:

'The world is full of a vast variety of beautiful things, but most of them are ephemeral. The dewdrop and the daffodil, the rainbow and butterfly, last for a few moments or a few days and are gone; preserved only in memory, or in lines written by a great poet. Precious stones . . . endure . . . eternally.'

Basil Anderson will have left an imprint upon many people depending upon the circumstances under which introduction or meeting occurred. Many of his earlier students will remember his end of term competitions combining gemmological queries with attractively illustrated clues wherein lay subtle hidden word-play.

He had the gift of teaching with enthusiasm, and the power to impart or implant that enthusiasm. He was a big man, physically, mentally and morally, and like many big men he was gentle in nature.

Every day at lunch time he, with C. J. Payne and Robert Webster, solved *The Times* crossword puzzle. It was a sort of fetish; the discussion over words and the constant use of dictionaries or encyclopaedias were typical of B. W. Anderson.

His mother took considerable interest in his education. He told me that it was she who instilled in him this attitude to look things up, to make sure; almost, one might say, 'to leave no stone unturned'. His earliest memories of home embraced a grandfather who was a mineralogist, a cabinet of mineral specimens, and delightfully as he told me a quartz sphere which B. W. A. pronounced as glass. His mother, a lady chess champion, was also a devotee and collector of the works and papers of Charles Lamb. Certainly Basil Anderson inherited this enjoyment of literature and use of the English language which is seen in the style of his writing. Few people write so elegantly upon gemmology, a difficult subject. A lover of poetry, and himself a useful composer, it would be a mistake to imagine that B. W. Anderson was anything like a willowy long haired 'poetic' type.

He had a rugged schooling at Sedbergh in Yorkshire where any signs of meekness, shyness or even gentleness of nature were soon ironed out and dispersed by the very public attitude the boys of his age took to such characteristics. One of the tough sports at that time was fell racing, which meant both uphill and downhill running over boulder-strewn and boggy conditions. Anderson excelled at this. I often saw him run for a bus down Hatton Garden and along Holborn Viaduct when he was well into his sixties.

Whilst a graduate at King's College he held a record for putting the shot, and in later years at Ditchling, his home in Sussex, he held the scoring record for the local cricket club. He was essentially an outdoor man, a country lover and keen ornithologist. He participated in amateur dramatics and had a good voice and loved singing. I have heard him suddenly burst into song at the old Lab in sheer exuberance for a lovely day. He was fond of music and had a keen eye for artistic ability. He was regularly asked to judge at local art shows.

This man of science who put Britain well to the fore by reason of his researches was no back-room boy or scientific boffin. Although he gained his degree in chemistry, he was very much anti-chemicals when it came to soil and food production. For some considerable time at his home in Ditchling he grew his own vegetables, using only gardening compost and organic matter. He kept goats for milk, and had a clutch of Marham hens which layed only brown eggs. At home they baked bread from whole-meal flour.

He lived at one time in the only thatched cottage on Farleigh Common, Surrey, a mere fifteen miles from the centre of London. In those days, as a much younger man, he rode a motor-cycle and sidecar combination to East Croydon station. Each day, he told me, he tried to clip seconds off his time for the journey. During the war years he rode a bicycle to Hassocks station, although he confessed not to be terribly good on repairs or maintenance.

We visited him at Ditchling when my son was about two years old (1952). We were met at the station by Basil Anderson driving a somewhat battered baby Austin Seven. He had not lost his zest for cutting corners and, being familiar with the somewhat narrow roads, seemed to be hurtling around in rallying style. He soon had my son in a wheelbarrow and was busy running up and down the large lawn to the considerable delight of the then youngest Farn.

He was a man of many interests, outdoors, athletic, artistic, music lover, a man of letters and superb gemmologist.

After having worked with Basil Anderson for many happy years, having been taught by him at Chelsea Polytechnic, and having had his friendship and corresponded with him over these last twelve years in retirement, I am still amazed at the many facets of B. W. Anderson. This good living, outdoor man, this man of vision whose scientific reputation has earned him a perpetual memorial in gemmological annals, is unique in our history. Who else but B. W. Anderson could start a book with such beautifully rendered words? Who else but B. W. Anderson could finish up an equally erudite paper on 'The Classification of Diamonds on the

Basis of their Absorption and Emission of Light' (*J.Gemm,* IX, 2, 44-54, April 1963) quoting

'Reason has moons, but moons not hers
Lie mirror'd in her sea,
Confounding her astronomers,
But O! delighting me'?

Basil Anderson ends with a plea, speaking of diamond, hoping that some mystery will remain, and that this incomparable mineral will remain unpredictable. Who else but Basil William Anderson, Fellow of King's College, Batchelor of Science, Fellow of the Gemmological Association, could write on science with the pen of a poet? He is unique, a man one could hope to imitate, but never aspire to equal. A. E. Farn

* * *

Mr R. E. H. Jeffreys, F.G.A. (D.1956), Stroud, died on 5th November, 1983.

Mr William A. Peplow, F.G.A. (D.1928 with Distinction), Stourbridge, died on 29th November, 1983.

