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and

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ASSOCIATION
OF GREAT BRITAIN

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GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

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THE PLEASURES OF DISCOVERY

By B. W. ANDERSON, B.Sc., F.G.A.

(being the substance of a talk given to the Gemmological Association of Great Britain at Goldsmiths' Hall on 29th October, 1973).

IN the talk I gave in January* I described our early struggles in the Precious Stone Laboratory from 1925 onwards, first in learning our main job of pearl testing and later in improving and extending the techniques for testing gemstones of all kinds. To-night, in continuing the inside story of the Laboratory I am proposing to stick pretty closely to one main theme rather than risk getting lost in recalling a host of little incidents: the theme being the story of discoveries of new gem varieties and new gem minerals in which we were lucky enough to be involved to a major or minor extent.

At the present time there are some 2500 separate mineral species known to science. Each year a number of new names are added, but most of them are not only very rare but quite insignificant in form. One sometimes feels rather sorry for some worthy scientist whose name is given by its discoverer as a compliment to some very indifferent mineral! The small importance of most of these is indicated by the fact that in a standard text-book such as the

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* *J. Gemm.*, 1973, XIII (7), 249-262.—Ed.

1971 edition of Dana's Manual of Mineralogy only some 200 species were considered worthy of description.

But the discovery of a new gem mineral is a rare event, for it implies that the specimens found are at least large enough to be cut as stones suitable for jewellery, and usually that they are transparent and pleasingly coloured. From the trade point of view the recovery of new varieties of an already known mineral may be much more important. One has only to think of demantoid (1878), kunzite (1902), and tanzanite (1967) as instances of this.

Gahnospinel

Our first investigation into stones which had not previously been described concerned certain blue spinels from Ceylon which had a normal appearance but which were found to have a refractive index, and particularly a density, which was far higher than any quoted in the literature. C. J. Payne and I had already noted several such anomalous stones, but the real challenge came in 1935 when T. W. Oliver, who was then a gemmology student at Chelsea Polytechnic, showed me a blue spinel which puzzled him in having a refractive index of over 1·74 instead of the customary 1·715 or 1·72 of a spinel with so pale a lavender blue. In the Laboratory we found the actual figures to be 1·7432 for the refractive index (using the minimum deviation method), and the density to be 3·947, which was even more startling.

The hunt was now on: we set to work in earnest to search for comparable stones, working through parcels of Ceylon stones borrowed from the rich stock of E. Hahn & Sons, who were in those happy days established in 26, Hatton Garden. We also segregated by means of Clerici solution high-density blue spinels from samples of the Ceylon gem gravels. The rarity of these "anomalous" stones is indicated by the fact that of over 300 spinels examined, only four had densities above 3·85.

Eventually we had in our hands a graduated range of blue spinels ranging from our No. 1 specimen, which was a pebble polished as a prism by Mathews Lapidaries, which gave us the measured figures of 1·7469 for refractive index and 3·981 for density, down to No. 22, which had the normal values of 1·7153 and 3·584 respectively.

We realized that the replacing element causing these enhanced figures had to be one known to form a "spinel" on its own and one which would have no influence on the colour. Our guess that this element was zinc soon proved to be correct. We prepared a graph on which we plotted the density and refractive index of pure magnesium spinel and the corresponding figures (4·625 and 1·805) for a man-made zinc spinel, known in nature as the mineral gahnite. The zinc-rich spinels of our newly discovered series were found to fit satisfactorily along the line between the two points and were well away from the line leading from the plot for magnesium spinel to that for the iron spinel, hercynite. Our "gahnospinels", as we christened them, varied in colour from pale to dark blue, according to their content of ferrous iron, but this had very little influence on their properties. Any considerable influx of iron causes spinel to become black and opaque and fit only for mourning jewellery. Ceylonite and pleonaste are variety names which have been used for such stones, typical values for which are 3·8 for density and 1·78 for refractive index.

We also used a small grating spectrograph made for us by Bellingham and Stanley to record the emission spectrum of small samples of stones selected from our series, fusing them in a purified carbon arc for the purpose. The spectra not only showed the expected increase in the strength of the zinc emission lines in the higher density samples, but also revealed the unexpected fact that *all* blue spinels from Ceylon contain at least a trace of zinc.

Dr Max Hey, the highly skilled analyst in the Mineral Department of the Natural History Museum, kindly carried out a quantitative analysis of one of our "top" stones and found it to contain 18·21% zinc oxide, 16·78% magnesium oxide, and 1·93% ferrous oxide—to which last the colour and absorption spectrum were due. We then had enough data to justify a paper on these stones, which was published in the *Mineralogical Magazine*(1)—this being the Journal of the Mineralogical Society, which is the accepted vehicle for contributions to mineralogy in this country.

This whole investigation was ideal for our first serious incursion into mineralogy. In those far-off days specimens for our purpose were readily and cheaply obtainable (Ceylon, it may be remembered, was still under British rule); we had recently acquired a Beck table-spectrometer, which enabled us, with suitably cut stones, to measure refractive indices and dispersions to four decimal places, and we were able to make accurate density determinations even on small specimens by suspension in Clerici solution followed by measurement of the R.I. of the solution to four places of decimals in a hollow prism and working from a graph we had prepared showing the connexion of the density and R.I. of this solution. It also gave us practice in an essential part of all research work—the art of "consulting the literature" to ensure that our findings had not been already written up by other workers.

A brief word on this last process may be of help to beginners in this fascinating business called research. Looking round the shelves laden with scientific journals in a big science library, such as the one in Southampton Buildings off Chancery Lane, which was formerly the Patent Office Library and is now the Science Library of the British Museum (proximity to which was not the least of our blessings), one might despair of making a thorough search. But it is not so difficult as it seems. For the past few decades at least, Mineral Abstracts have existed and a rapid search through the indexes of their more recent volumes under "spinel", say, will lead you to papers on the subject that interests you. Consulting the latest of these will provide you with all the necessary references up to that time: the author will have done that work for you. A knowledge of German may be helpful, but copying facilities are provided by the library, and in ten minutes you can be provided with a photocopy which you can brood over at your leisure.

Before leaving the subject of gahnospinel I might mention that the highest figures yet encountered were in a blue spinel sent for a routine test in 1964. This had density 4·06 and refractive index 1·7542. It is hardly likely that even so extreme a case might be confused with sapphire, but it is not uncommon for stones containing only a small proportion of zinc to have refractive indices around the 1·728 mark—a value associated in the mind with *synthetic* blue spinel.

Kornerupine

One thing leads to another. During our search for blue spinels of high refractive index in parcels of mixed Ceylon stones, we had come across a few specimens which we couldn't identify. These were brownish-green in colour, had a density nearly matching that of methylene iodide (3·33) and refractive indices 1·670—1·683. They were strongly pleochroic from pale brown to dark green and had vague absorption bands in the blue and violet. We put them on one side in a packet, labelled "Y", as we could find nothing in the tables of mineral properties to tally with these constants.

