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and

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GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

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OF GREAT BRITAIN
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Vol. 11 No. 8 OCTOBER 1969

THREE SYNTHETICS FOR THE RECORD

By B. W. ANDERSON
Director, Precious Stone Laboratory of the London Chamber of Commerce

ONE of the useful functions of a Gem Trade Laboratory is to give warning, through an appropriate channel, to gemmologists less favourably placed, when some unusual type of synthetic, fake, or even natural gemstone is encountered which may be a cause of future trouble to the uninitiated. Of the three synthethics described below only the first is likely to be a serious menace, but it seemed a good opportunity to put the others on record also for the benefit of readers of the Journal.

1. A New Synthetic Emerald

All previous forms of synthetic emerald have been heralded with some degree of publicity. Their producers have been at pains to proclaim the excellence of their wares; brochures have been issued, articles written, and leading gemmologists have published reassuring statements explaining how to distinguish each latest synthetic from earlier products and from the natural emerald.

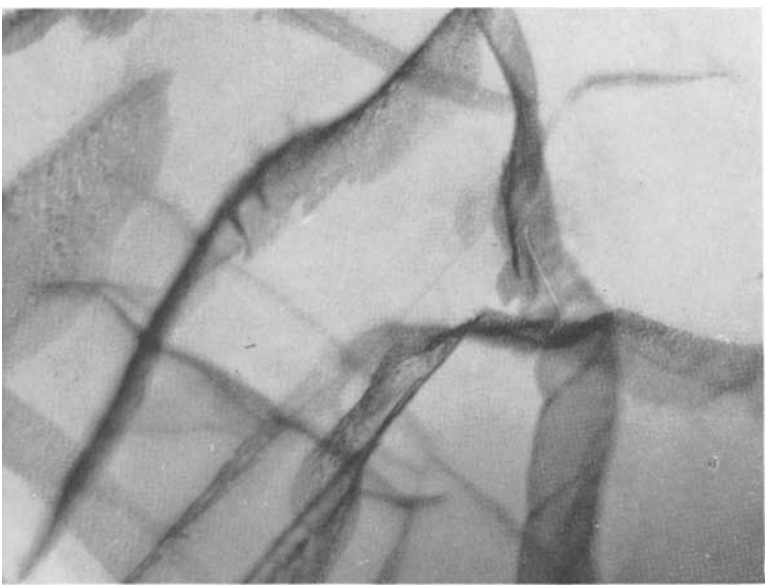
The type presently to be described crept up on us unawares, being sent in for test in the ordinary run of business, and it caused us quite a bit of trouble, as will appear hereafter.

Ostensibly the stone was an emerald of good colour and quality, weighing about two carats, mounted as a single stone ring.

Suspicion was at once aroused by the inclusions, which were twisted two-phase feathers very reminiscent of Chatham, Gilson,

and other flux-fusion emeralds, but in its properties the stone was different from any other emerald we have met, natural or synthetic. Refractive indices were 1·574–1·580 and (after removal from its setting) the density was found to be 2·72. There was virtually no fluorescence, even between crossed filters, though the chromium lines were clearly visible in the stone's absorption spectrum. The reason for the lack of fluorescence was undoubtedly the presence of iron, since quite a strong absorption band was seen at 4270A in the violet—a band belonging rather to the aquamarine variety of beryl than to emerald.

Despite these anomalies, we were convinced that the stone must be synthetic, but were glad to obtain permission to send the specimen to our good friends in the G.I.A. Gem Trade Laboratory in New York. They in turn elicited the powerful aid of Dr. Kurt Nassau of the Bell Telephone Laboratories, well-known for his skill in the preparation of crystals of all kinds, including laser and gem materials, and for much else besides. It happened that Dr. Nassau had recently concluded some interesting research on the infra-red absorption spectra of natural and synthetic beryls, in the course of which it was shown that all natural emeralds show absorption bands



Feathers in new type flux-fusion emerald.

due to water in this part of the spectrum, while in synthetic emeralds these bands are absent when grown by flux-fusion methods. Our "mystery" emerald showed no water bands and was thus confirmed as a flux-grown synthetic: a welcome piece of support not available in a gemmological laboratory. Since then, another such stone has been encountered in routine testing, and we understand that the Los Angeles Laboratory of the G.I.A. has tested similar pieces. The grapevine suggests that the emeralds are produced by a lone individual who is an employee of one of the big U.S. companies.

Low refractive index, low density, an intense red under the Chelsea filter, red fluorescence under long and short wave U.V. lamps, will continue to be useful signals for the flux-fusion emeralds most frequently met with, but it is hoped that the above will serve as a warning that not all flux-fusion emeralds can be expected to show these well-known features. Any stone which shows suspicious inclusions should be submitted for a laboratory test, and a complete absence of fluorescence under crossed filters should warn gemmologists to look for that 4270A band, which we have never observed previously in any emerald. Mercifully, the three-phase inclusions shown so beautifully in Colombian emeralds are so far beyond the skill of the laboratory worker to reproduce in his manufactured crystals.

2. Synthetic Blue Quartz

The process of growing large flawless untwinned crystals of quartz has for many years been a scientific and commercial commonplace. Such crystals are in constant demand in the electronics industry for wavelength control and time-keeping of high accuracy, making use of the well-known piezo-electric properties of the mineral. The gemmologist has been uneasily aware that he would find it difficult to distinguish the man-made material from the natural product should the occasion arise, comforting himself with the thought that the mineral is so abundantly found in the earth's crust that the necessarily slow and expensive method used in its artificial production would make its utilisation for gem purposes unattractive, especially as the "know-how" for the production of desirable coloured quartzes does not seem to have been mastered.

The writer was thus more than mildly astonished to find that a bright blue stone, mounted in a single-stone ring, was not, as at first supposed, a cobalt-blue glass but a veritable crystalline quartz,

with the standard refractive indices, birefringence, and hollow interference figure. The cobalt bands were after the manner of those in glass—that is, well spread and with the central band relatively narrow as compared with cobalt blue spinels. There was no need of course, to look for further proof of synthesis, and a faint memory made the writer turn to a paper in the "American Mineralogist" where was to be found a description of just such a product, complete with absorption curve.

The appearance of such a stone in an ordinary commercial context continues to be astonishing, especially when one learned that it had been bought in Russia, together with another cheap ring containing a green synthetic spinel. Unlikely indeed, perhaps not to be repeated; but worth noting as a curiosity and as a warning to take nothing for granted, but to make sure in one's testing that all possibilities have been considered. This prim advice is needed by the writer himself, who, in testing this particular stone, made a very untidy and unsteady progress towards the truth.

3. Lithium Niobate

As mentioned at the beginning of the article, the third artificial gemstone to be described has not been encountered by the writer in routine testing, but was first shown to him at the Stockholm Conference by Dr. E. Gübelin on behalf of Dr. W. Eppler, who could not attend.

As with strontium titanate, lithium niobate is known only as a synthetic material, not being represented in nature. In America, apparently, it has been on the market for some time under the trade name of "Linobate", a reasonable abbreviation from its chemical full-dress. It has considerable attractions as a gem material, a high refractive index, good dispersion, and a wide range of bright colours, but is low in hardness and has a double refraction high enough to induce a "fuzzy" appearance in the zircon-sphene-rutile manner.

Lithium niobate can be produced either by the Verneuil or by the Czochralski "pulling" method from a platinum crucible. The melting point is 1250°C., hardness 5+, density 4·64, refractive indices 2·30 for the ordinary and 2·21 for the extraordinary ray. Dispersion is about 0·120 for the B–G range. Colours include green (Cr), red (Fe), violet (Co.), yellow (Mn or Ni); the colorants being introduced either as oxides or as titanates.

THREE IMPORTANT PIECES OF JEWELLERY FROM THE PERSONAL COLLECTION OF HER MAJESTY THE QUEEN

By M. J. O'DONOGHUE, M.A., F.G.A.

WITH the gracious permission of Her Majesty the writer was recently able to examine three pieces of great gemmological interest from her personal collection of jewellery. It was possible to make a close examination of the pieces which, together with information kindly supplied by designers and cutters has enabled me to set down some details which are otherwise not easily ascertained. The items chosen for the article were the Andamooka opal, the Williamson pink diamond and the wattle and tea-tree brooch. Photographs are reproduced with the permission of Her Majesty and are Crown Copyright.

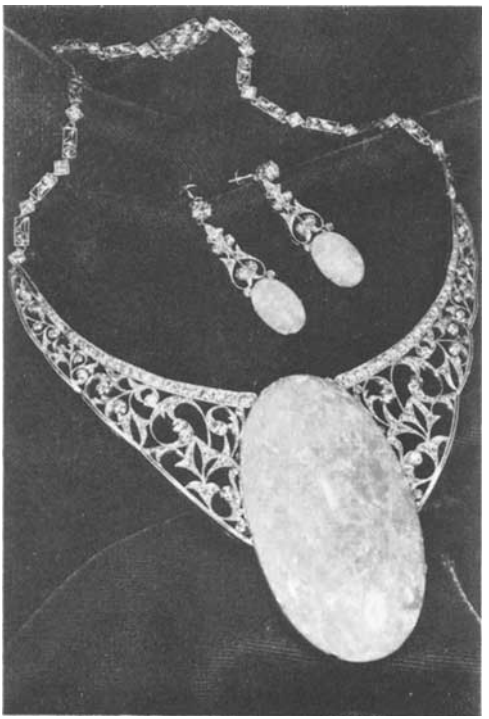
The Andamooka opal was found at Stevens Creek Diggings, Andamooka, South Australia, and was recovered in 1946 from a depth of approximately 30 feet. The weight was over 6 oz. Troy and the stone measured $4'' \times 2\frac{1}{2}''$. It was then cut by Mr. J. D. Altmann, of Altmann and Cherny Pty Ltd. of Melbourne, and presented to Her Majesty by the South Australian Government at a state banquet in Adelaide during the royal tour of 1953-54.

After cutting the dimensions were $81 \times 45 \times 5$ mm and the weight 203 ct, the form of cut being the oval cabochon. A pair of earrings and a pair of cufflinks were subsequently fashioned from the same rough.

On examination the predominating colours are seen to be green and blue, but on turning the stone the other spectrum colours are seen. There are no areas without good colour and the only slight blemishes, two small sandspots flanking the centre, are scarcely visible to the unaided eye.

Messrs. Wendt, of Adelaide, set the opal in a palladium necklace with 180 white diamonds which are arranged in a scroll motif. The side pieces are hinged in sixteen places with a chain of small diamonds at the back.