Mr Michael Syder, F.G.A. (D.1964), Nottingham, died on 30th October, 1983.

GIFTS TO THE ASSOCIATION

The Council of the Association is indebted for her gift to Miss P. Lapworth, F.G.A.A., Guildford, Surrey, for a set of the Australian Gemmologist for 1982, Vol. 14, Nos 9, 10, 11 and 12; also for a brochure on sapphires in New South Wales prepared by the Department of Mineral Resources, New South Wales, 1983.

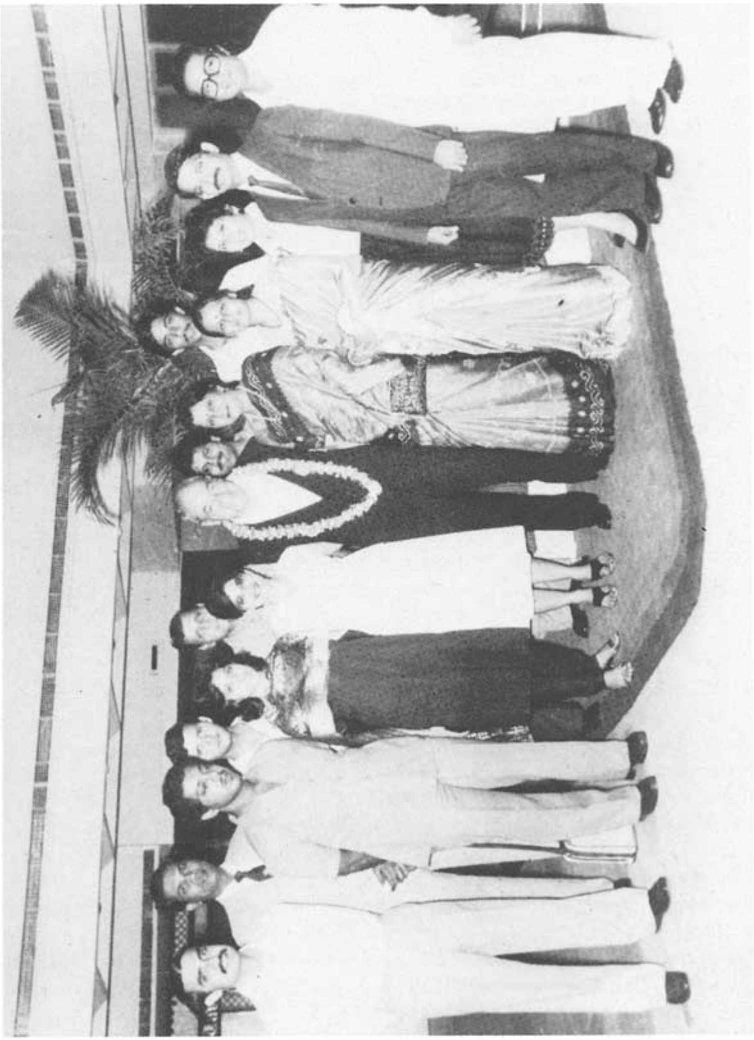
NEWS OF FELLOWS

On 15th November, 1983, at the Woodlands Hotel, Lisburn, N.Ireland, Mrs Vera Buchanan, F.G.A., gave a talk on gem testing to the Ulster Jewellers' Association gem group.

Between 5th and 9th November, 1983, Mr Richard T. Liddicoat, Jr, Hon. F.G.A., Chairman of the Board of Governors of the Gemological Institute of America, visiting India on the invitation of the Forum of Indian Gemmologists, addressed a meeting of gemmologists and traders in Bombay and had a series of other meetings with individuals and groups, at which he met a number of other Fellows (see Figure 3: reading from left to right—Mr S. R. Ghaswala, F.G.A., Mr G. Bhashkaran, F.G.A., Mr U. G. Chavan, F.G.A., Mr D. N. Lakdawalla, F.G.A., Miss Vispi R. Lal, D.Gem.G., Dr N. J. Lakdawalla, F.G.A., Mrs D. R. B. Lal, F.G.A., Mr Richard T. Liddicoat, Jr, Hon.F.G.A., Mr K. R. Jhaveri, G.G., Mrs I. J. Vikamsey, F.G.A., Mr N. Jashnani, G.G., F.G.A., Mrs K. R. Jhaveri, F.G.A., Miss Monica Malkani, Mr R. Jhaveri, F.G.A., and Mr K. T. Ramchandran, F.G.A.).

On 9th November, 1983, Mr Gwilym M. Jones, F.G.A., of Abergavenny, gave an illustrated talk to the Bristol & West of England Jewellers' Association on his work as a consultant gemmologist and some of the unusual items which he had come across.

FIG 3.



MEMBERS' MEETINGS

Midlands Branch

On 27th January, 1984, at the Society of Friends, Dr Johnson's House, Bull Street, Birmingham, Messrs E. G. Butcher and R. Rushforth (from Johnson Matthey Jewellery Products) gave a talk (followed by a discussion) on 'Refining and Processing of Gold as it affects the Jewellery Industry': they also showed a video film called 'Gold', covering extraction and refining.