At that time I was very interested in the absorption spectrum of enstatite, since we had found that the attractive green pebbles from Kimberley showed a beautifully clear-cut line at 5060 Å and I wanted to know whether specimens from other localities showed the same. The Natural History Museum had in their collection a cut stone weighing 9·18 carats, which had been rescued from an "idocrase" box by Dr Herbert Smith on the basis of a refractometer test, and more plausibly labelled "enstatite". I asked permission from the then Keeper of Minerals, Dr L. J. Spencer, to examine the stone, and we found that it was not an enstatite, but did tally closely in properties with our unknown "Y" specimens. Naturally the Museum people were now interested, and Dr Claringbull by x-ray analysis was able to identify our unknowns as *kornerupines* of a hitherto unrecorded type. Previously the only gem quality kornerupines known were pale aquamarine-coloured stones from Madagascar, containing less iron and with rather lower constants.

By one of those lucky and highly improbable chances with which we have been favoured from time to time in our work, a mounted kornerupine of "our" kind was sent to us for testing by a York jeweller. I was able to purchase the stone (which weighed 6·74 carats) for a reasonable price: the jeweller was very happy to replace it by a tourmaline rather than to try and sell a stone which had a name quite unknown to the public. A slice was removed from this for analysis, the recut stone weighing 3·50 carats.

Kornerupine is a complex borosilicate of aluminium, magnesium and iron, and the chemical analysis, undertaken by Dr Max Hey, was unusually difficult on a micro-scale, owing to the presence of boron, which several previous analysts had missed. For Dr Hey, this developed into a major piece of chemical research into the best methods for analysis of this difficult subject and a re-assessment of all previous analyses.

Meanwhile our main concern was to prove that these "new-style" kornerupines did in fact come from Ceylon, which we strongly suspected from the company they kept, by the style of cutting, and some of the inclusions. Through the kindness of Mr Hans Van Starrex we were sent two generous consignments of the gem gravel from Matale, and from the first of these, after about an hour's search, we were delighted to find the first recorded kornerupine from the illam of Ceylon. Twenty minutes later another turned up—but in the second parcel there were none. My method was to segregate the pebbles of likely colour, then quickly run through them with the spectroscope, eliminating all the zircons, which formed the bulk of the parcel. Any stones which seemed possibly to be kornerupine were passed to Mr Payne who examined them with a dichroscope and checked their density in methylene iodide, in which kornerupine remained virtually suspended.

The long chemical investigation naturally involved delay, and it was not until more than two years after the war had started that the full details were published.(2) After the war, Mr Kenneth Parkinson, on one of his several successful visits to Ceylon in search of rare gemstones, returned with a cut kornerupine weighing 9·89 carats and a large piece of rough weighing 24·12 carats. This was unusual in showing traces of prism faces and is now in the collection of the Natural History Museum. And at about this time Dr E. H. Rutland sorted through some 15 lb. of illam provided by Mr. Reggie Mathews, and was able to recover 8 kornerupines, which yielded cut stones ranging in size from 0·30 to 1·15 carats. These were mostly the usual brownish-green, but some were distinctly green and one was yellow.

Before leaving kornerupine, let me say just a word about another "new" occurrence of the mineral which we were the first to establish.

About 1937 we had acquired a small but very pretty green stone weighing 0·22 carat, which had refractive indices and density near those of the Ceylon kornerupines discussed above. After these had been identified by the Museum we realized that this stone, too, must be a kornerupine, but from some other source. Not until August 1952 did we know that this source must be the Mogok stone tract in Burma, for it was then that A. C. D. Pain submitted for test a collection of interesting stones, all from Burma, amongst which was a bright green specimen with only the table facet polished, which we identified as kornerupine. The colour, the inclusions and the properties were close enough to ours to make us sure that the origin was the same. It is curious how the jingle "anything you can do, I can do better" seems to be appropriate when it comes to Burma versus the Ceylon gem-fields.

The War

When Munich made it clear that war must inevitably come, Payne joined the Territorial Army and was trained as a gunner, whilst I enrolled with the Auxiliary Fire Service in London. When war was declared Payne was called up at once and spent the next few years fighting with the Eighth Army, rejoining the Laboratory in September, 1945, just in time to prevent my being totally submerged in a sea of pearl testing. I was able to carry on with such testing work as there was with the aid of Sgt Stelling, a stalwart commissionaire, who had been taken on for the holiday period but who stayed for the "duration". Actually, after the initial shock of war and the London "blitz", the amount of testing work became quite heavy for one person. The number of tests undertaken dropped from the 1938 figure of 776 to 531 in 1939 and 323 in 1940, but had risen to 782 in 1944 and to 1062 in 1945. It was in 1946 that the really great expansion began and we enlisted the help of Robert Webster and Alec Farn, which completed the "Phalanx of Four" which coped with the strenuous testing work of the next 25 years.

I mustn't dwell on those war years, as I want to carry on with the story of discovery of new gem minerals, but a few points perhaps may be worth recalling.

As a safety precaution, our Committee had moved our valuable x-ray equipment to a basement belonging to Johnson, Matthey & Co. in Poland Street. This made the testing of undrilled and part-drilled pearls a very time-consuming business, as I had to go down to Poland Street to take the photographs, and then post back to the Laboratory to develop them.

The Laboratory had several "near misses" with bombs and fire, with minor damage. On the worst occasion I was luckily fighting a fire nearby and obtained permission to see how things were in the Lab. A large cupboard full of chemicals had fallen on its face, making a truly unwholesome mess on the floor. All I could do at the time was to pick up the small bottle containing the spontaneously inflammable yellow phosphorus, which I could see glowing in the dark, and put it into a bucket of water to wait for the morrow. I also had to comfort as best I could our diminutive housekeeper and his tearful wife, who had been sleeping each under one of our endoscopes when the bomb fell, and awoke to find that the apparatus had fallen on and around their legs. It required a good deal of cannibalization from other endoscopes to get ours into working order again.

During this war period I was able to do some useful work on the classification of diamond absorption and fluorescence, the distinction between pyrope and red spinel, etc. I also became aware for the first time of the advantages of the Beck 2458 prism spectroscope for spotting purposes, and with its aid discovered the "difficult" absorption spectrum of turquoise, which has since proved extremely useful. But now I must resume my main narrative.

Taaffeite

The discovery of the new gem mineral Taaffeite reads like a gemmological fairy-tale. Count Taaffe, only son of the 12th Viscount Taaffe of Corran, Baron of Ballymote in County Sligo, Ireland, was born in Bohemia in 1898, and died in Dublin in 1967. He was the first of his family to be allowed to return to Ireland after its long exile in Bohemia and Austria. Taaffe was a keen amateur both of gemmology and astronomy, and found it both profitable and

Count Taaffe

interesting to peddle in gemstones. Amongst his sources for inexpensive stones were the boxes of oddments which many jewellers keep behind their counters, finding them useful for jobbing purposes. In October 1945 he spent some days looking through the boxes belonging to a friendly jeweller, Mr Robert Dobbie, and paid him £14 for the stones which interested him, which were mostly broken out of jewellery: badly rubbed or chipped in many cases.

Taaffe worked with meagre equipment, but made very effective use of what he did possess. He had no refractometer and no accurate balance. His chief instrument was a Bausch and Lomb binocular microscope without a stage, giving a magnification of 21 diameters.

His first steps, to which he attached great importance, in tackling a mixed batch of stones such as the lot from Mr Dobbie, was to clean the stones very thoroughly and then divide them by eye into batches according to colour. He then examined each stone very carefully, holding it in tongs and scrutinizing it from all angles over a sheet of white paper. The illumination was a flexible desk lamp with a 100 watt bulb.