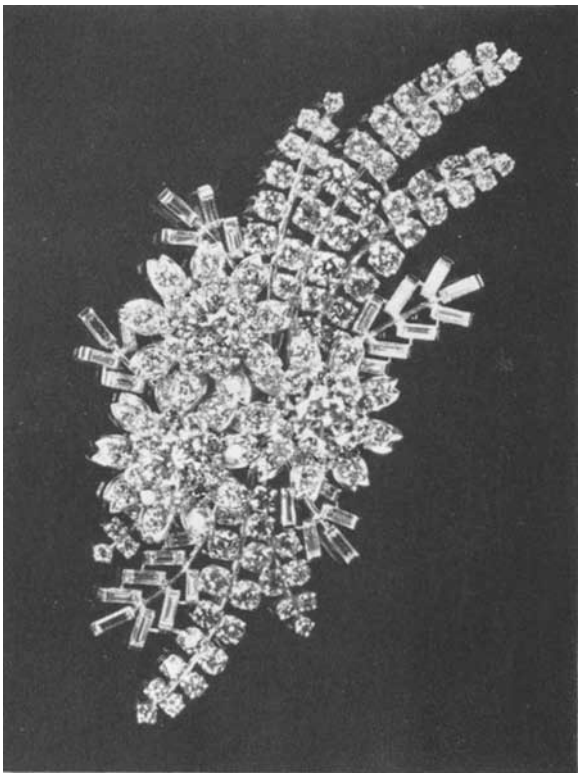
In this chain each diamond is set in a diamond-shaped mount alternating with links pierced in the matching scroll designs and finishing with a diamond-set catch. The motif of the earrings is the same as that of the side pieces.



The Andamooka opal necklace and earrings

The necklace and earrings are kept in a box in which is mounted a silver plate reading "Her Majesty Queen Elizabeth II. A token of loyalty and appreciation from the people of South Australia 23 March 1954".

The brooch was presented to Her Majesty by the Australian Federal Government during the royal tour of 1953-54. Two national flowers of Australia are represented - the Wattle or Mimosa and the tea-tree (*Leptospermum*). The blossoms of the tea-tree are composed of golden-yellow diamonds and the stem and leaves of white diamonds, which also form, in baguettes, the leaves of the wattle. In all there are 161 stones with a total weight of 23·14 ct.



Diamond brooch representing the Australian wattle

This overall weight is made up of:

27 brilliants	with a total weight of	3·43 ct.
44 baguettes	,,	3·82 ct.
87 golden yellows	,,	10·81 ct.
2 large whites	,,	5·08 ct.

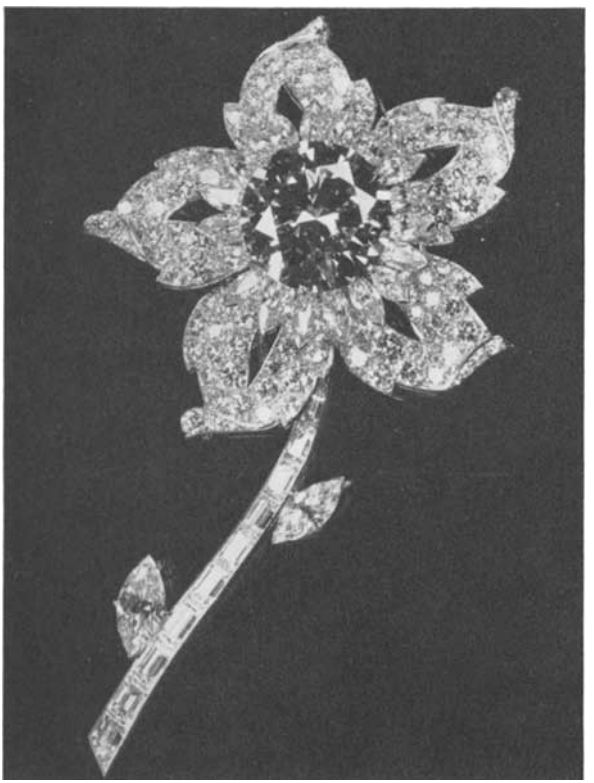
The stones were obtained from Messrs. Triefus & Co. Ltd., of Holborn Circus, London, who themselves obtained some of the golden-yellow diamonds from a private collection.

The brooch is made of platinum and was created by Messrs. William Drummond and Co., of Melbourne, whose mark appears on the stem.

I am indebted to Messrs. Triefus and to Messrs. William Drummond for information.

The pink diamond was found by the late Dr. John Williamson at his mine at Mwadui in Tanganyika and weighed 54 ct in the rough. It was presented by Dr. Williamson to Her Majesty, then Princess Elizabeth, on the occasion of her wedding in 1947.

The cutting was carried out by Messrs. Briefel and Lemer at their London factory and Princess Elizabeth accompanied her grandmother Queen Mary to the factory to see the work being carried out. The stone was cut and polished entirely on the scaife and the round shape was achieved by the polisher grinding away the circumference in a series of small straight facets. It took three months to complete the table facet, four top hooks and four bottom hooks, and during this stage a hole in the bottom of the



The Williamson Pink which comprises the centre of a flower brooch in the form of a jonquill-shaped spray

stone was worked out. The second stage of polishing to the finished stone took approximately three weeks, much of the work being done in the solder dop of the older type. On completion the weight was 23·60 ct and the stone was completely pure and flawless. I am greatly obliged to Messrs. Briefel and Lemer for this information.

The stone is set as the centrepiece of a jonquil-shaped flower brooch created by Messrs. Cartier of Bond Street, London. The brooch is of platinum and is $4\frac{1}{2}''$ long. The petals are set with brilliants and the pink diamond is surrounded by white navettes. The stem is composed of baguettes with two buds.

All the diamonds in the brooch came from the Williamson mine. There is a two-prong spring fastening and the stem is marked Cartier London. The weights of the white diamonds are:

21 navettes	with a total weight of	9·73 ct.
12 baguettes	,,	4·64 ct.
170 rounds	,,	12·40 ct.

EUCLASE FROM MINAS GERAIS, BRAZIL

By FRANCISCO MULLER BASTOS, F.G.A., G.G.

UNTIL a short time ago, the existence of euclase in Brazil was restricted to the well-known mineralogical area of Ouro Prêto in the state of Minas Gerais. Today, however, the attention of many Brazilians is directed to the northeast of the country.

There, nobody can deny, there have been going on a rapid development and progress which are drastically modifying the environment of this arid region. Perhaps it has been this thrust of interest that has resulted in the discovery of various minerals, among them the euclase. So, this mineral is found also in the state of Rio Grande Do Norte in a place called Alto Do Jacu. However, the crystals from that source, which I had the opportunity to examine, are full of inclusions. They are almost opaque, with a few being translucent. Consequently they are not good to cut.

Ouro Prêto, the former capital of the state of Minas Gerais, is considered today a national monument. This old city is very well-known for its rich history since Brazil's independence. But for the mineralogists and gemmologists Ouro Prêto is famous for the imperial topaz or Ouro Prêto topaz. This area of Ouro Prêto consists of several small towns and villages such as Rodrigo Silva, Gambá, Hargreaves, Bôa Vista, Saramenha, Tripuhy, Burnier, Dom Bosco and Capão Do Lana.

The matrix of euclase is in quartz veins in the crystalline schists, always accompanied by metallic oxides such as specularite. This rock is very similar to the matrix of the topaz. Euclase is also found associated with topaz. I myself found euclase fragments in a typical topaz mine. This mine is called Angelo (Lavra Do Angelo) and is situated near Ouro Prêto.

Also blende and cinnabar can be found together with the euclase. I have heard, that near Dom Bosco and Hargreaves in the Bulho Hill, some blende and sphalerite have been found with euclase. The same thing happens in the Capão farm were some cinnabar with a beautiful adamantine lustre, associated with pyrite, is also found with some euclase.

When the first explorations were made in the area of Ouro Prêto, much euclase was thought to be topaz. Chiefly, the colour-

less and the light and dark yellow euclase were sold as such. I remember very well that many years ago euclases were offered to me as topaz. Later this difference was noted when very good and beautiful specimens of euclase were shown and studied in broad daylight.

The name euclase is derived from two Greek words meaning easy cleavage. The euclase found in the rich mineral district around Ouro Prêto has different colours that vary from the colourless to a medium blue. Some green crystals, that resemble the beryls from the region of Capelinha, are also found. The light yellow or "Kerosene" stone is the most common, whereas the violet-coloured crystal is the rarest. If the crystals were flawless, free of other minerals, they would normally be colourless. The coloured crystals like light blue, light green, bluish-green, yellow (kerosene colour) etc. owe their colour to the presence of small quantities of mineral agents.

Euclase is a beryllium silicate, the chemical formula being $Be(AlOH)SiO_4$. The faces of the crystal are smooth. Euclase belongs to the monoclinic system and the prismatic habit is characteristic. The lustre is vitreous and the fracture conchoidal. In the well formed euclase crystals from Ouro Prêto, proportions of Ca, Fl, Fe, Sn, Al and Si are found in greater or lesser quantities.

The density varies from 3·08 to 3·10 according to the colour. The colourless stones show an invariable density of 3·08. The hardness of 7·5 is constant. In euclase from Rodrigo Silva I found the R.I. to vary from 1·651 and 1·671 to 1·658 and 1·678. It should be noted that all the Ouro Prêto euclase has a small quantity of Sn in its chemical composition. I could not find any characteristic inclusion in this material.

As euclase is a mineral of easy cleavage, some lapidaries have difficulties in cutting the stones. The facets should not be placed on a cleavage plane and the best colour is obtained by a correct orientation of the crystal.

When the stones have the light blue colour, they resemble aquamarines. However, the identification is easy, because the R.I. of aquamarine (beryl) is 1·575-1·582 and the R.I. of euclase is 1·651-1·678. Also the S.G. of aquamarine (beryl) 2·70 is different from the S.G. 3·08 or 3·10 of euclase.

Besides the confusion with aquamarines, euclase is also confused with topaz—especially yellowish or colourless euclase crystals.

This happens with some crystals and cut stones too. The cut stones however, are easily checked with the refractometer: euclase 1·651-1·678, topaz 1·630-1·638. The S.G. also eliminates any doubt with euclase 3·08 to 3·10 and topaz 3·54. Also, some confusion occurs with cut greenish topaz. It, too, resembles euclase. These confusions can be easily eliminated by R.I. and S.G. tests.

From the mines of Ouro Prêto rare and beautiful specimens came to collectors and museums. From the mines of Rodrigo Silva, I have already had the opportunity to see beautiful conglomerates in which euclase is found together with topaz and specularite, forming beautiful specimens. Generally the euclase from this mine has bluish colour. However, the stones from Bôa Vista are yellowish. Also, very rare specimens are found where the three minerals, euclase, topaz and specularite appear to be associated with quartz and mica. In Hargreaves, some euclases were found and continue to be found in the rock crystal. From the old mine called Morro came some of the largest and most beautiful euclase crystals yet found, some of them 6 cms in length.

Finally, we can also include, in the Ouro Prêto area, the villages of Antônio Pereira and Cachoeira Do Campo. In Antônio Pereira principally the discovery of euclase has already been confirmed.

DIAMOND PROPORTIONS

By F. S. H. TISDALL, F.G.A.

THE article describing the Petterson proportion-slide and its use, appearing in the *Journal* for October, 1968, prompts me to describe a simple method which I devised by which may be ascertained the degree of approximation with which a "modern" cut diamond approaches the theoretical proportions for the supposedly perfectly cut stone as worked out mathematically by Tolkowsky in 1919.

The optical properties of gem quality diamond material are constant, and, assuming the proportions of the Tolkowsky brilliant-cut to be correct for obtaining the optimum amount of "fire" and brilliance, such proportions, once determined, will be valid for all time.