On 24th February, 1984, at the Society of Friends, Mr B. A. Cooley from De Beers Industrial Diamond Division at Ascot, Berks., gave a talk entitled 'Diamond grits and powders, natural and synthetic'.

North West Branch

On 19th January, 1984, at Church House, Hanover Street, Liverpool, Mr Alan Hodgkinson, F.G.A., gave an illustrated talk entitled 'To Venus through Sri Lanka and back'.

On 16th February, 1984 at Church House, Mr Alan Williams, F.G.A., gave a talk entitled 'Basic instruments for the gemmologist'.

On 21st March, 1984, at Church House, Mr D.Wilkins, F.G.A., gave a talk entitled 'Rescued from the scrapbox'.

South Yorkshire & District Branch

On 6th December, 1983, at the Sheffield City Polytechnic a practical evening was held with emphasis on synthetic gemstones.

On 26th January, 1984, at Sheffield Polytechnic, the Annual General Meeting was held, at which Miss J. I. Platts, F.G.A., and Mr J. I. Reynolds, F.G.A., were re-elected as Chairman and Secretary respectively. Immediately after the A.G.M., Miss J. I. Platts, gave an illustrated talk following her recent trip to Australia, which included a visit to the Coober Pedy opal location.

MR DOUGLAS WHEELER'S RETIREMENT PARTY AT GOLDSMITHS' HALL

In honour of Mr Douglas Wheeler, F.G.A., on the occasion of his retirement, a Reception attended by 160 people and hosted jointly by the Gemmological Association of Great Britain and the National Association of Goldsmiths of Great Britain and Ireland (of which he was Assistant Secretary and Deputy Secretary respectively) was held at Goldsmiths' Hall on 18th November, 1983.

Douglas Wheeler joined the two Associations forty-seven years ago. In 1941 he volunteered for the R.A.F. and after training in Canada saw active service flying Lancaster bombers. He was commissioned at the age of twenty-one. In 1946 he returned to his desk and two years later passed the Diploma Examination and was elected F.G.A., having studied at Chelsea Polytechnic under B. W. Anderson.

During the evening, presentations were made to Mr Wheeler by Mr David Callaghan, F.G.A., Chairman of the G.A., (of a Sanyo Compact Disc Player and a cheque—see Figure 4), Mr Robert Croydon, F.G.A., Chairman of the N.A.G., Mr Jack Murphy on behalf of the Retail Jewellers of Ireland and Ulster Jewellers Association, and Mr John Green, of Rayner Optical Company Limited, all of whom paid tribute to his unfailing cheerfulness and willingness to share his vast knowledge of the trade and gemmological matters gained through years of experience, and emphasized how much he would be missed by members and staff alike.

FIG. 4. The Chairman making the presentation to Mr Douglas Wheeler in Goldsmiths' Hall, with Mrs (Kath) Wheeler on the right.

In his reply, Mr Wheeler—Douglas to all those present—said that he had greatly enjoyed his years with the two Associations and had been lucky in the people he had met and worked with. He said also that, although he was very sorry to be leaving all his many friends, he looked forward to a new life of retirement in Norfolk. A bouquet of flowers was presented to his wife, Kath, who had been closely associated with the N.A.G. for many years, keeping their sales ledger in order.

ANNUAL REUNION OF MEMBERS AND PRESENTATION OF AWARDS

The Annual Reunion of Members and the Presentation of Awards took place in Goldsmiths' Hall on 14th November, 1983. The Chairman, Mr David Callaghan, F.G.A., presided and welcomed as the Association's guest to present the awards Professor Dr Hermann Bank, F.G.A., President of the German Gemmological Association (Deutsche Gemmologische Gesellschaft), which was celebrating its fiftieth anniversary. Professor Bank's daughter Monika also was present that evening to receive her Diploma.

In 1983 the gemmological examinations had been conducted in twenty-six centres in the United Kingdom and ninety centres throughout the world, all of which required the services of officials and provision of examination materials, including specimens and instruments for the practical examination.

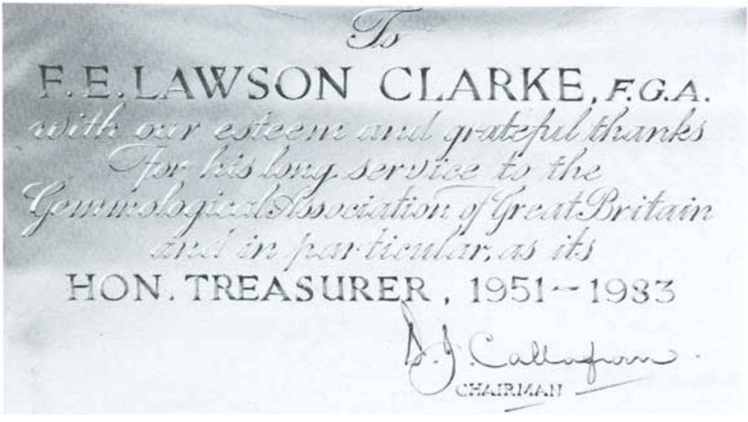
In addition to Professor Bank's daughter, Mr Callaghan was glad to welcome Mr Leslie Fitzgerald, who in addition to organizing the gemmological courses and examinations was also responsible for the administration of the educational courses and examinations of the N.A.G. It was regrettable, however, that again this year the Tully Medal had not been awarded: this had not been given since 1976, and, while they looked forward to the next occasion when it would be awarded, the Examiners jealously guarded the high standard they had set for it.