The stone which, incredibly, was later found to belong to a new mineral species was amongst a group of violet, mauve, and lilac coloured stones. These were mostly spinels, but the stone in question showed in certain directions distinct signs of double refraction. In his own words "every speck of dust on the back and every scratch appeared double, like on a badly wobbled snapshot". Since, as we now know, the stone had a D.R. of only 0·005 and weighed only 1·42 carats, this was a remarkably acute piece of observation. He confirmed that the stone was birefringent by a test between crossed nicols, took a remarkably good density measurement (the average of ten attempts, using a hand-held balance) and finally on November 1st he posted the stone to me at the Laboratory with a covering letter: "This time a new riddle: what is this mauve stone? It seems to me to answer all the characteristics of spinel, yet it shows double refraction: doubling of facets visible under the Greenough, extinction when polarized, though with queer colour effects. Could anomalous double refraction be so strong? R.I. too high for topaz, too low for corundum. What is it?"

The stone as received weighed 1·419 carats. Its shape suggested that it had been cut in Ceylon. The refractive indices were 1·718 for the extraordinary ray and 1·723 for the ordinary ray—

thus the stone was uniaxial negative. It gave a clear uniaxial interference figure through the table facet. The density as then determined by hydrostatic weighing in ethylene dibromide was 3·621—later corrected to 3·613 by our Clerici solution flotation method, using blue spinels as indicators, one slightly denser and the other a little less dense than the taaffeite. The absorption spectrum was weak, but resembled that of blue spinel very closely.

I replied to Count Taaffe on November 5th, stating our findings and asking permission to have an x-ray analysis made if possible without harming the stone.

Preliminary x-ray tests carried out by Dr Claringbull confirmed the optical indications that the stone could not be spinel. To enable more x-ray and chemical work to be carried out Count Taaffe courageously agreed to having first one slice and then another removed from the culet region, stipulating only that the remains of his historic little stone be returned to him as a faceted gem. This work was most skilfully carried out by Charles Mathews Lapidaries Ltd, the stone being reduced first to 0·95 and then to 0·56 carat. With a little imagination one can appreciate Taaffe's feelings, knowing that he had discovered something quite new to science, but with only one small specimen as the representative of the new species.

On small crushed fragments from the stone x-ray powder, rotation and oriented Laue photographs were taken, showing the mineral to be hexagonal and to belong to the hexagonal trapezohedral class of symmetry—a class to which only "high" quartz (formed above 573°C) is known to belong. Preliminary analysis showed the presence of magnesium, aluminium and beryllium, and the final analysis, which was not completed until 1951, and was carried out by Dr Hey on only 6·16 milligrams of material, gave the essential formula as $MgO.BeO.\ 2Al_2O_3$—that is, intermediate in composition between spinel and chrysoberyl. The "Oscars" were mounting up for taaffeite: it was the first mineral to be first encountered as a cut gemstone; it belonged to a very rare class of crystal symmetry; and it was the only mineral known to contain both beryllium and magnesium as essential constituents. Data for an artificial compound of similar composition which were published in 1946 showed only a rough resemblance to those for taaffeite.

Naturally we kept a sharp look-out for further specimens, and examined every pale mauve spinel we could lay our hands on with extreme care, but it was not until October 1949 that the second taaffeite came to light, the honour and credit falling to C. J. Payne. He was working rather late in the Laboratory on an interesting collection of 104 stones (mostly from Ceylon) sent in by a dealer for a routine test. There were a number of green sapphires and pale blue spinels and one kornerupine, which served as a curtain-raiser for a pale mauve stone weighing 0·86 carat which gave what appeared to be a taaffeite reading on the refractometer. This was confirmed by the observation of a uniaxial interference figure. Payne was naturally enormously excited by his discovery after four years of searching, and rang me up at Goldsmiths' Hall where Webster and I were attending at a Gemmological Exhibition being held there. Next day I was on holiday in Devon and had to carry on some cautious haggling by telephone with Payne as intermediary. At any cost, we *had* to have that stone. By using the kornerupine as a stalking horse we were able to obtain the two stones for £20.

After publication of the taaffeite story in *Nature*, the gemmological journals, and *Mineralogical Magazine* in 1951,(3) keen gemmologists the world over were on the look-out for further specimens, but taaffeite number three did not appear until Christmas Eve, 1957, when it was spotted in the New York Gem Laboratory by our friend Robert Crowningshield. A further ten years were to elapse before a fourth specimen was indentified in America following an article on the subject by George Bruce in the *Modern Jeweler*. This was a "giant" of 5·34 carats, and, surprisingly, dark brownish-purple in colour.

In 1963 came a report that crystals of the mineral up to 1 cm in length had been found in the Hunnan Province of China, though not of gem quality, and specimens are to be seen in the Mineralogical Museum of the Academy of Sciences in Moscow. Since then, tiny green crystals found in the Musgrave Ranges of Central Australia were found to be a "polytype" of taaffeite in which nine subcells instead of four make up the unit cell, giving threefold in place of sixfold symmetry to x-ray patterns. One day, I am sure, a pebble of taaffeite will be found in the Ceylon gem gravels.

Of the four cut taaffeites mentioned, the original specimen was purchased by Mr R. K. Mitchell after Taaffe's death, together with other stones from his small collection; the stone discovered by Payne is where it should be—in the Natural History Museum in South Kensington—while the American stones are apparently both in the hands of a private collector, though one was on show for a year at the Smithsonian Institute in Washington.

Sinhalite

Less than a year after the paper on taaffeite was read before the Mineralogical Society, Dr Claringbull was able to announce the establishment of yet another new gem mineral, which he named sinhalite from its origin in Ceylon.(4) But on this occasion we were spectators rather than protagonists, though we were able to provide many specimens to aid the work, as sinhalite had been knocking around for some time under the disguise of brown peridot. Robert Webster indeed nobly sacrificed part of his only specimen for Dr Hey to analyse. Whereas, when the taaffeite paper was read, all we had to show was two small cut specimens, Claringbull had a score of sinhalites to show (one a giant of 75 carats) which had crept from their wrongly labelled packets for the occasion. There was even a small pebble of sinhalite which had been picked from a sample of illam by Dr E. H. Rutland.

Credit for the sinhalite discovery belongs properly to Dr George Switzer of the Smithsonian Institution, who took an x-ray powder photograph of scrapings from the girdle of a "brown peridot" in the U.S. Museum collection and found spacings which clearly differed from those of olivine. Knowing this, Dr W. F. Foshag (Switzer's chief in the Institution) cast doubts on a specimen of "brown peridot" in the Natural History Museum when Dr Claringbull was showing him round the mineral gallery, which gave rise to an energetic attack on the problem.

Sinhalite contains no silica, being a magnesium aluminium borate, $MgAl\ BO_4$. Like peridot, it is orthorhombic, and its refractive indices, birefringence and density are very close to those of brown iron-rich peridots or olivines which are occasionally met with in Arizona and elsewhere; the chief difference being in the β index, which in peridot is nearly mid-way between the greatest and least indices, while sinhalite is clearly negative in sign. The absorption spectra are also very similar in the two minerals, but sinhalite shows an extra band at 4630 Å. Sinhalites have been found in packets of golden zircons and of yellow chrysoberyls—they vary in colour from pale straw yellow, but at their best are very attractive, being clean, transparent, and obtainable in important sizes. In fact, of all the newly discovered stones that I am talking about this evening sinhalite is the only one that has the slightest commercial importance. On the "anything you can do . . ." principle which I mentioned earlier, it was Burma which provided the first well-shaped sinhalite crystal, which C. J. Payne had the the privilege of measuring.