The writer prevailed upon the generosity of Messrs. D. & P. Clark, diamond merchants, to provide a "specimen" diamond which Mr. P. Clark himself considered to be of good make, and proportions. It was then necessary to ascertain, by measurement, what these proportions actually were. It is now the accepted practice to express these proportions as percentages of the width of the girdle, which is taken as 100. The actual measurements were first obtained as follows:

A small millimetre gauge, equipped with a vernier scale, permitting measurement to an accuracy of $\pm$ ·05 mm, was sawn and filed down as shown in Figure 1.

The required measurements (Fig. 2) were the following:

1. Height of crown (above girdle).
2. Depth of base (below girdle).
3. Width of table.
4. Width of girdle.

Angular measurements of crown and girdle facets relative to the plane containing the girdle necessarily follow from these measurements, and are, therefore, neglected in the experiment. They could be calculated with little trouble.

By placing the diamond as shown in Fig. 3 (securing it in position with a small piece of plasticine) it was by no means difficult by carefully adjusting the slide of the gauge so that its upper jaw

was just level with the girdle of the stone to ascertain the height of the crown. In the writer's view the thickness of the girdle itself, in a well made stone, has a negligible effect on the measurements, and is disregarded. In the case of the stone provided the height of the crown was 1·1 mm. The overall depth of the stone, using the gauge in the normal way, was found to be 4 mm, thus giving two requisite measurements:

Height of crown 1·1 mm.

Depth of base 2·9 mm (i.e. 4-1·1).

The width of the table facet, owing to the transparency and reflective powers of diamond material was, admittedly rather more difficult to obtain. The diamond was seated level in a small lump of plasticine and the width of the table (between the centres of opposite facet edges) measured with a pair of hair dividers. The dividers were then transferred to the millimetre gauge, and, with the aid of the vernier, a measurement was made to a degree of accuracy of ± ·1 mm. The girdle width, using the gauge normally presented no difficulty.

(The making of all these measurements is considerably facilitated by the use of a headband magnifier).

The two remaining measurements were:

Width of table 4·3 mm.

Width of girdle 6·78 mm (estimating the second decimal place).

Figure 4 is a sectional sketch of the stone to scale × 10.

In the following table the "ideal" proportions of the Tolkowsky brilliant-cut, expressed as percentages of the girdle (100), are compared with the relative dimensions of the above diamond, similarly expressed:

	Tolkowsky brilliant	*Experimental brilliant*
Girdle width	100	100
Table width	53	63·4
Crown height	16·2	16·2
Base depth	43·1	42·7

From this it will be seen how very close to the mathematically calculated ideal an actual, well made, modern diamond approximates, as assessed by a trained and experienced eye.

Figure 5 shows the sectional outline of the two sets of dimensions superimposed, the unbroken line being that of the actual specimen,

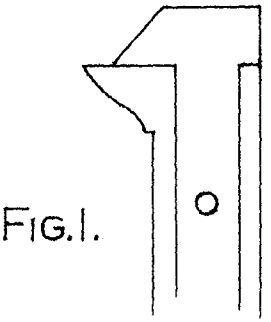


FIG. 1.

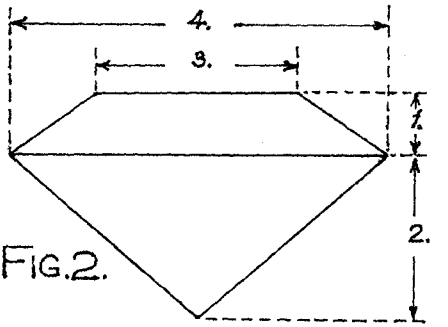


FIG. 2.

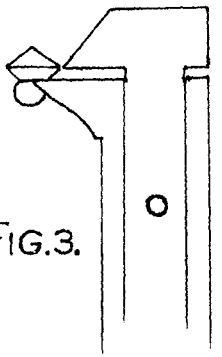


FIG. 3.

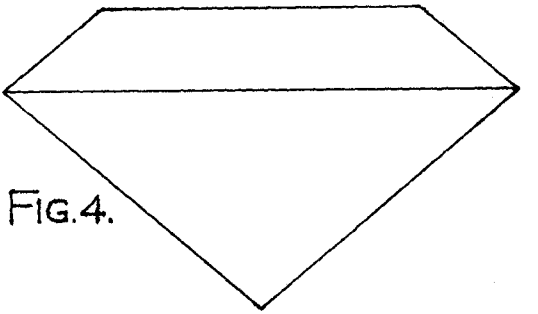


FIG. 4.

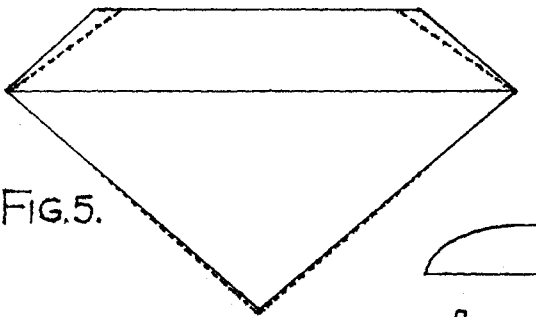


FIG. 5.

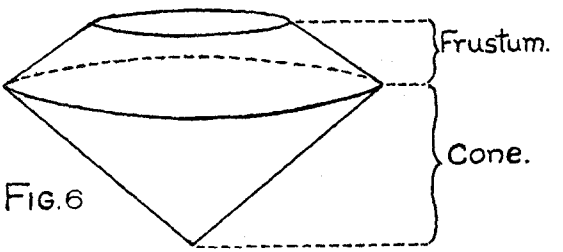


FIG. 6

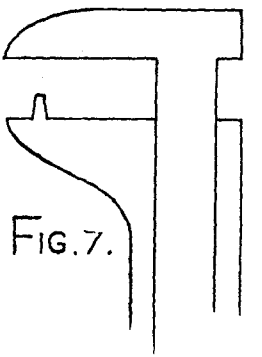


FIG. 7.

and the broken line indicating the ideal. The only major difference between the two sets of measurements is in the width of the respective tables, that of the experimental brilliant-cut being somewhat wider than that of the ideal, which accords with modern practice.

All who handle diamonds regularly will, of course, continue to assess the "make" of a stone by its general proportions, and overall effect of "fire" and brilliance, as apparent to the trained eye; and although the calculated "ideal" will certainly yield these optical effects in the highest degree, it is also true that some latitude is permissible without seriously detracting from them.

Nevertheless, it seems to the writer worthwhile, at such trifling cost and trouble, to have available a simple method of comparing the proportions of any diamond of sufficient size to warrant it with those of the ideal.

A slide rule will facilitate the conversion of actual measurements into percentages.

Finally, the writer's thanks are due to Mr. Clark for kindly providing a specimen diamond.

Calculating the Weight of a Diamond by Measurement

A consideration of the outward aspect of a modern brilliant-cut diamond suggests that it nearly approximates to a frustum (a truncated cone), and a cone, base to base (Fig. 6).

Elementary solid geometry teaches us that the volume, and therefore the weight of such a solid is proportional to the product of its thickness (t) and the square of its diameter (d):

i.e. Weight—ktd^2

where k is a constant to be determined.

In the case of diamond, the weight of which it is often necessary to ascertain when mounted (and therefore when scales are of no use), the writer, some years ago, calculated this constant as 6·37.

More explicity the weight of a normally proportioned brilliant cut diamond is given by the formula:

Weight (in carats)—$6{\cdot}37td^2$

where t is the thickness of the stone, measured from table to culet, and d is its diameter, measured across the girdle, the dimensions t and d being expressed in centimetres and decimal parts thereof.

A calculation such as the above, though amounting only to simple arithmetic, is made both rapid and easy by the use of a

slide rule; the only problem is to ascertain accurately the dimensions t and d.

To obtain these the writer has adapted a perfectly ordinary millimetre gauge as shown in Fig. 7. The lower jaw of the gauge was gapped with a small file and a square peg of brass soldered in. The brass peg was then carefully filed circular and slightly tapered until the top measured about 1·5 mm in diameter. The height of the peg above the level of the lower jaw of the gauge was left at exactly 3 mm.

The peg will fit neatly under the back rail of a diamond ring, and by closing the jaws of the gauge so that the top of the peg rests on the culet of the stone, and the upper jaw rests squarely on the table, a measurement of the thickness of the diamond may be made. It is, of course, necessary to subtract the height of the peg (in this case, 3 mm) from the measurement in order to get the thickness of the diamond itself. A high degree of accuracy (with care to $\pm$ ·05 mm) may be achieved if the gauge is furnished with a vernier.

The width of the stone is obtained simply by inserting the jaws of the gauge between the claws on opposite sides of the girdles. As the jaws on my particular gauge were on the thick side, I filed them down to a suitable width, and removed the file marks with a buff stick.

It is, of course, true that accurate gauges can be purchased which will do all and more than is claimed for the above simple device, but by the means described a considerable expense is avoided, and one has the satisfaction of producing at negligible cost a piece of apparatus which will perform the desired mensuration both satisfactorily and accurately.

CORUNDUM FROM MALAWI

By E. H. RUTLAND, Ph.D., F.G.A.

THE existence of gem quality corundum on Chimwadzulu Hill, Southern Malawi, was reported by Dr. K. Bloomfield in 1958(1). Subsequently a comprehensive study of a wider area was made by the Malawi Ministry of Natural Resources and this again comprised the corundum locality. The results were published by that Ministry in 1965(2). During 1965 a claim was pegged by Messrs. Gunson (Exports) Limited of Limbe, Malawi, to examine a wide terrain and to exploit the mineral occurrences in it, with special emphasis on the corundum. Following a market survey production of rough corundum commenced and a cutting shop was set up in Limbe in 1967/68 for processing the rough crystals into mountable gem stones. The corundum is now being produced and marketed by an associated company, Kirk Mining and Gem Export Company Ltd.

The ultrabasic body, Chimwadzulu Hill, altitude 5,200 ft.

The corundum occurs *in situ* in an epidotized amphibolite and in gravel on the summit plateau of Chimwadzulu Hill, some fifty miles south of Lake Nyasa, close to the frontier of Portuguese East Africa. Dr. Bloomfield has come to the conclusion that the amphibolite originated from a peridotite intruded into geosynclinal sediments. The corundum crystals are embedded in a coarse aggregate of rounded hornblende crystals up to 5×3 cm in size, enclosed in a fine-grained granular grey matrix of epidote and plagioclase. It appears that the south western sides of the hill have been enriched with corundum down to valley level by eluviation. Recovery is at present mainly from shallow pits and surface gravels near the top of the hill.

The rough material examined so far consisted of a parcel of mainly transparent crystals, yellow, green and blue in colour, of which many were parti-coloured. Most were from 5 to 30 mm in length but larger crystals have been submitted more recently and these are on exhibition at the Geological Museum, London, together with some cut stones. The larger rough stones comprise six crystals from 2 to 4 cm in diameter. The colours range from pink

White corundum crystal in gravel, Chimwadzulu Mine.

through yellow and pale green to a dark greyish green. All these crystals show well developed basal pinacoids and some have prominent triangular growth figures on these. Rhombohedral faces are less prominent. The prism faces are rough, the other faces smooth. The crystals are mostly squat to tabular, but one prism is elongated. All have a pronounced basal parting. The rhombohedral parting is rather less prominent. There is some iron staining along the parting planes.