Professor Bank then presented the awards to the successful candidates and delivered an address, which is recorded in full below.

The Vice-Chairman, Mr Noel Deeks, F.G.A., then thanked Professor Bank and congratulated him on the double event of the Fiftieth Anniversary of the Deutsche Gemmologische Gesellschaft and his daughter's success in the examinations.

There followed a presentation to Mr F. E. Lawson Clarke, F.G.A., on his retirement as Honorary Treasurer. The Chairman first recalled that Mr Lawson Clarke had been Treasurer of the Gemmological Association for thirty-two years (1951-1983), following in the footsteps of his father, the late Victor W. Clarke, Hon. F.G.A., who had held the same office in 1924-1925 and again from 1932-1942, when he became Chairman. (Another example of long service to the Association was Mr Douglas Wheeler, F.G.A., the Assistant-Secretary, who would be retiring at the end of the year after forty-seven years service). Mr Callaghan then presented Mr Lawson Clarke with a carved sodalite dish with a silver plaque in the centre engraved with the arms of the Gemmological Association (see Figure 5), the dish being contained in a case to which is affixed the silver plaque shown in Figure 6. After a bouquet of flowers had been presented to Mrs Clarke and Mr Lawson Clarke had expressed thanks, the proceedings terminated.

FIG. 5. Carved sodalite dish (diameter approximately 6 inches) with central silver plaque presented to Mr F. E. Lawson Clarke, F.G.A., on his retirement as Honorary Treasurer.



To
F.E. LAWSON CLARKE, F.G.A.
with our esteem and grateful thanks
For his long service to the
Gemmological Association of Great Britain
and in particular, as its
HON. TREASURER, 1951 – 1983
D.J. Callaghan
CHAIRMAN

FIG. 6. Silver plaque on the case containing the sodalite dish.

PROFESSOR HERMANN BANK'S ADDRESS

Es war für mich eine grosse Ehre, nach 7 Jahren wieder von der Gemmological Association of Great Britain eingeladen zu werden, um den erfolgreichen Kandidaten der Diplom-Prüfungen des Jahres 1983 ihre Urkunden auszuhändigen. But as in 1976 I think that you would prefer that I try to continue in your language, and I beg you to excuse my poor English.

It was a great honour for me to be invited to present the awards of the Gemmological Association of Great Britain to the successful candidates of 1983, and I thank you very much for this invitation and the friendly welcome. The occasion is particularly pleasing for me for several reasons—(1) it is exactly 30 years since I passed the Diploma Examination in 1953 and became F.G.A.; (2) as you have realized already, my eldest daughter is among you successful candidates; (3) it was pleasant to be able to present the Anderson-Bank Prize this year after Basil Anderson did it last year; (4) one must enjoy such an occasion anyhow. Since I have been asked to address you after having fulfilled my first task, I shall now try to fulfil my second too, and I should like especially to speak to the candidates.

You have now got your Diplomas, and we hope that you do not think, as Goethe expressed it in his *Faust,*

What you possess black on white you can confidently carry home,

and relax on your success. It is one of your duties to always perfect your gemmological education, to keep your knowledge on a high standard, and you must allow me now to give you some advice.

Gemmology was much easier thirty years ago, and, if students of 1953 such as myself had remained on the level of knowledge of that time, they would now be lost. The developments and the progress have been so enormous in all fields of gemmology that it has been necessary for us to learn steadily to keep always up to date.

There have been discovered new minerals. There have been found old minerals worth cutting. There have been invented new synthetics and artificial products. There have been effected new colour manipulations, so many irradiations and diffusions and heatings, that it has also been necessary to use new techniques to disclose all these phenomena. Often the techniques must be more and more scientific to get the right results.

For a long time gemmology was regarded only as a more commercial and technical appendix of mineralogy. The discovery of new mineral species by gemmologists and the necessity of adoption of scientific methods to distinguish between gemstones and their substitutes or their manipulations have brought gemmology to the level of a science. Last year the I.M.A. (International Mineral Association) has formed its own commission on gem materials. That means, the I.M.A. has accepted gemmology on its own as a scientific part of mineralogy. More and more mineralogists are taking an interest in gemmological problems and assisting us to solve them, doing research on new minerals and varieties as well as on synthetic and imitation stones, their properties and distinguishing characteristics. Comprehensive information is increasingly important, and jewellers' customers want more information. Therefore jewellers must have better education to be able to pass the required information on to their interested customers.

The Gemmological Association of Great Britain recognized this demand at the earliest stage and started gemmological education courses over fifty years ago, and the courses have become an example and a model for gemmological Associations in other countries. The title 'F.G.A.' is highly esteemed throughout the world—hence the number of students every year. It is your proud duty to uphold the professional reputation which this title implies.