Painite

In painite we have the rarest mineral of them all: in fact I find it rather amusing, considering that no cut stone exists, that a description of the stone occurs in at least five books on gemstones. The original dark red crystal, well-formed though rather water-worn, was found in one of the small ruby mines near Ohngaing village in the Mogok district of Burma. Mr A. C. D. Pain, who suspected it might be something new, sent it to the Laboratory for testing. The crystal at first sight looked as though it were tetragonal, but C. J. Payne, finding the prism angles to be exactly 60° realized that in fact it was hexagonal. It weighed 8·5 carats. The density was found to be 4·01 and the refractive indices 1·8159 for the

A. C. D. Pain

ordinary and 1·7875 for the extraordinary ray, giving a birefringence of 0·0284. The hardness was measured as 8 on Mohs's scale by an indentation method. The dichroism showed a brownish-red for the ordinary ray and deep ruby red for the extraordinary.

Permission was given for a thin slice to be removed from the base of the crystal for Claringbull and Hey to carry out the necessary x-ray and chemical work. Analysis showed the mineral to be a borosilicate of calcium and aluminium, but it proved difficult to ascribe to it a definite formula. The specimen was justly named after its discoverer, and presented by him to the Museum where most of the work on it was done.(5)

Chromium lines were visible in the red end of the spectrum, and the colour was probably due to this, at least in part. In confirmation of this, the stone showed a red glow under crossed filters. It is difficult to judge how attractive a cut painite might be. In bulk, the colour was too deep to be effective, but one might guess that small stones might look very much like Siam rubies.

Ekanite

For the last of my stones we return to the gem gravels of Ceylon, and once more it was a keen gemmologist who set the ball rolling. This was Mr F. L. D. Ekanayake of Colombo, Ceylon, who, in 1953, sent a round cabochon dark green stone showing a faint four-rayed asterism to his friend, Mr R. K. Mitchell, accompanied by a letter in which he stated "I am sure this is a new mineral". After some preliminary work Mr Mitchell allowed us to try our hand at solving the mystery of this peculiar stone. It appeared to be quite amorphous not only optically but to an x-ray beam, and yet the tiny oriented needles to which the asterism was due argued some degree of crystallinity. The density was 3·28 and R.I. 1·60.

An attempt at spectrum analysis in the Laboratory showed the presence of calcium, silica, and traces of lead. This last made me think in terms of glass, and I sent the stone to D. K. Hill, a well-known glass technologist, for his opinion. He at first confirmed the glass hypothesis, but then discovered by a much more skilled spectrum analysis than we could muster, that thorium was a major constituent of the material. Hill's estimate was about 26 or 27% thorium oxide—which later proved to be almost exactly correct. On hearing this news the penny dropped, and I realized that we were dealing with a metamict—a crystal the structure of which had

F. D. Ekanayake
(Reproduced from *The Gemmologist*)

broken down due to 600 million years or so of internal bombardment with alpha particles, as in the case of the green metamict zircons we already knew so well. The trace of lead was also explained—this was the end product of the disintegration of thorium.

During this prolonged investigation, by another of those extraordinary chances of which I have already spoken, Mr Solomon, who was at the time an instructor of students of gemmology in Plymouth, sent me a cabochon stone of this same metamict material, asking if I could tell him what it was since it had puzzled his students! When I told him the story he kindly gave me the specimen.

As one would expect, Ekanayake's stone proved to be quite strongly radioactive, leaving a trace after being placed on a photographic film for a few hours. Using a slice taken from the stone, we tried to return it to its original crystalline state by heat treatment: but heating at 1000°C failed to bring about the hoped for alteration and transformed the stone into an opaque putty-coloured mass.

It was several years before the Museum could proceed with the necessary complete analysis, which entailed a formidable piece of work, and in the meantime Ekanayake had recovered three further pieces of the mineral from the same gem pit where the original was found—at Eheliyagoda near Ratnapura.

The final analysis, carried out by D. I. Bothwell, showed the new mineral to be essentially a silicate of thorium and calcium, though about 2% of uranium was also present. A preliminary note was published in *Nature* on June 10th, 1961, establishing the new mineral at last, and appropriately honouring its discoverer in the name ekanite. R. K. Mitchell gave an excellent account of the long drawn-out investigation in the *Journal of Gemmology*, and shortly afterwards Dr Edward Gübelin who, unknown to us, had been working intensively on the new mineral, of which he had acquired no fewer than 12 specimens, published a long and brilliant paper on the subject in *Gems and Gemology*, *The Gemmologist*,(6) and elsewhere, which precluded the need for any further work on our part.

Since that time, crystallized forms of ekanite have been reported from Central Asia by Russian workers and from Saint-Hilaire, Quebec Province, in pegmatite veins. The crystals are tetragonal. The reason for these not having been reduced to the metamict stage lies in their much younger geological age—60 million years against 600 million.

One thing that took away much of the pleasure from these investigations into new gem minerals was the long delay between the initial burst of ordinary gemmological work on the stones and the final necessary chemical analysis and crystal structure analysis which had to be performed before the mineral could be properly established and the conclusions published as a scientific paper. One could not very well press for speed from the skilled Museum workers, for work which involved a great deal of time and effort, which had to be added to their own research programmes and routine work for the Department. And we ourselves in the Laboratory found it increasingly hard to find time to work continuously on any project as the demands of essential daily testing work became more and more pressing. Visits to the library became lunch-time snatches, and one felt guilty in doing any work which could be termed purely academic. And most of you know how hard it is to pick up the threads of any piece of work which has been put on a shelf and allowed to grow cold.

Amongst the advantages of such pieces of research are the sharpening of technical skills, an increased international reputation for the Laboratory and a closer liaison with mineralogists—a liaison which is vital in the present state of our science.

For those of you who have found my topic for this evening too remote from everyday experiences and problems in the Trade to interest you, I can promise a thoroughly down-to-earth talk next October, when I understand that I am going to be allowed to speak to you again.

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AGATE-STAINING IN THE EARLY PART OF THE CENTURY

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

IN 1913 Dr O. Dreher published a book entitled *Farben des Achates*, in Idar-Oberstein. Long out-of-print, there is no copy in the library of the Gemmological Association nor in the British Museum. However, in his recent book, *Gemstone & Mineral Data Book*, John Sinkankas summarizes a number of Dr Dreher's findings.(1)

For obtaining a red colour Dr Dreher recommends a dye solution with the following composition: ¼kg iron nails dissolved in 1kg concentrated nitric acid. When the liquid is clear the agate slabs are soaked for a duration depending on their thickness, e.g. 3 mm thick, 6-10 days, 7-10 mm from 3-4 weeks. Stones are then heated in a closed crucible for 2-3 or 8-10 days again according to the original thickness. Dreher found the iron nitrate supplied by a chemical house less satisfactory than the somewhat cumbersome nail method. S.Hoffmann(2) worked through the same method to obtain red agate.

For blue Dreher used 250 g of yellow potassium ferrocyanide dissolved in 1 litre of lukewarm water. Stones were immersed for 8-14 days. They are then washed and subsequently placed in a lukewarm saturated solution of ferrous sulphate.