Some cut stones of very attractive colour were examined with the following results:—

	Colour	*Cut*	*Weight in ct.*	$n\omega$	$n\varepsilon$
1.	blue	round, mixed	3·58	1·770	1·760
2.	blue	pendeloque	7·41	1·770	1·761
3.	blue	oval, mixed	6·47	1·770	1·760
4.	pale bluish green	emerald-cut	3·35	1·770	1·761
5.	red	step-cut	0·52	1·771	1·762
6.	red	step-cut	0·51	1·771	1·763
7.	red	pendeloque	2·59	1·772	1·763

The *refractive indices* were measured in sodium light on a Rayner refractometer and are estimated to be accurate to $\pm 0{\cdot}001$.

Dichroism was strong; it ranged from a pale yellowish green to a purplish blue for the blue stones. Even the pale stone No. 4 had quite appreciable dichroism. The red stones had a pale brownish-red ε ray and a deep magenta ω ray.

Inclusions: fine channels were found in all but two of the red stones, one of which had small black crystals and short rods, presumably of hornblende. Between crossed polars, stones No. 1, 3, 4, showed twinning planes, allied in stone 3 with colour-zoning. Stone 5 had a healed fissure containing both liquid and gas.

Spectrum: this was well developed and normal for the rubies. The sapphires showed the three iron lines prominently, the 4500 A line being very clear even in the pale stone No. 4.

X-ray fluorescence: fragments from a pink and a green stone were examined by X-ray fluorescence for elements of atomic number greater than 11 on a Hilger and Watts Fluovac at the Institute of Geological Sciences, London. Apart from major aluminium the pink stone contained minor iron and traces of chromium. These elements were also present in the green stone

but in this case the chromium was minimal and there was a somewhat larger trace of manganese.

Luminescence: the blue stones did not fluoresce under long wave ultra-violet light. The fluorescence of the red stones was weak, presumably in consequence of the iron content.

More recently some parcels comprising several hundred cut stones from the same locality were examined by Mr. E. A. Jobbins and myself at the Geological Museum. These stones had not yet been sorted and graded; they were of all sizes up to some 12 carats and varied widely in cut and shape. The colours of the sapphires ranged from yellow and pale blue and green, through greyish blues and greens to a very fine rich blue and a dark iron blue. The rubies were much smaller and most were pale but some had a very good colour, reminiscent of good Siam stones.

REFERENCES

(1) "The Chimwadzulu Hill Ultrabasic Body"—Transactions of the Geological Society of South Africa, Vol. LXI.
(2) *Bulletin No.* 17: "The Geology of the Kirk Range—Lisungwe Valley Area" by Dr. K. Bloomfield and Dr. M. S. Garson.

Gemmological Abstracts

BANK (H.). *Durchsichtiger grüner Aktinolith (Strahlstein) als neuer Edelstein.* Transparent green actinolith as new gem. Zeitschr.d.-deutsch. Gemmologischen Gesellschaft, 1969, 18, 1, pp. 1-5.

Actinolite is an iron-containing calcium-magnesium hydrosilicate, it is monoclinic and the names come from the Greek actis—ray and lithos—stone. It is pleochroic from light yellow to dark green. The particular stone which the author described was first thought to be a tourmaline, the density was found to be 3·05 and the R.I. 1·620-1·642, the birefringence being 0·022, but was then found to be monoclinic. It has a perfect cleavage. The author then examined about 80 specimens and the results are published in table and graph form. There is a bibliography of 13 items. As origin Africa is given, but no further details.

E.S.

PENSE (J). *Die Fission-track-Methode und ihre Bedeutung für die Edelsteinkunde.* The fission-track method and its importance to gemmology. Zeitschr.d.deutsch. Gemmologischen Gesellschaft, 1969, 18, 1, pp. 6-11.

The author discusses the importance of the fission-track method in the determination of gems, especially synthetic materials, illustrating his ideas with diagram, micro-photograph and two descriptive sketches of lattices. The method is built on disturbances of the crystal lattice. Bibliography.

E.S.

LENZEN (G.). *Farbgraduierung und UV-Fluoreszenz des Diamanten.* Colour gradation and UV fluorescence of diamonds. Zeitschr.d.deutsch. Gemmologischen Gesellschaft, 1969, 18, 1, pp. 12-14.

The article deals with the blue fluorescence of diamonds of the cape series and other off-colour stones. Because of this blue fluorescence some off-colour diamonds seem to be blue-white or over-blue when viewed in white light. The author submits that it is not sufficient to view the stone in daylight or under the

Koloriscope and Diamondlite, but that each stone should also be examined under a UV lamp. E.S.

BANK (H.). *Ueber die Lichtbrechungsindizes brasilianischer Smaragde.* Concerning the refractive indices of Brazilian emeralds. Zeitschr.d.deutsch.Gemmologischen Gesellschaft, 1969, 18, 1, pp. 15-19.

Although some mines in Brazil yield good quality emeralds, the term "Brazilian emeralds" is applied to those found near Bom Jesus dos Meiras (Brumado) in the southern part of Bahia. These are chrome-containing beryls of a pale green colour. It was found that these stones have a higher R.I. than generally presumed, and that other Brazilian emeralds have comparatively high values, such as those found in Carnaiba, near the Campo Formoso in Bahia, or in Salininha, also in Bahia. Tables of the results are given, together with bibliography of 15 items.

E.S.

DRAGSTED (O.). *Der "Sonnenstein" der Wikinger.* The "sun stone" of the Vikings. Zeitschr.d.deutsch. Gemmologischen Gesellschaft, 1969, 18, 1, pp. 20-21.

There is a legend that the Vikings could orientate themselves not only according to the sun and the stars, but in cloudy conditions used a "sun stone". Mr. Ramskou of the Mineralogical Institute was especially interested in this and thought it most likely that cordierite was the stone used as its dichroism can show a colour change from dark violet to nearly colourless and it is found as "pebble" in Norway. He flew to Greenland and it was seen that the cordierite varied only a few degrees from the sensitive sky compass of an aeroplane.

E.S.

HELFRICH-DÖRNER (A.). *Welcher Sinn verbirgt sich hinter den Namen der Edelstein ?* What is the meaning behind the names of the gems? Zeitschr.d.deutsch. Gemmologischen Gesellschaft, 1969, 18, 1, pp. 22-34.

The author gives the origin of the name for various gemstones and usually adds a note as to the usage, or qualities attributed to the stone, or a historical note or anecdote.

E.S

NASSAU (K.) and CROWNINGSHIELD (R.). *The Synthesis of Ruby.* Lapidary Journal, 1969, April, May, June and July.

A painstaking survey of the synthesis of ruby. The so-called "reconstructed" rubies, claimed to have been made from chips of natural ruby in the period 1885-1905, were re-examined by microscopic and x-ray fluorescent analysis. "Reconstruction" experiments involving the partial melting of natural rubies were also performed. It is concluded that the "reconstructed" rubies were manufactured by a pre-Verneuil form of the flame-fusion process using a complex three-step seeding and growth procedure, and using purified alumina and not natural ruby as the feed material. The term "reconstructed" should accordingly not be used for any form of usable gem ruby.

The authors have not been able to establish the originator of the technique that first produced "Geneva" synthetic rubies. The techniques of modern production including Czochralski, pulling the melt, flux growth, hydrothermal growth, and growth from a vapor phase, are described. The Verneuil technique is still used for over 99 per cent of the total production of synthetic ruby.

S.P.

MALLORY (L. D.). *Opal Mining in Western Mexico.* Lapidary Journal, 1969, 23, 3, and 4.

An account of the occurrence, mining and marketing of Mexican opal. The gem does not occur in well defined veins, but in areas of matrix which may not be contiguous. Production in Western Mexico has increased and marketing arrangements do not usually permit the acquisition of opals by the casual buyer. The price of opal is unlikely to decline.

S.P.

TRUEB (L. B.) and BUTTERMAN (W. C.). *Carbonado: a microstructural study.* Amer. Mineral, 1969, vol. 54, pp. 412-425.

Brazilian carbonados consist of mostly anhedral, randomly oriented diamond crystallites ranging in size from a fraction of a micron to over 20 μm. These crystallites are aggregated and interlocked into porous polycrystalline masses with a microstructure reminiscent of ceramics. Aluminium silicate inclusions occur.

R.A.H.

ASSOCIATION NOTICES

A PHYSICIST'S VIEW OF DIAMOND

DR. M. J. A. SMITH, of the School of Physics, University of Warwick, speaking to members of the Gemmological Association at Birmingham, on 16th April immediately following the 39th annual meeting, said:

"One thing which we all have in common is that we share a fascination for diamonds, although my interest is mainly in synthetic stones.

"Some of the most important technological innovations which have come to pass in recent years have been the result of various impurities added to normally pure materials.

"In the case of diamond, it is well known that if you take a blue stone it contains aluminium. The technique which I shall describe to you this evening and the one which we use at Warwick enables us to detect the aluminium and to determine exactly where it is situated in a particular diamond. This we can do without damaging the stone at all, and, moreover, we can see a remarkably small concentration of these impurities. I suppose we can see something like about one part in 100 million if necessary.

"When we come on to synthetic stones, I am sure you are aware that the the commercially available ones which you can obtain from the General Electric Company or De Beers are made by, as I call it, the heating and squeezing technique. You take some carbon, heat it to a high temperature and squeeze it at a high pressure. If you also add some nickel or iron or similar material to the mixture you will end with coloured synthetic diamond.

"Quite a lot of the work which we have done has been concerned with synthetic stones and exactly how nickel and iron goes into a diamond and also with the effect they have on the properties of diamond, in particular on the process of growth. If we could say, for example, that the nickel goes in in this way and in so doing it produces a diamond of given shape or size, I think we can all see this would be quite important to the diamond industry.

"The properties which interest a physicist as far as diamond is concerned, I suppose, range over all its known properties.

"First of all there is the hardness. This has been appreciated for many years and quite a lot of work is going on at the present time particularly at Cambridge on how the hardness varies with the particular direction in which you make the hardness test on a face of the diamond.

"A physicist would also be interested in the optical properties of diamond as it is used a lot in laboratories for high pressure windows. Of course we must know the optical properties of diamond because we might well be looking at the optical

properties of the material inside the high pressure apparatus so that if we did not know the optical properties of the diamond itself, then indeed we could not draw any conclusions about the material inside. Of course as you might imagine these optical measurements enable us in another way to have a look at some of the impurities in diamond.

"As far as the electrical properties of diamond are concerned, it is interesting to note that diamond is being used these days as a thermometer. If I can again refer back to the blue stones which contain aluminium, the interesting point about these, electrically, is that if you take an avometer and place it across the blue stone it should read quite low resistance. What is more this resistance will depend markedly on the temperature, so what we tend to do if we want to measure the temperature of a liquid around 1,000°C—where the diamond would just about be stable over a long period of time—we might take one of these blue diamonds, place an avometer across it, drop it into the liquid and just read the resistance which can then be related to the temperature.