In the Preliminary Course the Gemmological Association of Great Britain tries to give to the students a general idea, and, in the Diploma Course, special theoretical knowledge and practical ability to use the various methods. However, we can only give and receive instruction until the day of the examination.

> *Education combines the knowledge of the past with the unknown dark of the future by using wisely the present.*

The candidates of today know—or at least should know—what we knew thirty years ago, and they also know what happened in these thirty years, but they and we do not not know what problems will occur in the next thirty years. The unknown dark is spread over the developments of the future.

One fact is certain. New technologies will create new problems, and we can solve these problems only when we study steadily and try to keep on the newest stand of knowledge of the theoretical part and of the practical know-how of the methods.

A poet once said

> *We must demand the extraordinary from ourselves to be able to do the ordinary.*

This we should at least try to do.

If you have the slightest doubt, do not hesitate to consult an experienced colleague. We have a German proverb:

> *Was für einen vielzuviel,*
> *ist für 2 ein Kinderspiel.*
> (What one cannot do
> is child's play for two.)

Experts are not made in Heaven, and it is better to ask than to make an error.

> *Student is, who wants to learn something:*
> *Fellow or journey-man is, who knows something:*
> *Master is, who devised or invented something.*

Always take enough time to test a stone; never be in a hurry. Take your time also to study the *Journal of Gemmology* and other sources of information, and try to think, as Goethe expressed it:

> *Do not say, 'Tomorrow I will do this and that':*
> *Do it, and wait until tomorrow and say then 'I did it.'*

which means

> *Never put off till tomorrow what you can do today*

Mineralogical gemmologists and mineralogists try always to find and to develop new scientific equipments and methods which are suitable for easily distinguishing between gemstones and their substitutes, if possible without detroying them (neither gemstones nor substitutes).

Do not think that you only need to know a bit.

> *A lttle learning is a dang'rous thing:*
> *Drink deep, or taste not the Pierian spring.* *

That means that we should try to obtain a thorough and comprehensive, broadly based knowledge.

---

*Pope, *Essay on Criticism*, 216.—Ed.

The old Chinese said:

What you hear, you easily forget:
What you see, you keep better in mind:
Only what you have touched and worked with, you keep forever.

So, please, use your instruments and get practice. In over ninety-nine per cent of cases you can identify a stone by means of our classical gemmological instruments—the polariscope, the conoscope, the refractometer, the microscope, the spectroscope, the UV lamp, etc. Only in very few cases is it necessary to consult x-ray powder methods or x-ray fluorescence or even x-ray topography or tomography, the microprobe, IR spectroscopy or other more scientific equipments. But they are absolutely necessary for basic research and for doubtful cases.

It is not enough to have knowledge, it is necessary to use it:
And it is not enough to be willing, you must also do it.

So do work to get acquainted with methods and with all gemstones and their substitutes. The more you gain practice for yourself, the more you become sure on the one side but the more you also understand the verity of the two words of Socrates:

Scio nescio. (I know that I do not know.)

But Goethe consoles us when he writes:

It is not important what we do know,
But that we always have the right idea at the right moment.

And it also is not correct that you should only *buy* instruments and text-books, because often the purchase of a book is mistaken for the appropriation of the contents. So buy, *use* and *read.*

Successful candidates, I congratulate you on your Diplomas and I welcome you among the Fellows of the Gemmological Association of Great Britain. I wish you every success in your gemmological future.

It is not so important that one or the other of you will become a famous gemmologist, but it is important that each and every one of you does his or her duty so that your Clients have confidence in gemmology and gemmologists. To merit this confidence, do not remain on your present level of knowledge: study carefully to keep always up to date. Then I hope that your gemmological practice will be characterized by a minimum of errors, a maximum of perfect results, and an optimum of joy. I wish you all the best and what is generally necessary in human life—a bit of good luck. Thank you.

COUNCIL MEETING

At the meeting of Council held on Tuesday, 21st February, 1984, at the London Tara Hotel, Wrights Lane, Kensington, London, W8., the business transacted included the election to membership of the following:

FELLOWSHIP

Anand, Sumedha, Bombay, India. 1983
Bagnall, Douglas A., Don Mills, Ont., Canada. 1983
Bank, Monika I., Kirschweiler, W. Germany. 1983
Basnayake, Senarath B., Katugastota, Sri Lanka. 1983