For black the stones are immersed in a solution composed of 375 g of sugar per litre in which they are soaked for 2-3 weeks, with the occasional addition of water to replace losses through evaporation. They are rinsed and dried and then placed in a bath of concentrated sulphuric acid. This is warmed for one hour until it is hot. The stones are soaked for 1-2 hours while the acid is brought close to boiling point (340°C). They are carefully washed on removal. It was not necessary to bring the acid to boiling point to achieve carbonization of the sugar.

Green staining is accomplished by the use of a saturated solution of chromium trioxide in 1 litre of water. Immersion lasts from 8-14 days for thin slabs, 2-8 weeks for thicknesses of 3-10 mm. After removal and rinsing the agates are placed in ammonium carbamate acid carbonate followed by heating to redness.

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G.G.G.—A NEW MAN-MADE STONE WITH A GARNET-TYPE STRUCTURE

By ROBERT WEBSTER, F.G.A.

A CUT specimen of gadolinium gallium garnet which has been presented to the Gemmological Association by Mr Walter E. Johansen, of Morgan Hill, California, is the subject of this short article. It is another potential gem material which has no counterpart in nature and some crystals were described by M. J. O'Donoghue in the *Journal of Gemmology* last October.(1) It is said, however, that there is no intention of marketing this type of stone; crystals are grown for scientific purposes, one of which is said to be in connexion with "substrates for magnetic bubble memories",(2) a subject of which most gemmologists are ignorant.

Gadolinium gallium garnet, usually abbreviated to G.G.G., corresponds to the formula $Gd_3Ga_5O_{12}$ and forms colourless crystals, which can, however, be 'doped' to give various colours. Gadolinium and gallium are elements not previously mentioned in connexion with gemstones, so it may be of interest to give some facts concerning these somewhat rare elements.

Both gadolinium and gallium are chemical elements of group three in the periodic table. The rare-earth metal gadolinium, having the atomic number 64 and a density of 7·898,(3) was discovered in 1880 by C. Marignac, who showed that "terbium earth" contained a new element, which was named gadolinium, as well as terbium. Gallium, a member of the boron-aluminium family, has the atomic number 31 and forms grey octahedra with a density of 5·92.(4) The element was discovered by Lecoq de Boisbaudran in 1875 by spectroscopically examining zinc blende from the Pyrenees, the spark spectrum of gallium giving two well-defined lines in the violet at 4170Å and 4030Å. Gallium was one of the elements predicted by Mendeleef in 1869 to fill gaps in his table; at that time he named this then undiscovered but anticipated element as eka-aluminium.

The refractive index of G.G.G., which is of cubic crystallization, is given as 2·01 or 2·03,(2) and the dispersion as 0·038(2) which is not very much lower than that of diamond itself (0·044 B to G). The density is about 7·05(2) (say 7·00 to 7·09) and the hardness is about 6½ on Mohs's scale. The lustre approaches that of diamond.

Visual examination of the stone weighing 1·15 carats presented by Mr Johansen showed it to be a round brilliant-cut stone, colourless with a distinctly brownish tinge and showing a good 'fire'. It would make a very good simulant of diamond, especially if it is produced without the brownish tinge, and this is said to be quite possible. The stone when examined under the microscope was found to be clean except for a group of very small bubbles, and when the stone was viewed between "crossed polars" the field remained dark through a 360° revolution of the stage.

The most important observation made was that of the luminescence of the stone, for under the long-wave ultra-violet lamp (3650Å) the fluorescent glow was found to be a weak orange in colour. This could be seen quite well with the medium-pressure mercury-vapour ultra-violet lamp with Wood's glass filter but scarcely at all with the long-wave fluorescent tube lamp, owing to the residual visible light passed by this type of lamp. Under the short-wave ultra-violet lamp (2537Å) the glow produced was a strong orange but did not appear to show any phosphorescence. This orange glow examined with a hand-spectroscope showed it to be discrete and consisting of a strong sharp band in the orange, which could rather be called a line than a band, and there were some weaker bands, which may be further bands from this luminescent glow or perhaps could be mercury and neon lines reflected from the lamp emission by the facets of the stone. Under x-rays the glow seen was a strong orange-pink with a weak afterglow, which seemed to occur after a short delay and appeared to be a weak bluish or greenish white in colour. Mr O'Donoghue (loc. cit.) using G.G.G. from another source found the glows to be:—

Long-wave ultra-violet (3650Å) = straw colour.

Short-wave ultra-violet (2537Å) = peach, with no phosphorescence.

X-rays = lilac, with no phosphorescence.

In consideration of the facts that the material is of use in "magnetic bubble memories" and that gadolinium itself is said to be ferromagnetic below 16°C,(5) the magnetic effect of the stone was investigated. These experiments seemed to show that the stone did not affect a magnetic needle, at least a cased compass needle, but the stone was found to be weakly attracted to a small magnet. This was further confirmed by noting that a loss of weight occurred when the stone was arranged on a cork resting on one pan of a balance which was then put in poise. A small magnet held over the stone produced a deflection of the balance indicating needle. The stone was not electroconductive.

No distinctive absorption spectrum was observed, but there may be a very weak band in the blue. Between "crossed filters"—that is, using a flask of copper sulphate solution over a white light source and the stone viewed through a spectrum red filter—a weak reddish glow could be seen, but some of the deeper red filters did not seem to show the effect at all clearly. When the red filter was changed to a hand-spectroscope the bright orange fluorescent line was not observed, nor, indeed, could this fluorescent line be at all clearly observed when the stone was bathed in long-wave ultra-violet light.

To sum up, gadolinium gallium garnet would make an excellent simulant of diamond. Although it is understood that there is no intention of marketing this material as gem material, it must be a potential gemstone if only as the result of amateur lapidaries getting hold of rough material. Its distinction appears to be fairly easy by the high density, or, if mounted, by the orange fluorescence under short-wave ultra-violet light. The magnetism, although an interesting feature, is hardly strong enough to be a test, and certainly not if the stone be in a setting. The most attractive tests for this stone seem to lie in the use of the short-wave ultra-violet lamp in conjunction with the spectroscope to pick up the fluorescence line, and if the stone be unset then the density will clearly identify it.

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A NEW LOOK AT GREEN GARNETS

By G.V. AXON, F.G.A., G.G.

ARE garnets taken for granted? By the public perhaps, but not by the gemmologist or the mineralogist. Somehow, garnets constantly create news from the gem front. The spelling, for instance, seems now to have been agreed upon as pyrope, almandine and spessartine for one isomorphous group, and grossular, andradite and uvarovite for the other. It's a mixed bunch of spelling. More important, perhaps, are the chemical formulae. The addition of iron to the formula for pyrope means that all garnet groups, except grossular, basically are idiochromatic, not allochromatic. Thus grossular should be, and is, the garnet that provides the greatest number of hues, while andradite, because of its ability to substitute other metals for calcium and iron, is the next most important in hue variety. Other garnets allow some substitution of importance. Pyrope, for instance, is made a much brighter red by the addition of chromium, while spessartine loses some of its beauty when iron invades the manganese.