"Another interesting property of diamond concerns its surface and I think this is where probably the physicist may well have a lot in common with those of you who are involved in making jewellery. If you want to make a ring, I am told that you squeeze claws around the diamond and keep your fingers crossed, although I do not suppose it is quite as simple as all that, surface adhesion is clearly important. Some of the work which we hope to do at Warwick in the very near future and which from our point of view has unfortunately been started in Germany recently, is to have a look at diamond which has been subjected to a chlorine atmosphere at very high temperature. The idea of this is to try and induce some sort of surface reactivity on the diamond and to see if we can bind the diamond to something like araldite. It seems to me that it would be of great technological importance if one could bind diamond chemically to another material. It would clearly be of great interest to those who use diamond. So this is a new field, which I think will be pursued over the coming years.

"Probably the final property of diamond in which the physicist might be interested is that of radiation damage. If you take a diamond and put it into a nuclear reactor and bombard it with some particle or other we might ask what happens to it? Now I think that this is of interest at the moment to the physicist because diamond being such an essentially simple material it is therefore very attractive to the theoretical physicist, and if you can irradiate it and distort the lattice in some way then it is interesting to know exactly how the lattice has been distorted and it is in some ways a model system for trying out the theories which you might have about radiation damage. However, I am sure this technique may well become important to people like yourselves because by irradiating diamonds you can change their colour. Sometimes this colour is permanent and sometimes it can be bleached by heating.

"The technique of electron spin resonance ESR, which we use at Warwick to study diamond, is a non-destructive way of looking at the impurity content. A pure diamond consists of carbon atoms, each of which is surrounded by four others, and each carbon atom has four electrons, which form bonds with the neighbouring atoms. In each one of these bonds there are two electrons, which spin in opposite directions. The electrons are, as we say, paired. If you take pure diamond and put it in the ESR machine you get nothing out of it at all.

However, if you take diamond which contains nitrogen, and some natural stones contain large amounts of nitrogen which were presumably introduced during the volcanic action when they were formed, the only difference from our point of view between nitrogen and carbon is that nitrogen has five electrons available for bonding instead of the four which carbon has. When we put nitrogen into diamond it goes in in place of the carbon, four electrons are used for producing paired bonds and there is one electron on its own. This unpaired electron spinning on its axis acts like a small bar magnet, so if I now place a diamond containing nitrogen into a large magnet then indeed this bar magnet will rotate or precess about the axis of the applied magnetic field. If the size of the magnetic field is increased it will precess even faster. It so happens, and this is the reason why this technique became available after the war, that in a magnetic field of a reasonable size which can be produced in a laboratory, electrons from the nitrogen will precess at a frequency of about 9,000 megacycles which is just the same frequency as that used during the war for radar and indeed which is still used for this purpose. If now you shine some of the high frequency radio waves onto this precessing electron so that their magnetic field is at right angles to the large steady field which you apply and if the magnitude of the large magnetic field is increased, when the precession frequency becomes equal to the frequency of the radio waves, the unpaired electron precesses violently and eventually points in the opposite direction. So if you take a diamond which contains many nitrogen atoms then all those which are pointing one way turn the other way and vice versa.

"The important point is this. To return to the case of the bar magnet. If you place a bar magnet into a magnetic field it is true that it can either point so you have NS NS or another stable position is NN SS, but one is slightly more stable than the other. Similarly, with these precessing electrons slightly more of them prefer to be in the lower energy direction (NS NS) than in the other direction. If we change their directions at the same rate then we need to put in a net amount of work because more are going one way than are going the other way. This means that if we measure the intensity of our radio waves then indeed we find that their level has dropped slightly when the resonance effect takes place in the diamond. This is electron spin resonance.

"What we usually do, therefore, is to increase the size of the large magnetic field and observe the drop in the level of radio frequency power which occurs if nitrogen is present. It so happens that in the case of nitrogen you do not just get one dip but rather three dips and there is no doubt that what is being observed is nitrogen, as no other likely impurity would produce this spectrum. This is how we show that there is nitrogen in diamond.

"This work was done in 1959 by another Smith, in America, on natural stones, a small percentage of which are what are called Type 1 diamonds, and contain a lot of nitrogen. We could go further and say that in the case of aluminium, we would again get a dip, but this would have a form characteristic of aluminium. If you were to have iron in the diamond you should again get a dip characteristic of iron, but to the best of my knowledge nobody has seen this yet in diamond. We have seen a resonance from nickel in synthetic stones and so have the people in South Africa. There are a lot of impurities which you can identify by this technique and all you have to do is to put the diamond into a magnetic field and to shine high frequency radio waves on to it.

"We decided we would have a look at synthetic stones and it is very interesting in that they are nearly all Type 1; they all have a lot of nitrogen in them. We thought we would like to see that synthetic diamonds in this respect were the same as natural diamonds so we took a synthetic stone, which as you know is very small, and managed to orientate it along its crystal axes. The ESR spectrum changes as you rotate it and in fact the changes which we observed were exactly the same as the changes which we would get for nitrogen in natural diamonds.

"You might say, 'well this work was being done in 1959 and we were producing synthetic diamonds about that time or shortly afterwards, why didn't somebody else do it before you?' The answer to this is very simple. If you take a synthetic diamond and put it into your ESR machine you find that you do not observe three lines, but only one. What is more it is broad because as I said to you before there are nickel and iron in diamond which are ferromagnetic. When you put synthetic diamond in the magnet the nickel and iron cause a distribution of the magnetic field around the nitrogen, so much so that it effectively obliterates the structure in the spectrum. So what we managed to do was to take these synthetic diamonds and to heat them up to about 1,500°C in a vacuum. This is just like squeezing an orange, the nickel and the iron melt and evaporate. What we did then was to waive a bar magnet over these heated stones and those which were not attracted to the bar magnet were those which had very little nickel and iron in them. We used those stones for our measurements, and sure enough the ESR lines had narrowed from something like 30 gauss down to about $\frac{1}{2}$ gauss and we were able to see all the detailed structure. We were also able to get some other resonances from the nickel and iron before we heated these stones whereas after we had heated them we obtained nothing at all. So I am trying to stress that this can be a very valuable technique for having a look at diamond.

"Something else which we did was to measure the way in which nitrogen actually goes into the synthetic diamond. Does it go in uniformly or does it go in in one bubble and then diffuse out? We managed to resolve this problem by recording the ESR spectra of stones of gradually increasing size. We showed that there was a greater concentration of nitrogen in the smaller stones. Thus it seems to us that within the synthetic diamond the concentration of nitrogen in the centre of the stone is large and it gradually gets less as you go towards the outside. It suggests that you have a bubble of nitrogen when you make these synthetic stones somewhere in your high pressure apparatus and as the stone grows out it tends to grow out from a nickel nitrogen complex in the centre and as it grows out the concentration of nitrogen goes down.

"One interesting thing we found after sorting through thousands of stones was that a few of the stones supplied by the General Electric Company were octahedral in shape rather than cubo-octahedral, which is their normal shape and we thought we would look at them. We put them in our ESR machine, expecting to get a nitrogen resonance because there is always nitrogen in synthetic diamond, but we could not observe one. We tried this experiment a number of times. We also checked the cubo-octahedral stones from the same batch and obtained a very good resonance from them. We then sent these stones to Professor Chasette in the Congo who had done quite a lot of optical absorption measurements on similar stones. He was able to look at the infra-red absorption of nitrogen in these very small synthetic stones and confirmed that he could

detect no nitrogen in the octahedral stones whereas he could in the cubo-octahedral ones. We would suggest, therefore, that nitrogen has a significant effect on the final shape of synthetic diamond.

"A lot of the very interesting work in the diamond field is probably going to come by the controlled addition of impurities into the material. I gather that it is now possible to make synthetic diamonds which you can see through and the size seems to be increasing all the time. You can make a lasar by adding cobalt, chromium or neodymium to glass. The chances are that when you get to this stage with diamond, the good mechanical and thermal properties of this material will be an important advantage. It is extremely exciting, and I think when the problem of adding a wide range of impurities to diamond has been solved, then the physicist will be very pleased."

GIFTS TO THE ASSOCIATION

The Association is indebted to Mr. John Fuhrbach, Texas, for some rhodolite garnet rough.

GEMMOLOGICAL TUITION

South American wishes to visit U.K. for two months to receive private practical tuition. Offers to Secretary of the Association.

MORLEY COLLEGE

Morley College, 61 Westminster Bridge Road, London, S.E.1, has arranged various lectures on the study of gemstones on Wednesdays, 6.30 to 8.30 p.m. Fees for a single course of 35 classes are 42s. 6d. a year plus 10s. 0d. College Registration fee which gives the use of the library, refectory and other facilities. Further courses after the initial one cost an extra 10s. 0d. per course. Terms next academic year are as follows: 5th January to 21st March and 6th April to 27th June. Enquiries should be made of the Principal of the College.

GEM BUSINESS

Gemmology student, 23 years, engaged in the gem and jewellery trade wishes to correspond with those interested in gemmology and gem business. Z. A. Saleh, 63 Britol Buildings, Colombo 1, Ceylon.

OBITUARY

In August Australia lost its most prominent figure in the world of gemmology when Arthur Wirth died after a long illness. He had an encyclopaedic knowledge to which he was continually adding by study and maintaining contacts overseas. Arthur Wirth was a pioneer gemmologist, always willing to assist those who sought his advice, and he will be sadly missed.

Col. Elbert M. Barron, Austin, Texas, U.S.A., 5th Jan, 1969. (Ordinary Member 1953).

Lee, Harold, of Wimbledon, London, S.W., 11th June, 1969. (Ordinary Member 1952).

COLOURED DIAMONDS—NATURAL OR ARTIFICIALLY TREATED?

In the article by Charles Schiffmann in Vol. 11 No. 7 on coloured diamonds, illustrations 6 and 7 were unfortunately transposed.

GEM DIAMOND EXAMINATION

There were 29 entries for the 1969 Gem Diamond Examination arranged by the Association. The following is a list of successful candidates arranged alphabetically:

Qualified with Distinction

Pitt, Robert William, Sutton Coldfield
Thompson, Michael William, London
Turner, George Maurice, Airdrie

Qualified

Alabaster, A. Paul, Birmingham
Allan, Wallace Stewart, Ayr
Barrenger, Jonathan, Weybridge
Bentley, Dennis Cyril, Epsom
Cooper, Sydney Bernard Nikon, London
Fieldhouse, John Ernest, Sutton Coldfield
Fuller, Robert Geroge, Chesham
Gibson, Paul Walter, London
Glen, Susan Elizabeth, Coventry
Goodson, David Lloyd, Wolverhampton
Grey-Harris, Stephen James, Bristol
Hill, Dennis Alan, Glasgow
McRae, Arthur John Hutchison, Glasgow
Menton, Joel, Edgware
Mitchell, Roger, London
Neil, Peter Black, Glasgow
Pardoe, Paul Roger, Worthing
Sadler, David Alex, Ayr
Scorer, Brian, St. Albans
Simmonds, Stephen Maurice John, Stanmore
Whelan, Kenneth James,
Whitehead, Henry John, Edinburgh
Williams, Christopher John, West Wickham

GEMMOLOGICAL ASSOCIATION OF SPAIN

The Gemmological Association of Spain (*Associacion Espanola de Gemologia*) has recently opened impressive headquarters in the centre of Barcelona. The new offices contain two laboratories, classroom and a lecture room in which over eighty people can be seated. This room is also used for films (it has a separate projection room) and receptions. The Spanish Association's headquarters owe much to the enthusiasm of Sr. Juan Domenech.