Beattie, Roy A., Jimboomba, Qld, Australia. 1983
Berger, Nicolaas H. M., Woerden, Netherlands. 1983
Bonham, Frank C., Laguna Beach, Ca, U.S.A. 1983
Brand, Lester J., Germiston, S. Africa. 1983
Campion, John E., Rosyth. 1954
Chant, Joanna K., Dorchester. 1983
Chu, Hong-Sung, Taipei, Taiwan. 1983
Collado Castelles, Ma Dolores, Valencia, Spain. 1983
Dam, Hedwig M., Franeker, Netherlands. 1983
Dings, Christianne A. M., Valkenswaard, Netherlands. 1983
Dykstra, Jeannine B., Toronto, Ont., Canada. 1983
Ebert, Gabriela E., Neckarsteinach, W. Germany. 1983
Elsten, Antonius R. M., Purmerend, Netherlands. 1983
Feather, Russell C., II, Fairfax, Va, U.S.A. 1983
Floyd, Nancy E., Toronto, Ont., Canada. 1983
Fretzin, Leonard H., Chicago, Ill., U.S.A. 1983
Haughton, Michael, Bolton. 1983
Hillgarth, Antonella C., Geneva, Switzerland. 1983
Hollis, Patricia A., New York, N.Y., U.S.A. 1983
Inoue, Yoshie, Tokyo, Japan. 1983
Jashnani, Navin B., Bombay, India. 1983
Jennings, Joan M., Natal, S. Africa. 1983
Kaper, Robert, Washington, D.C., U.S.A. 1983
Karmakar, Sambhunath N., Bombay, India. 1983
Kjellin, Ewa B., Umea, Sweden. 1983
Kozen, Shigekazu, Osaka, Japan. 1983
Kwok, Addy S. C., Kowloon, Hong Kong. 1983
Lam, Cecilia L. K. L., Kowloon, Hong Kong. 1983
Langoulant, Peter B., Inglewood, W.A., Australia. 1978
Lee, Jeffrey K., Don Mills, Ont., Canada. 1983
Lette, Edward C. G., Amsterdam, Netherlands. 1983
Lloyd, Stephen R., London. 1983
Lowes, Elizabeth H., Toronto, Ont., Canada. 1983
McLean, Donald P., Toronto, Ont., Canada. 1983
McCornack, Constance B., Seattle, Wash., U.S.A. 1983
McGorrian-Morgan, Pauline J., Downpatrick, Co. Down, N. Ireland. 1983
Mahajan, Maryada D., Bombay, India. 1983
Majeed, Ismath A. M. M., Colombo, Sri Lanka. 1983
Mallawarachchi, Gayani N., Kadawatha, Sri Lanka. 1982
Mascetti, Daniela, Milan, Italy. 1983
Mata, Carmen, London. 1983
Merchant, Sandhya J., Bombay, India. 1983
Mohideen, H. M. Sultan, Madras, India. 1983
Moore, Stephen S., Pacific Palisades, Ca, U.S.A. 1983
Niinobe, Hiroko, Hyogo, Japan. 1973
Nikiforides, Constantine W., Surfers Paradise, Qld, Australia. 1983
Nikiforides, Tina, Surfers Paradise, Qld, Australia. 1983
Pandya, Manoj K., Bombay, India. 1983
Pattani, Hitesh K., Bombay, India. 1983
Pitt, John R., Stourbridge. 1983
Ponn, Roger E. F., Tulsa, Okla, U.S.A. 1983
Punchihewa, Leslie J., Colombo, Sri Lanka. 1983

Rajayohan, Rasiah, Karainagar, Sri Lanka. 1983
Ramaiya, Rajendra D., Bombay, India. 1983
Rhodes, Alexandra M., London. 1983
Rikkoert, Abraham, Schoonhoven, Netherlands. 1983
Ruest, Andre E., Gloucester, Ont., Canada. 1983
Shaw, Constance Helen, Toronto, Ont., Canada. 1983
Smith, Edward, Vineland Station, Ont., Canada. 1983
Smith, Ronald G., Nottingham. 1983
Soni, Sara, London. 1983
Steil, Patricia R., Hong Kong. 1983
Suenaga, Eiji L., Sapporo, Japan. 1983
Svendsen, Nina Vedeler, Rud, Norway. 1983
Valls Bascu, Joaquin, Barcelona, Spain. 1983
van Soest, Wilhelmina N. M., Wychen, Netherlands. 1983
van Stokkom, Francis A. J. A., Dongen, Netherlands. 1983
Virani, Nilesh A., Bombay, India. 1983
Wennberg, Mats T., Stockholm, Sweden. 1983
White, J. Marlene, Sacramento, Ca, U.S.A. 1983
Zawacki, Charles G., Anchorage, Alaska, U.S.A. 1983
Ziogos, Georgios, Thessaloniki, Greece. 1983
Zunz, Laura A., London. 1983