The green garnet known as demantoid is, of course, in the andradite family and is finely coloured by chromium. The only garnet with chromium as part of its formula, uvarovite, is a fine green but has produced only small faceted stones, usually from Asbestos (Quebec) material. The other green garnet sometimes coloured by chromium, grossular, is rare, comes in small pieces from Tanzania, and cuts as a stone that most connoisseurs would probably regard as finer than demantoid. There may be, of course, other sources that the writer is unaware of, but these three chrome-green garnets are worth a slight discussion.

All are rare, although demantoid from the Urals must once have been in good supply, to judge from museum displays. The fibres by which demantoid is identified by loupe, before more exacting scrutiny, are found, probably in greater clusters, in some chrome-green sphenes, even though their chemical composition may not be the same. This clouding of the sphene often precludes easy sighting of the huge double refraction, but the small yet fine chrome-green sphenes that do not contain fibres—material from Pennsylvania, that is, as distinct from Mexican—show the double refraction clearly.

The arrival a few years ago of chrome-green synthetic garnets caused a nuisance to begin with, but that seems to have died down, and little if any trouble has been reported—at least not in New York. Thus gemmologists are faced with relatively few problems in the green garnet field in spite of the many varieties that theoretically at least might come along. Faceted uvarovites are nearly as scarce as hens' teeth. The chrome-green grossulars are almost but not quite in the same category. The synthetics have been exposed and gemmologists should be on their guard. The sphenes that may look like green garnets are rare, and only those sphenes that contain fibres are truly misleading. Demantoid remains almost supreme.

As for the future, probably not too much may be expected from pyrope, almandine and spessartine, but grossular, andradite and even uvarovite may produce surprises. Yellow topazolite in the andradite family is mentioned in textbooks and may turn up again, even if only in small crystals. Uvarovite has produced a few small stones and may produce more. Grossular, in theory at least, provides the best source, although demantoids of fine quality could also again be found in quantity.

The gem world is full of surprises, as tanzanite has proved. The earth's surface has only been scratched, and new gems and new supplies are sure to come. How many gemmologists are aware that catapleiite[*] and weloganite[†] have now been found in clear crystals, and that facet-grade lazulite has become almost commonplace? Chrome-green garnets, therefore, may once again become a popular gem variety.

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[*] See J. Gemm., 1964, IX, 5, 183.—Ed.

[†] $Sr_5Zr_2C_9H_8O_{31}$; in trigonal crystals, lemon-yellow to amber; having H.3½: S.G.3·22 (±0·03) R.I.α1·558, β1·646, γ1·648 (all ±0·003); see Mineral Abstracts, 1970. **21,** 2, 159.—Ed.

GROWTH FEATURES IN SOUTH AFRICAN EMERALD CRYSTALS

By R.M. YU, Ph.D.

Physics Department, University of Hong Kong

ABSTRACT

Growth features in thirty pieces of South African emerald crystals have been studied by transmission, reflection and interference microscopy. Altogether four different shapes of etch pits, four distinctive types of inclusions and one type of striations are classified.

INTRODUCTION

The growth features are birth marks of a crystal. They are useful for identification as well as for deducing the condition under which a crystal was grown. For example, Sunagawa(1) has distinguished between synthetic and natural emeralds by comparative study of their surface structures. In the present study of growth features thirty pieces of the most perfect crystals are chosen from one thousand carats of South African emerald rough. These crystals are in nearly perfect hexagonal prisms with lengths varying from 3 mm to 10 mm and lateral dimensions from 1 mm to 4 mm. The most interesting surface structures observed are the various shapes of etch pits on the $\{10\bar{1}0\}$ faces of the crystals. The hexagonal pyramidal etch pits and the hexagonal prismatic etch pits are frequently observed in many crystals while the long groove etch pits and square pyramidal etch pits are only occasionally observed. Four distinctive types of inclusions are classified. These include feathers, liquid-filled tubular fissures, veils and three-phase inclusions. In some crystals sets of striations perpendicular to the c-axis are also observed.

EXPERIMENTAL METHOD

A Leitz Dialux-Pol polarizing microscope with a universal rotating stage is used for transmission microscopy in polarized light. For reflection and dark field microscopy an Olympus N9 microscope is used. By replacing the objective lens with a Watson 8 mm interference objective and using a sodium lamp as a monochromatic light-source, two-beam interferograms of crystal surface structures can be obtained. This is particularly useful in mapping the contours of the etch pits.

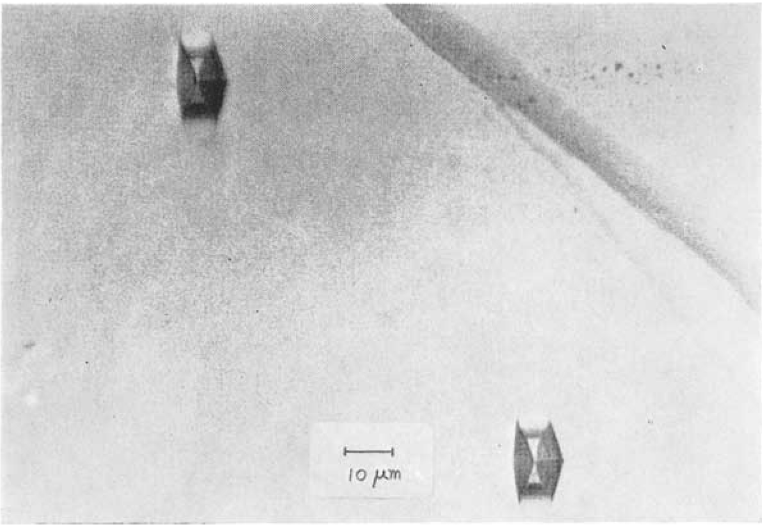
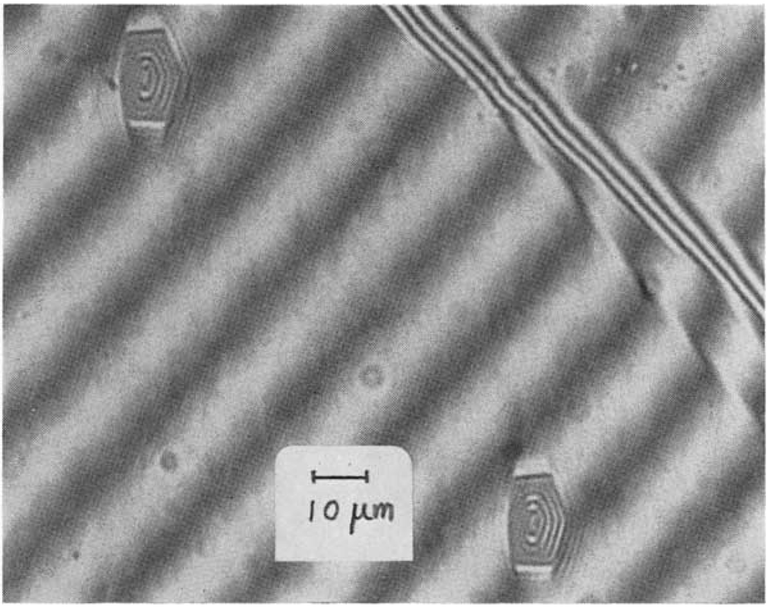


FIG. 1. Hexagonal pyramidal etch pits
(a) reflection micrograph (above)
(b) interferogram (below)



ETCH PITS

During the growth of a crystal some part of the molten salt may become undersaturated as a result of temperature fluctuations or compositional changes. Dissolution of the crystal then takes place preferentially at crystal imperfections where the strain energy is released by dissolution of deformed or foreign materials. Thus the emergence point of a dislocation line on the crystal surface is selectively etched to give rise to an etch pit. The shape of an etch pit depends on the crystal structure as well as on the nature and orientation of the dislocation line with respect to the crystal surface. The following four types of etch pit have been observed in the $\{10\bar{1}0\}$ faces of the South African emerald crystals:

(i) Hexagonal pyramidal etch pits.