From small beginnings a few years ago when three gemmological enthusiasts decided to establish an organization the Spanish Association now has 350 members. Sr. Manuel Masso, of Barcelona, a pioneer of gemmology in Spain, is the first President. The Association collaborates with the Instituto Gemologico Espanol, in Madrid, and the G.A. of G.B. in the arrangement of examinations held at Barcelona University. There is also a gemmology group in Valencia. Students are prepared for the G.A. examinations, the Fellowship Diploma being highly regarded in Spain. The first quarterly Bulletin of the Association, *Gemologia*, was produced in March, 1969. Instruction arranged at the Association's premises and the classes and examinations in gemmology conducted at Barcelona University, are under the direction of Dr. M. Font-Altaba, Professor of Crystallography at the University, who is assisted by Dr. J. Bosch-Figueroa, Dr. Montoriol-Pous and others.

The Spanish Association is in the course of establishing a collection of gems, minerals and a library. The University and the Association have made rapid strides in promoting the study of gemmology in Spain.

GEMMOLOGICAL ASSOCIATION OF ALL JAPAN

In September the Association received a visit of twenty-eight members from the Gemmological Association of All Japan, including the Chairman Mr. Wadachi Yamada and the Executive Director, Mr. Akira Chikayama. The Japanese Association kindly presented the Association with a selection of gem materials occurring in Japan, together with a map of their location. Also presented was a Gem Light pen with stone holder attachment for the examination of mounted and unmounted gems.

COUNCIL MEETING

At a meeting of the Council of the Association held in London on 25th June, 1969, the following were elected to membership:

ORDINARY MEMBERSHIP

Ajmera, Prabhu Das,
Kowloon, Hong Kong
Allum, Peter Dennis,
Shaftesbury, Dorset
Arai, Morimitsu, Tokyo, Japan
Arimura, Kazu,
Kagoshima-Ken, Japan
Barlow, Allan Edward, Leicester
Bartlett, Kenneth Joseph,
Bicester, Oxon.
Bayne, Irwin, Toronto, Canada
Broomhall, Alan Richard,
West Bromwich, Staffs.
Challis, Peter James,
Liverpool, Lancs.
Cornwall, John H., North Creek,
New York, U.S.A.
Cross, Barry Ian, London, N.2
Curry, Harold L., Eugene,
Oregon, U.S.A.
De Bruin, Alphonsus Gerardus,
London, N.W.6
Deegan, Paul A.,
Palmerstown, Ireland
Dunn, Oliver Ralph, Preston, Lancs.
Emmanuel, Peter J., Croydon, Surrey
Farrelly, Ultan Alphonsus,
London, W.4
Farrington, Richard Raymond,
Toronto, Canada
Folch, Bru, Rosendo,
Barcelona, Spain
Fore, Larry Dean,
Honolulu, Hawaii
Fukagawa, Koji, Tokyo, Japan
Fukuchi, Katsuo, Tokyo, Japan
Haiduven, Richard G., Freeport,
Grand Bahama Island
Hawthorn, Graham,
Solihull, Warwicks.
Hemachandra, Amitha Buddhi
Wijesurendra, Colombo, Ceylon
Hemachandra, Ranjith Thissa,
London, S.W.19
Heyman, Adolf Pelrus Alexander,
London, W.12
Higasa, Mituteru, Tokyo, Japan
Hunt, Graham John,
Kidderminster, Worcs.
Hutley, Kenneth Michael,
Redcar, Teesside
Imai, Takayasu,
Nagano Prefecture, Japan
Ito, Yasuo, Aichi-ken, Japan
Jones, George Alfred, London, N.W.4
Kato, Hisaaki, Tokyo, Japan
Kielty, Nikolas, London, W.6
Kirekawa, Jun,
Kanagawa-Ken, Japan
Kokubo, Satoshi, Hyogo-Ken, Japan
Larrazolo, Ruth L.,
Fort Clayton, Canal Zone
Ledsham, David, London, N.W.5
Lithgow, Thomas,
East Kilbride, Lanarkshire

Maher, Francis N., Dublin, Ireland
Maiwurm, Frederick William, Newark, Delaware, U.S.A.
Mansuralli, Dhupalia Shamauddin, Paris, France
Mathis, Jr., Robert Chester, Tacoma, Washington, U.S.A.
Melvin, Ena Margaret, Newton Centre, Mass., U.S.A.
Miller, Stanford, Nashville, Tenn., U.S.A.
Nagasawa, Takeo, Hyogo-Ken, Japan
Nashimoto, Hiroshi, Tokyo, Japan
Newbold, Leslie John Claude, Tusmore, S. Australia
Ohmori, Mikio, Osaka-shi, Japan
Oshino, Ken, Tokyo, Japan
Palihena, Arthur Lionel, Talangama, Ceylon
Peeling, Alison Ruth, Hemel Hempstead, Herts.
Pickering, John Pearce PT. Noarlunya, S. Australia
Roberts, David Charles, London, W.2
Saeki, Kenji, Hiroshima-Chi, Japan
Samkay, Han, Malang, Djatim, Indonesia
Stewart, Joanne Lowe, Balboa Heights, Canal Zone
Taniguchi, Riyohei, Aichi-Ken, Japan
Voskamp, George, The Hague, Holland
Wharton, Stuart, St. Albans, Herts.
Wijeratne, Chandrakumara Kamalasri, London, S.W.5
Winstead, Frances F., Eugene, Oregon, U.S.A.
Yamamoto, Hirotake, Hyogo-Ken, Japan
Yamazaki, Shoichi, Tokyo, Japan

FELLOWSHIP

Butler, Barry, Sheffield, Yorks. D.1968
Holden, Terence, Bolton. D. 1968

The Council decided, for purely domestic reasons, to discontinue advertisements in the *Journal* (other than those connected with activities of the Association). Two assistant correspondence course instructors were appointed.

COUNCIL MEETING

At a meeting of the Council held on the 24th September, 1969, 8 Fellows and 118 Ordinary Members were elected, and there were 54 transfers from Ordinary Membership to Fellowship. A list will be published in the January 1970 issue of the Journal.

It was agreed that there would have to be future adjustment in the cost of correspondence course fees and Association membership to take into account increased costs of office occupancy, remuneration, publication printing and other charges. The Council agreed to the Secretary of the Association relinquishing the the title of Director of Examinations.

SYLLABUS OF EXAMINATIONS

Zoisite has been added to the diploma syllabus of examinations under section 4(a)(ii).

EXAMINATIONS IN GEMMOLOGY 1969

In the 1969 examinations in gemmology organized by the Gemmological Association of Great Britain 460 candidates sat for the preliminary examination and 307 for the diploma. Centres were again established in many parts of the world and the number of entries for both examinations was the highest in the history of the Association.

Upon the recommendation of the examiners, the Tully Memorial Medal and Rayner Prize have not been awarded.

The following is a list of successful candidates, arranged alphabetically:—

Diploma Examination

Qualified with Distinction

Bajo Ortiz de Apodaca, Julian F., Pamlona, Spain
Garre Alcaraz, Felipe, Seo De Urgel-Lerida, Spain
Hancock, Peter John, London
Hawthorn, Graham, Solihull
Hindle, David Ronald, Exeter
Jefferis, Marcia Nicoletta, Watford
Karolus, Martin, Mannheim, Germany
Kennedy, William, Baltimore, U.S.A.
Mosey, Irene, Lancaster
Osborne, David Leonard, Leigh-on-Sea
Pienaar, Herbert Svinde, Stellenbosch, S. Africa
Pitt, Nicholas Charles Hamilton, Stourport-on-Severn
Reilly, Hugh Joseph Andrew, Fife
Renton, Brent Sanderson, Preston
Russell, Lionel Harold, London
Sanchis Estrems, Jose, Valencia, Spain
Stewart, Reginald William, Bickley

Qualified

Ali, Nasim, Sutton
Allen, Rendall James, Darwen
Almenar Ibanez, Vicente, Valencia, Spain
Amigo Descarrega, Jose Ma, Barcelona, Spain
Andrade Malde, Julio, La Coruna, Spain
Andrews, Robert Eric, Cheadle Hulme
Arbunies Andreu, Manuel, Barcelona, Spain
Armengol Abril, Emilio, Barcelona, Spain
Baxter, James, Edinburgh
Beevor, Christopher Anthony, Pinner
Berger, Francis, Geneva, Switzerland
Bergmans, P., Rotterdam, Holland
Bloomberg, Maurice, Ilford
Bosch Senao, Pilar, Barcelona, Spain
Bradshaw, Stephen C., London
Brady, Deanna Mary, Pensby, (Cheshire)
Brennan, John Douglas, Birmingham
Brooking Grassy, Alberto, Madrid, Spain
Brown, Kenneth John, Gymea, Australia

Buyce, Milton Raymond, New York, U.S.A.
Carballal Cirici, Montserrat, Barcelona, Spain
Castro Ferrer, Jaime, Barcelona, Spain
Chang, Felix S.Y., Taipei, Republic of China
Christophersen, Elsa, Sandnes, Norway
Citoler, Ignacio Tormo, Gerona, Spain
Clarke, Doreen Patricia, Camberley
Collingridge, James William, Tonbridge
Cragg, George Edward, Leicester
Crawford, Brian Henry, Cape Town, S. Africa
Deeks, Noel William, Luton
Egea, Anthony, London
Estrada Mollet, Frederic I, Barcelona, Spain
Farras Sole, Jose, Barcelona, Spain
Farwell, Yvette, London
Fernandez Gil, Enrique, Valencia, Spain
Ferneyhough, Miles Howson, Henley-in-Arden
Fischer, Marianne Elsa, Stellenbosch, S. Africa
Fruhwald, George, Wiesbaden, W. Germany
Fry, Peter Maurice, Dover
Gartrell, Mark Paul, London
George, Antony Philip, Crawley
Gibbs, Keith Gerald, Sutton Coldfield
Glover, James J., Scarborough, Canada
Gonzalez-Requeral Valdes, Adriano, Gerona, Spain
Grey, Alan Peter, Weybridge
Gull, Peter, Walsall
Gunn, John Francis, Witham (Essex)
Hammersley, Gordon J., Michigan, U.S.A.
Harral, Benjamin David, Barnsley
Hayes, Bernard, Liverpool
Heyerdahl, Sten Scheen, Oslo, Norway
Hill, Josephine Ann, Sheffield
Hird, Frank, Sheffield
Hitchen, Melvin, Wakefield
Hlaing, Tin, Rangoon, Burma
Hkakyi, Rangoon, Burma
Hobbs, Robert George, London
Hoberg, Gunter, Idar-Oberstein, W. Germany
Hodgson, Jean Frances, London
Holm, Franz (Jorgen Flood), Bromma, Sweden
Holmes, Kenneth, London
Horsfall, Richard Thomas Lister, Halifax
Htwe, Win, Rangoon, Burma
Hundy, Christopher Leslie, Sutton Coldfield
Ingber, Ronald Max, London
Jackson, Della Ann, Prestbury, (Cheshire)
Jochems, Cornelie Madeleine, The Hague, Holland
Karlberg, Willy, Oslo, Norway
Kerfoot, Charles, Barnsley
Khaing, Myint, Rangoon, Burma
Kitson, Geoffrey Knowles, Sheffield
Ko, Min, Rangoon, Burma
Kutchinsky, Roger Nicholas, London
Lane, Stuart Howard, Bideford
Lang, Lorna Merle, Victoria, Australia
Lattimore, John Christopher, Harrow
Lay, Khin Maung, Rangoon, Burma
Lay, Mg, Rangoon, Burma
Llobet Ocariz, Antonio, Gerona, Spain
Lopez Soler, Angel, Barcelona, Spain
Luder, Johan Gerard, The Hague, Holland
Lwin, Tint, Rangoon, Burma
McCormick, Wendy Lynette, Victoria, Australia
McCorquodale, Iain Douglas, London