ORDINARY MEMBERSHIP

Abe, Kazumi, Kofu, Japan.
Aketa, Harou, Tokyo, Japan.
Alahakoon, Vincent, Manama, Bahrain.
Anderson, Ellamae, Spokane, Wash., U.S.A.
Aouad, Nayla A., Sin El Fil, Lebanon.
Armfield, Ross W., Wanneroo, W. Australia.
Bell, Heather L., Formby.
Bertram, Hettiarachchige D., Avissavella, Sri Lanka.
Block, Rachel, London.
Caley, Heather J., Egham.
Chander, Marianne, London.
Chang, Yu-Mei, Tokyo, Japan.
Clack, Martin D., Chichester.
Cody, Carol J., London.
Crum, James L., Louisville, Ohio, U.S.A.
de Vilmorin, Marie, London.
Derks, Ruedi, Hettlingen, Switzerland.
Doi, Toshihiro, Kagawa, Japan.
Downing, Cecil A., Plymouth.
Dunn, Nigel P., Brierley Hill.
Eaton, Anne, Lymm.
Elson, Patricia D., Swansea.
Ely, Jana M., London.
Endo, Takako, Kofu, Japan.
Fardoost, Houshang, Haywards Heath.
Fein, Murray, Whitestone, N.Y., U.S.A.
Fitzpatrick, Bruce, Seal Beach, Ca, U.S.A.
Fujii, Shinichi, Tokyo, Japan.
Fushimi, Sayuri, Kofu, Japan.
Gerhart, Anna M., San Diego, Ca, U.S.A.
Goldie, Patrizia M., London.
Gunaratne, Ananda L., Kundasale, Sri Lanka.
Hashimoto, Masaki, Osaka, Japan.
Hobbs, Fiona G., Winchester.
Holden, Patti, Market Harborough.
Hookins, Gary C., Thames Ditton.
Horsfall, Clare, Blackburn.
Hosaka, Rumi, Kofu, Japan.

Hussain, Ghulam, Abbottabad, Pakistan.
Ichikawa, Kyoko, Tokyo, Japan.
Ishizuka, Keiko, Kagawa, Japan.
Iwama, Shinobu, Kofu, Japan.
Jesney, John, Eatonia, Sask., Canada.
Kamioka, Hitomi, Tokyo, Japan.
Kawaguchi, Tamaki, Kyoto, Japan.
Kazsuta, Masanori, Tokyo, Japan.
Kijima, Kohei, Kanagawa, Japan.
Kikano, Margo, London.
Kim, Choong H., Seoul, S. Korea.
Kishi, Masaki, Kanagawa, Japan.
Koike, Toshikazu, Tokyo, Japan.
Kojima, Yaeko, Tokyo, Japan.
Koll, Charles H., Welkom, O.F.S., S. Africa.
Kruithof, Pieter, Amsterdam, Netherlands.
Labastire, Sylvie, London.
Liyanage, Sita W., Sokoto, Nigeria.
Luff, Kenneth H., Sidcup.
McKenna, Bernard, Southport.
Malgarin, Brent, Bellevue, Wash., U.S.A.
Maruo, Tatsuzo, Kobe City, Japan.
Matsumoto, Chigako, Tokyo, Japan.
Misawa, Yukinobu, Tokyo, Japan.
Mizukami, Yurika, Kofu, Japan.
Murayama, Fumio, Akita City, Japan.
Murphy, Francis E., Halifax, N.S., Canada.
Nagasaka, Hiroko, Kofu, Japan.
Nakayama, Minoru, Tokyo, Japan.
Nishihara, Akio, Yamato City, Japan.
Ogawa, Katsuhiko, Tokyo, Japan.
Ohata, Keiichi, Tokorozawa City, Japan.
Ohkubo, Kafuyuki, Kofu, Japan.
Ohshiro, Kenji, Tokyo, Japan.
Okuyama, Osamu, Kofu, Japan.
Ono, Manabu, Tagawa City, Japan.
Osada, Masaki, Kofu, Japan.
Otsuka, Masayuki, Kagoshima City, Japan.
Owen, Jonathan C., Brighton.
Owen, Margaret C., Dallas, Tex., U.S.A.
Patton, Carol M., Lytham.
Payne, Michael D., Tunbridge Wells.
Pease, Elizabeth S., New York, N.Y., U.S.A.
Pendlebury, Elizabeth M., Bolton.
Perry, Nellie, London.
Quy, Caroline E., Chalfont St Giles.
Raths, Juan C., London.
Roman, Denise, Santa Monica, Ca, U.S.A.
Rosseel, Carl, Kortrijk, Belgium.
Saito, Shinobu, Kofu, Japan.
Sallee, Kenneth E., Roseville, Ill., U.S.A.
Sasaki, Kiyoshi, Iyo-Mishima City, Japan.
Sauers, Dennis E., Cypress, Ca, U.S.A.
Sawanobori, Norihito, Kofu, Japan.
Shimizu, Mika, Kofu, Japan.
Stephenson, Timothy, Creetown.
Stevenson, John, Wembley.
Stewart, John R., Perth.
Sultan, Rebecca, London.
Suzuki, Yasuyo, Kawaguchi City, Japan.
Taank, Avinash, Ilford.
Taank, Joshna, Ilford.
Takahara, Mihoko, Hiroshima, Japan.
Takeshita, Terumi, Kofu, Japan.
Taylor, Ian D., Macclesfield.
Uthayakumar, Kanapathippillai, Hitchin.
van Doren, Jean-Paul, Bognor Regis.
Vanderhaeghen, Ivan, Gent, Belgium.
Voce, Elizabeth, Topsham.
Walker, David G., Wellesley, Mass, U.S.A.
Watson, Thomas N., Nairobi, Kenya.
Wayne, Barry W., Chigwell.
Wilcox, Margaret, Marlow.
Wolkonsky, Alexander, St Cloud, France.
Woods, James M., Costa Mesa, Ca, U.S.A.