This is by far the most common type of etch pit in the samples. The reflection micrograph and interferogram of two such etch pits are shown in Figs. 1(a) and 1(b). The dark fringes in the interferogram are fringes of equal thickness spaced apart at 295 nm (half the wavelength of sodium light), thus the depths of these two pyramidal etch pits are about 1·5 μm. The bottom of the etch pit may converge to a sharp tip or a short line.

(ii) Hexagonal prismatic etch pits.

Fig. 2(a) shows a hexagonal etch pit with a truncated bottom while Fig. 2(b) shows three shallow etch pits whose outlines are barely visible. The flat bottoms of these hexagonal prismatic etch pits suggest that the dislocation lines had vanished or moved away at an early stage of the natural etching process. In later stages the etching no longer increased the depths of the etch pits, but only developed their lateral dimensions. To illustrate the difference between the pyramidal and the prismatic etch pits, both types of etch pit are shown on the same micrograph and interferogram in Figs. 3(a) and 3(b) respectively.

(iii) Long groove etch pits.

Figs. 4(a) and 4(b) are micrograph and interferogram of a long groove etch pit together with several hexagonal pyramidal etch pits. The long groove might have resulted from the etching of an edge dislocation line running parallel and very near to the crystal surface. The length of the long groove is then equal to that of the dislocation line. In this case it is 130 μm.

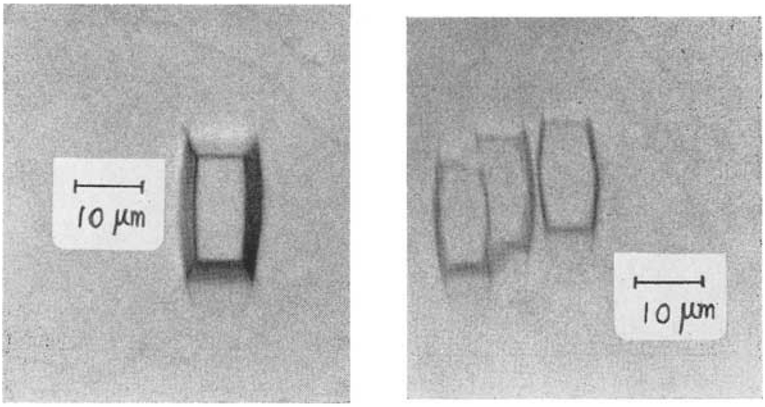


FIG. 2. (a) Hexagonal prismatic etch pit (reflection micrograph) (above left)

(b) shallow etch pits (reflection micrograph) (above right)

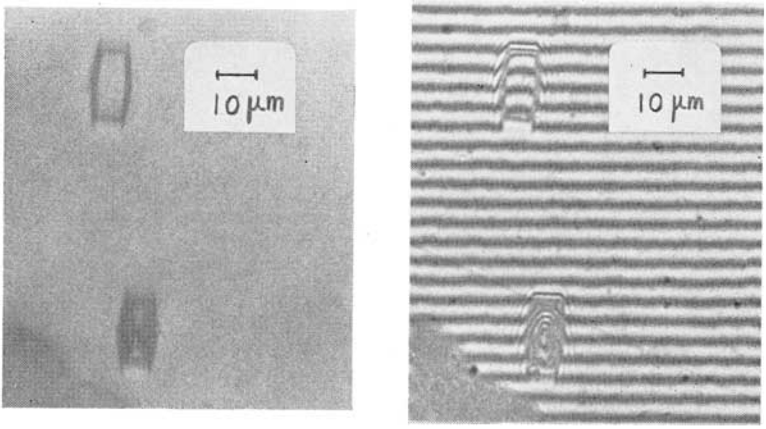


FIG. 3. Pyramidal etch pit and prismatic etch pit

(a) reflection micrograph (above left)

(b) interferogram (above right)

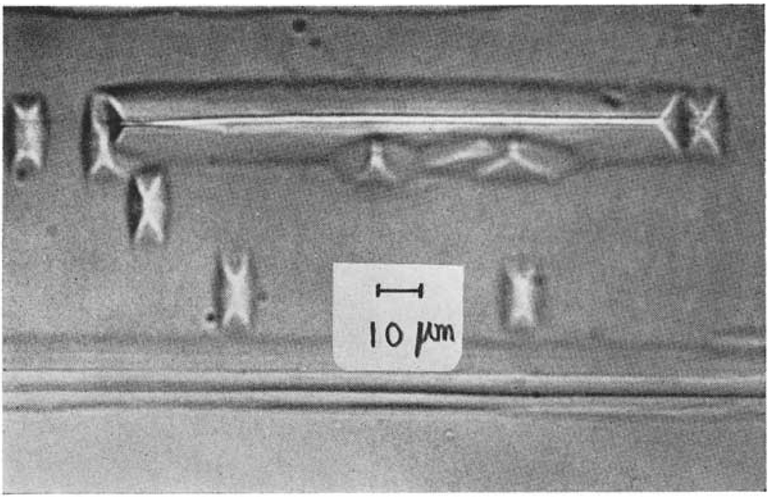
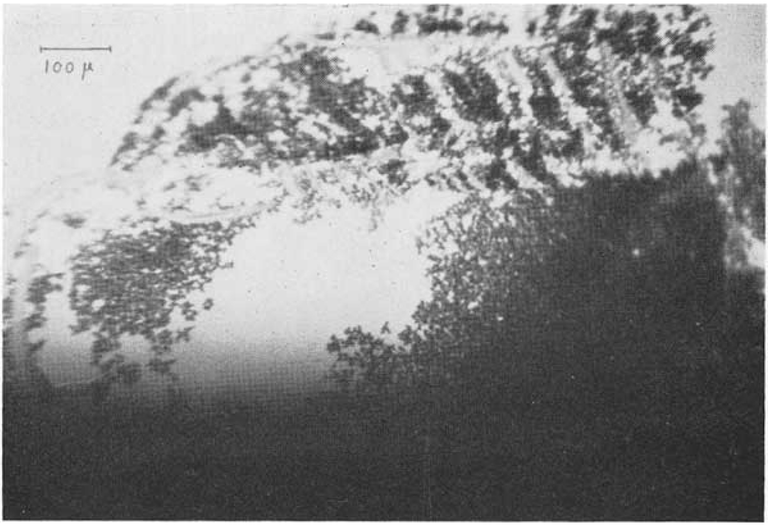


Fig. 4. Long groove etch pit and hexagonal pyramidal etch pits

(a) transmission micrograph (above)

(b) interferogram (below)



(iv) Square pyramidal etch pits.