Marschner, Helga, Berlin, Germany
Marshall, Terence, Nottingham
Matsuzaki, Shigeru, Tokyo, Japan
Matthews, Sidney Allen, St. Helens
Milton, Mark Seymour, Liverpool
Mirwald, Gerhard Markus, Tokyo, Japan
Mitchell, Terence, Salisbury, Rhodesia
Morgan, Alfred Douglas, Birmingham
Myint, Than, Rangoon, Burma
Navarro Bort, Rodolfo, Valencia, Spain
Perera Bravo, Alberto, Madrid, Spain
Peris Bataller, Francisco, Valencia, Spain
Pfeiffer, William v., Victoria, Australia
Potts, Helen Lucy, London
Rae, Francis Carl, London
Richardson, George, Glasgow
Ripolles Ferrera, Jose, Valencia, Spain
Rosich Chova, Francisco, Valencia, Spain
Sanchis Estrems, Salvador, Valencia, Spain
Sancho Canto, Jaime, Barcelona, Spain
Sancho Canto, Ma Pilar. Barcelona, Spain
Schnetz, John V. P., Kriens, Switzerland
Silcock, James Barry, Southport
Statham, Patricia Margaret, London
Suter, Peter, Lucerne, Switzerland
Swe, Soe Nyunt, Rangoon, Burma
Swe, Tin Tin, Rangoon, Burma
Tamai, Shyojiro, Tokyo, Japan
Tenhagen, Joseph W., Miami, U.S.A.
Thompson, Ian Trevor, Ripon
Tjwan, Albert Tan Hien, Surabaja, Indonesia
Torres de Goytia, Rafael, Valencia, Spain
Turvey, Jane, Rye
Van Deijl, Wilhelm Jacobus Ernst, Parow, S. Africa
Vaughan, Alan John, Invercargill, New Zealand
Vaughan, Susan Josephine, London
Verges Tuset, Maria, Barcelona, Spain
Villegas Sanvicens, Cesar, Barcelona, Spain
Walker, Patricia Joan, London
Wallace, Lindsay James, Gainsborough
Wallace, Robert James, Fife
Wasilkowski, Wanda K., Miami, U.S.A.
Watson, Vivian Peter, Northwood Hills
Webster, John Henry, Leicester
Widdup, Kenneth N., Lancaster
Wilkes, Ronald, Blackpool
Williams, Alan, Liverpool
Winder Toole, Angela Bernice, Penzance
Wright, William Anthony, Potters Bar
Zelley, Howard Douglas, Norwich

Preliminary Examination
Qualified

Ahmad, Syed Vaqar, London
Alahendra, Anandapala, London
Alam, Mohamed Rasheed Shah Mohamed, Idar-Oberstein, W. Germany
Alforja Matoses, Enrique, Sueca, Spain
Allardyce, Anthony S., Maidenhead
Allen, William, Newcastle-upon-Tyne
Amor Fuentes, Antonio, La Coruna, Spain
Anderson, Leonard John, London

Andres Barbera, Manuel, Valencia, Spain
de Anitua y Lorente, Ezequiel, Vitoria, Spain
Appleyard, John Trevor, Wakefield
Arnoldi, Regine, Idar-Oberstein, W. Germany
Ashelford, Enid, Bathurst, Australia
Atkinson, Arthur, Sunderland
Azagra Aznar, Eduardo, Zarogoza, Spain
Bailey, Helen M., Cleveland, U.S.A.
Bajo Ortiz de Apodaca, Julian F., Pamplona, Spain
Baker, Kenneth Robert, Whitehaven
Baker, Thomas Alfred, London
Balasubramaniam, Muruguppillai, Colombo, Ceylon
Baldi, Annie Fraser, Salisbury, Rhodesia
Barba Albos, Antonio, Cornella de 11, Spain
Barnes, Peter Howard, Swanage
Baro Duran, Valentin, Barcelona, Spain
Barrett, Garry Sydney, Sittingbourne
Barry, Wendy Mary, Bradford
Bayne, Irwin, Toronto, Canada
Belenke, Burton, Miami, U.S.A.
Benson, Ian Thomas, Manchester
Berger, Francis, Geneva, Switzerland
Binns, David George, Hastings
Bjerkedal, Jon, Oslo, Norway
Bjerkek, Jens L., Oslo, Norway
Blunt, David Anthony, Warwick
Boorsma, A., Rotterdam, Holland
Bramwell, Peter, Durham City
Brand, Jonathan David, Pinelands, C.P. S. Africa
Brook, Doreen May, Liverpool
Brooking Grassy, Carlos, Madrid, Spain
Brown-Greaves, Rosemary Lavina, Horsham
Burrows, Patricia Anne, London
Buyce, Milton Raymond, New York, U.S.A.
Byard, Jack, Bradford
Call, Jerry Eugene, New York, U.S.A.
Caplin, Stanley Henry, Southport
Carter, Neil, Toronto, Canada
Carulla Fornaguera, Nuria, Barcelona, Spain
Cerro Elias, Roque Del, Zaragoza, Spain
Challis, Peter James, Liverpool
Chalmers, William Andrew, Manchester
Chard, Keith Scott, Bromley
Christoffersen, Haakon, Oslo, Norway
Clavaguera Duran, Ricardo, Barcelona, Spain
Clogger, Thomas John, Leigh-on-Sea
Cobden, Felix Sydney, London
Connard, Charles Roger, Southport
Cucurella Comellas, Ignacio, Barcelona, Spain
Dack, Gordon Robert, Rochester
de Meillon, Laura, Pietermaritzburg, S. Africa
de Vogel, Johanna Maria, Bergschenhoek (Z-H), Holland
Differenz, Gabriele Monika, Bad Homburg vdH, W. Germany
Donahue, Jack Northcutt, California, U.S.A.
Drake, John William, Coggeshall
Dunstone, Anthony, Fowey
Dyer, Wilbur E., Illinois, U.S.A.
Edwards, Janet Roberta, Bebington
Elfatatri, Abedd Ghani, Leiden, Holland
Emmanuel, Peter John, Addiscombe
Enkovaara, Kristi Maarit, Barcelona, Spain
Esteve Vila, Vicente, Mataro, Spain
Eyre, George, Buxton
Facchinelli, Carlo Alberto, Trento, Italy
Farber, Thomas, Zurich, Switzerland
Fazli, Mohamed Saleem Mohamed, Colombo, Ceylon

Fernando, Charles Rienzie, Nugegoda, Ceylon
Ferre Picas, Eugenia, Barcelona, Spain
Ferrer Olivan, Carlos, Huesca, Spain
Ferrer Tor, Ma Luisa, Barcelona, Spain
Fink, Stewart, Blackpool
Foster, Susan Ellwood, Toronto, Canada
French, Donald Peter, Colchester
Gallart Santamaria, Fernando, Valencia, Spain
Garcia Gimeno, Jose Luis, Zaragoza, Spain
Gargano, Frank, New York, U.S.A.
Gent, Michael Charles, Blackpool
Gold, Stewart, Fergus, Canada
Gould, Trevor Anthony, Natal, S. Africa
Gregory, Susan Margaret, Liverpool
Grieve, Patricia Jenny, Reigate
Griffiths, Peter Haydon, Stourbridge
Grist, Nigel, Sheffield
Guldahl, Jens Ivar, Oslo, Norway
Gunawardana, Panadura Lohakaruge Abhaya, Nugegoda, Ceylon
Haag, Susanne Renate, Kirschweiler, Germany
Haakonsen, Hans Olaf, Sandefjord, Norway
Harding, David, Plymouth
Harris, Harold Leslie, Oxford
Hawes, John, Wakefield
Hayburn, John, Romiley (Cheshire)
Haycraft, Philippa Anne, Haywards Heath
Hayes, John Ernest, Altrincham
Hayward, Richard Alan, Port Talbot
Hazelden, John Norman, Worthing
Heather, John Christopher, London
Heetman, J. A. M. Th., Rotterdam, Holland
Heijkoop, Nicolaas, Rotterdam, Holland
Heyerdahl, Sten Scheen, Oslo, Norway
Heyes, Alan John, Lancing (Sussex)
Hilal, Mohamed Abdulla Mohamed, Colombo, Ceylon
Hiley, Hazel, Shipley
Hill, Brian Douglas, Chatham
Hislop, Hugh Strathern, Johannesburg, S. Africa
Hlakyi, Rangoon, Burma
Hoberg, Gunter, Idar-Oberstein, W. Germany
Hocking, Mark, Truro
Hodgson, Trevor David, Leeds
Holm, Franz (Jorgen Flood), Bromma, Sweden
Holmes, Brian Michael, London
Hooper, Michael Charles, Birmingham
Hovers, T., Tilburg, Holland
Howell, Timothy Joseph, Cirencester
Htwe, Win, Rangoon, Burma
Irizar Terradas, Jorge, Barcelona, Spain
Jacobs, Julius, London
Jamieson, Vivienne, Prudhoe (Northumberland)
Jayawardena, Wadutantri Hubert De Silva, Colombo, Ceylon
Jayetileke, Rienzie Antony Srilal, Ratnapura, Ceylon
Jochems, Cornelie Madeleine, The Hague, Holland
Johnston, Iain Henry, Dumbarton
Johnston, Robert Bruce, Auckland, New Zealand
Jones, Claire Patricia, Redhill
Jones, George Harrison, Burnham
Jones, Kenneth Edmund, Nottingham
Jornet Vila, Enrique, Tarrasa, Spain
Just Chova, Jose Vicente, Valencia, Spain
Kaneko, Masao, Tokyo, Japan
Karolus, Martin, Mannheim, Germany
Keefe, John Anthony, Purley
Khaing, Myint, Rangoon, Burma
Kilpatrick, Constance, Aberdeen