Yamamoto, Kaoruko, Kofu, Japan.
Yamanaka, Kimiko, Kobe City, Japan.
Yamauchi, Mineharu, Tokyo, Japan.
Yoshioka, Tadayuki, Kofu, Japan.
Zapatero, Luis M., Madrid, Spain.

ULSTER MUSEUM, BELFAST

In November 1983, the Geology Department of the Ulster Museum ran a course organized by Dr Rab Nawaz, F.G.A., comprising five lectures, one by Dr John Malone (Queen's University) on 'Diamonds', one by Dr John Preston (Queen's University) on 'Corundum and its Gems: Ruby and Sapphire', and three by Dr Nawaz on 'Beryl and its Gems : Emerald and Aquamarine'. 'Opal and Zircon Gems' and 'Topaz and Chrysoberyl Gems' respectively.

AMERICAN GEM SOCIETY GOLDEN JUBILEE CONCLAVE

The American Gem Society, founded (like the Gemological Institute of America) by Robert M. Shipley, celebrated its Golden Jubilee this year and for the first time invited international gemmologists to its Annual Conclave, which took place in Atlanta, Georgia, U.S.A., from 30th March to 3rd April, 1984.

SINGAPORE GEMOLOGIST SOCIETY

Information has been received of the formation in Singapore of the Singapore Gemologist Society. Among its objects are the promotion of increased understanding among and intercommunication between gemmologists in Singapore and around the world and the advancement of its members' knowledge in the gemmological field. Associate membership is open to gemmologists throughout the world. Entrance fee S$50: annual subscription S$50. Enquiries should be addressed to the Society at 3 Lengkok Merak, Singapore 1024.

CORRIGENDA

In *J.Gemm.*, 1983, XVIII(7)—
on p.654, between lines 23 and 24 insert 'Spinel and sapphire examined in New York Lab were found to be coloured by'
on p.656, line 3, for 'trip' read 'strip'

In *J.Gemm.*, 1983, XVIII(8)—
on p.678, line 25, for 'rhombohedrae' read 'rhombohedral'
on p.690, line 24, for 'only the' read 'only) the'
on p.772, line 9, for 'wollasonite' read 'wollastonite'
on p.772, line 10, for 'vesuviantite' read 'vesuvianite'
on p.773, line 4, for 'East' read 'Earth'

In *J.Gemm.*, 1984, XIX (1), on p.93, line 6, between 'Australia,' and 'Brazil,' add 'Austria,'

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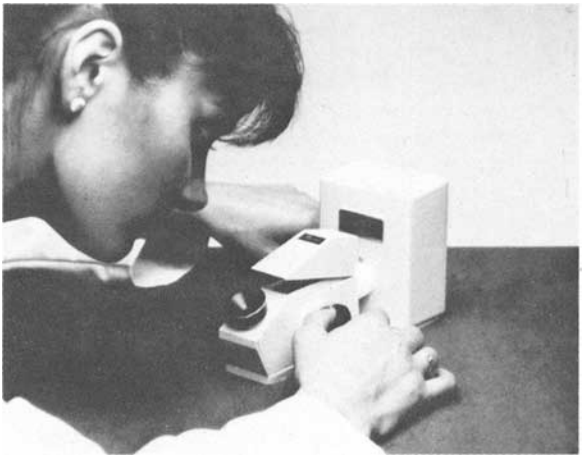

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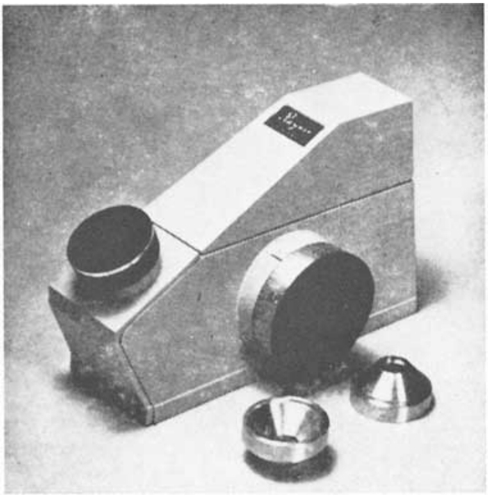

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Historical Note

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 and the Gemmological Association of Hong Kong.

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 Editor is 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 Editor.

Articles published are paid for, and a minimum of 25 prints of individual articles may be supplied to authors provided application is made on or before approval of proofs. Applications for prints should be made to the Secretary of the Association—not to the Editor—and current rates of payment for articles and terms for the supply of prints may be obtained also from the Secretary.

Although not a mandatory requirement, it is most helpful if articles are typed (together with a carbon copy) in double spacing on one side of the paper, with good margins at sides, top and foot of each page. Articles may be of any length, but it should be borne in mind that long articles are more difficult to fit in than short ones: in practice, an article of much more than 10 000 words (unless capable of division into parts or of exceptional importance) is unlikely to be acceptable, while a short note of 400 or 500 words may achieve early publication.

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