Kirkpatrick, David John, Leamington Spa
Klocke, Christel Elvira, Rexdale, Canada
Ko, Min, Rangoon, Burma
Komlos, Maxine, London
Landau, Henry, London
Lang, Lorna Merle, Victoria, Australia
Lang, Richard, Dartford
Langarita Led, Angel Jose, Zaragoza, Spain
Laug, Monika, Idar-Oberstein, W. Germany
Lay, Khin Maung, Rangoon, Burma
Lay, Mg, Rangoon, Burma
Lewin, David Alexander, Loughton
Lewin, Persephone, Loughton
Lewis, Adolph Lee, La Mesa, U.S.A.
Lieben, Christl, Vienna, Austria
Linden, Howard Morris, Westcliff-on-Sea
Llopart Saura, Jorge, Barcelona, Spain
Lunn, Peter J., Belfast, N. Ireland
Lwin, Tint, Rangoon, Burma
Lyons, Raymond David, Croydon
McAvoy, T. W. G., Worcester
McCarthy, Dennis William, London
McCormick, Wendy Lynette, Victoria, Australia
MacDonald, Robert Charles, Hebden Bridge (Yorkshire)
MacFarlane, Alan Taylor, Glasgow
MacKenzie, David Ian Gruinard, London
McMurrie, Alfred George, Liverpool
Maik, Shwe, Rangoon, Burma
Malde Pardo de Andrade, Alfredo E., La Coruna, Spain
Manifold, Miranda, London
Mark, M. D., London
Marschner, Helga, Berlin, Germany
Marthinsen, Elise, Tonsberg, Norway
Marti Girona, Ma Montserrat, Barcelona, Spain
Martinez, Gonzalez del Campo, Francisco, Cordoba, Spain
Masip del Rio, Mari Carmen, Barcelona, Spain
de Masso, Rosa Maria P., Barcelona, Spain
Mawson, Alan, Crewe
Mensua Alonso, Vicente, Valencia, Spain
Mercade Galles, Jaime, Barcelona, Spain
Meredith, Jack, Stockport
Miller, Elva E., Tennessee, U.S.A.
Miller, Stanford, Tennessee, U.S.A.
Miro Bauza, Antonio, Manacor, Spain
Mirwald, Gerhard Markus, Tokyo, Japan
Monche Maristany, Andres, Las Palmas, Spain
Monereo Vilalta, Juan, Barcelona, Spain
Mones Mendoza, Luis, Barcelona, Spain
Monico Pifarre, Amalia, Lerida, Spain
Monte Domenech, Joaquin, Barcelona, Spain
Moore, Brian, Birmingham
Mori, Masatoshi, Tokyo, Japan
Murdock, Brian, Manchester
Myint, Than, Rangoon, Burma
Narayanamurthy, K., Bentong, Malaya
Nelson, John Joseph, Walsall
Nemoto, Ki, Ankara, Turkey
Newman, William Sowden, Bradford
Nicholson, Christopher, Chatham
Nicolau Marti, Margarita, Barcelona, Spain
Noakes, Norman De Berri, Auckland, New Zealand
O'Driscoll, Thomas Raymond, Sale
Ortiz Corripio, Jose, Madrid, Spain
Parsons, Richard Frank, Chorley Wood
Payan Catalan, Isabel, Madrid, Spain

Peacock, S. B., Coventry
Pearce, Joan Emery, Liverpool
Peris Bataller, Francisco, Valencia, Spain
Perry, Glyn, London
Pfeiffer, William v., Victoria, Australia
Phillips, Frank Xavier, Cooksville, Canada
Phillips, Joan Doris, Manchester
Piederiet, J. J. F. M., Breda, (N.BR), Holland
Pienaar, Herbert Svinde, Stellenbosch, S. Africa
Pilling, Peter Leslie, Salisbury, Rhodesia
Placer Portela, Jose Luis, Valencia, Spain
Platts, Jean Isabel, Sheffield
Pollak, Charles John, New York, U.S.A.
Poole, Susan Elizabeth, Penarth
Post, Pieter, Schoonhoven, Holland
Prats Ballester, Juana, Barcelona, Spain
Presser, Clement Alfred, Victoria, Australia
Priest, Richard, Hartlepool
Racs, Yuval, London
Ratnasekara, Wakkuburage Ariyawansa, Ratnapura, Ceylon
Reeks, Howard Frederick, Toronto, Canada
Ribes Cudinach, Emilio, Barcelona, Spain
Ricart Ribera, Arturo, Barcelona, Spain
Richardson, R. F., Rolleston-on-Dove (Staffs)
Ritchie, Douglas A., Toronto, Canada
Riuttala, Alexander Nikolai, Los Angeles, U.S.A.
Rose, David Michael, Welling
Rowe, Beryl Lorraine, Toronto, Canada
Rubira Pascual, Carmen, Barcelona, Spain
Ruiz Corcoy, Nuria, Barcelona, Spain
Ryan, David Christopher, London
Saadi, Talal Asad Kamal, Durham City
Sallan Lopez, Rafael, Zaragoza, Spain
Sanchis Estrems, Jose, Valencia, Spain
Sanchis, Estrems, Salvador, Valencia, Spain
Sanz Ribera, Jose, Valencia, Spain
Schofield, Neil Stephen, Manchester
Schonrock, Gisela Grete, Zeekoculis/Cape, S. Africa
Schullin, Hans, Graz, Austria
Scott-Taylor, Dorothy Thelma, Chester
Share, Andrew Thomas, London
Shatha, Mohamed Thaha Mohamed, Beruwala, Ceylon
Shepherd, Naomi, Reading
Simkiss, Edward David, Solihull
Simons, Paul Armand, Amsterdam, Holland
Simpson, David, Edinburgh
Smith, Alan Geoffrey, Scarborough
Snipper, Alison, London
Soler Serra, Jorge, Barcelona, Spain
Standard, Alan Kimball, Hawkinsville, U.S.A.
Stephen, Robert Clark, London
Stevens, Ronald Claude, Auckland, New Zealand
Stitt, Hamilton William, Montreal, Canada
Stocks, Malcolm Herbert, Halifax
Stokoe, Colin Edmund, Wallsend
Straftis, C. M., Athens, Greece
Stromsvik, Arne, Oslo, Norway
Swe, Soe Nyunt, Rangoon, Burma
Swe, Tin Tin, Rangoon, Burma
Szungyi, John Peter, Kentucky, U.S.A.
Tann, Jennie, Rhondda
Tasis de Moya, Ma Terese, Madrid, Spain
Templeton, Paul Thomas, Oxford

Thornton, Timothy Mundell, Stocksfield (Northumberland)
Thurgar, Stanley Hughes, Burlington, Canada
Thurm, Rudolf Edmund, Ludenscheid, W. Germany
Tomas Castelltort, Armando, Barcelona, Spain
Tootill, Jack Edward, Toronto, Canada
Upchurch, David Ward, Colchester
Valentine, Max, Bristol
Vila Demestre, Anna, Barcelona, Spain
Wafer, Barbara, London
Walker, Thomas, Sunderland
Walkley, Albert James, Ellesmere Port (Cheshire)
Warrington, Harold G., Toronto, Canada
Warrington, Mairin T., Toronto, Canada
Watts, Terrence Joseph, Whitehaven
Webb, Michael William, Newcastle-under-Lyme
Weerasinghe, Gamani Bandula, Ratnapura, Ceylon
Weerenbeck, S. M. H., Wassenaar, Holland
Wharton, Stuart, St. Albans
Whatton, Edwin Albert, Sutton Coldfield
Whitehead, Buckley, Manchester
Wijeratne, Ckandrakumara K., London
Wild, William, Stourbridge
Williams, Patrick, Sileby
Wilson, Anthony Arthur, London
Wilson, Robert Henry, Chaldon
Wise, John, Leeds
Wolfson, Ivan, Randfontein, S. Africa
Wolstenholme, Lawrence Edward, Sheffield
Wood, Robert Matthew, Peterborough
Woolgar, Michael, Durban, S. Africa
Worthington, Legh, Nantwich (Cheshire)
Yoshimoto, Aiko, Hyogo Pref., Japan
Yruretagoyena Durant, Maria France, San Sebastian, Spain
Zarobabely, Aron, Tehran, Iran
Zivar, Mohamed Mohamed, Mount Lavinia, Ceylon
Zuker, Bernard, Toronto, Canada

JOURNAL OF GEMMOLOGY VOLUME 11

Nos. 1 - 8

1968 - 1969

Names of authors are printed in small capitals, abstract references are in italics.

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Garnet	**Fatsuta Mine**	**Fukuoka Pref.**
Spessartine Garnet	**Wada Pass**	**Nagano Pref.**
Almadine Garnet	**Yamanoo**	**I Baragi Pref.**
Uvarovite Garnet	**Wagyudani**	**Oita Pref.**
Grossular Garnet	**Kiuragi**	**Saga Pref.**
Andradite Garnet	**Nakatsugawa**	**Saitama Pref.**
Uvarovite Garnet	**Neoi**	**Gaihama Pref.**
Apatite	**Ashio Mine**	**Tochigi Pref.**
Epidote	**Nakatsugawa**	**Fukushima Pref.**
Datolite with Axinite	**Yamaura**	**Miyazaki Pref.**
Rhodochrosite with Pyrite	**Oppu Mine**	**Aomori Pref.**
Hastingsite	**Sampo**	**Okayama Pref.**
Silver Argentite	**Seikoshi Mine**	**Shizuoka Pref.**
Hornblende	**Shikashima**	**Fukuoka Pref.**
Olivenite Conichalcite	**Kitabira Mine**	**Yamaguchi Pref.**
Chalcedony	**Tamagawa**	**Yamagata Pref.**
Parasymplesite	**Kiura Mine**	**Oita Pref.**
Ikunolite	**Akenobe Mine**	**Hyogo Pref.**
Fergusonite	**Suisho Yama**	**Fukushima Pref.**
Ishikawaite	**Ishikawa**	**Fukushima Pref.**
Fukuchilite	**Hanawa Mine**	**Akita Pref.**
Haradite	**Yamato Mine**	**Kagoshima Pref.**
Rhodochrosite	**Oppu Mine**	**Aomori Pref.**
Cordierite	**Hokizawa**	**Kanagawa Pref.**
Stibnite	**Ichinokawa**	
Danburite	**Toroku Mine**	**Miyazaki Pref.**
Sulphur	**Shirane Mts.**	**Gunma Pref.**
Veszelyite	**Arakawa Mine**	**Akita Pref.**
Molypdite	**Otome**	**Yamanashi Pref.**
Apatite	**Kurokura**	**Kanagawa Pref.**
Arsenic	**Akatani Mine**	**Fukui Pref.**
Molybdenite	**Hirase Mine**	**Gifu Pref.**
Teineite	**Teine Mine**	**Hokkaido Pref.**
Arorthite	**Miyake Island**	
Manganknebelite	**Kurazawa Mine**	**Kanitsuga-Gun**
Pyrosmalite	**Kurazawa Mine**	**Kanitsuga-Gun**
Axinite	**Obira Mine**	**Oita Pref.**
Native Gold	**Nakase Mine**	**Hyogo Pref.**

RAYNER POLARISCOPE

The Rayner Polariscope allows not only uncut stones and rough specimens to be examined but stones in pieces of jewellery, rings, etc., can just as easily be tested to see whether they are doubly refractive.

An aperture at the front has been so placed that it can be used as an ordinary light source for the refractometer.

The instrument incorporates a rotating stone table. Upon rotation a doubly refractive stone will allow light to pass through it in one position and when rotated again will appear dark. If the specimen is singly refractive the amount of light passing through will normally be constant in whatever position it may be viewed. It is essential to view the specimen at a number of angles. Best results are usually obtained with the table of the stone facing downwards.

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