In one crystal only (sample No. 27) a large number of square pyramidal etch pits are observed. A chain of such etch pits are labelled (AB) in Figs. 5(a) and 5(b). The chain of etch pits indicates an array of dislocation lines marking a low-angle grain boundary in the crystal.(2) The grain boundary is nearly parallel to the basal plane of the crystal with the dislocation lines perpendicular to the prismatic $\{10\bar{1}0\}$ faces of the crystal. The distances between successive etch pits are measured to range from 2·6 μm to 5 μm. Since the Burgers vector for emerald is 9·20Å long, the misorientation angle lies between 38 seconds and 73 seconds. While square etch pits have been frequently observed in cubic lithium fluoride crystals(3) it is not yet understood why they are also occasionally found in hexagonal emerald crystals.

INCLUSIONS AND STRIATIONS

As a crystal grows from the melt extraneous particles or fluids may become trapped in the growing crystal to form inclusions. Sometimes impurities which have been dissolved in the molten salt may subsequently coagulate to form separate phases inside the crystal. These inclusions can occur in the solid, liquid or gaseous state and exhibit many different shapes and configurations. In the present samples of South African emeralds the following four types of inclusions and one type of striations are observed:—

(i) Feathers.

These are inclusions which look like feathers under a microscope (Fig. 6). By orientating the optical axis of a uniaxial crystal normal to that of the polarizing microscope four extinction positions can be observed as the crystal is rotated through 360° on the microscope stage. It is found that the feathers in the present samples always appear bright when the host crystals appear dark, and vice versa. This phenomenon indicates that the feathers in South African emeralds are crystalline entities with their optical axes inclined at 45° to that of the host crystals. Liquid feathers have been found in synthetic emeralds.(4) They should always appear dark under crossed polars. The present observation of crystalline feathers serves as an aid in the identification of South African emeralds.

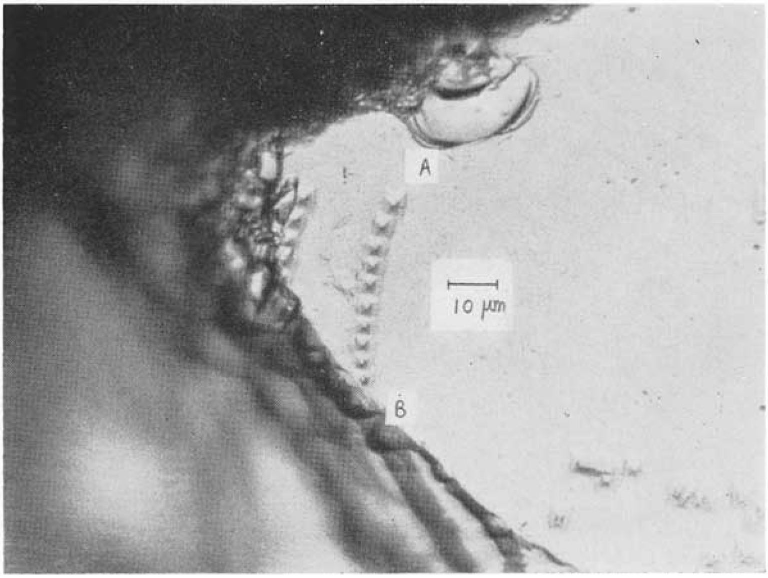
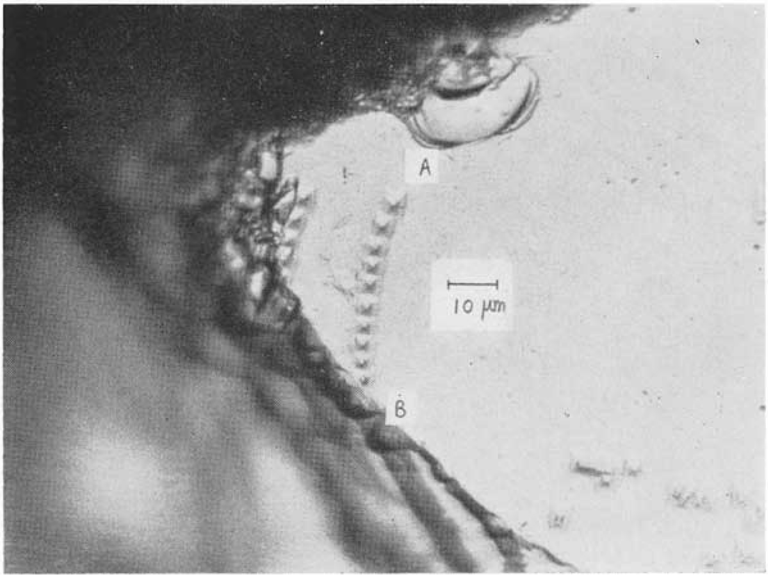


FIG. 5. Square etch pits
(a) reflection micrograph (above)
(b) interferogram (below)



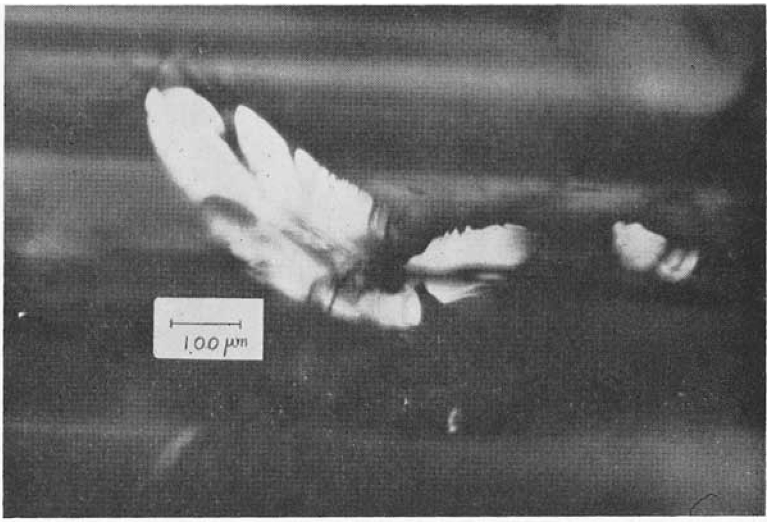


FIG. 6. Feather (transmission micrograph)

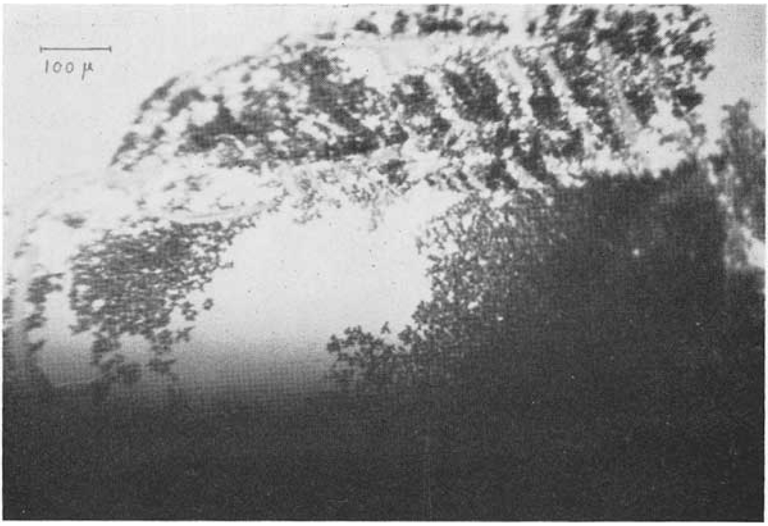


FIG. 7. Veil (transmission micrograph)

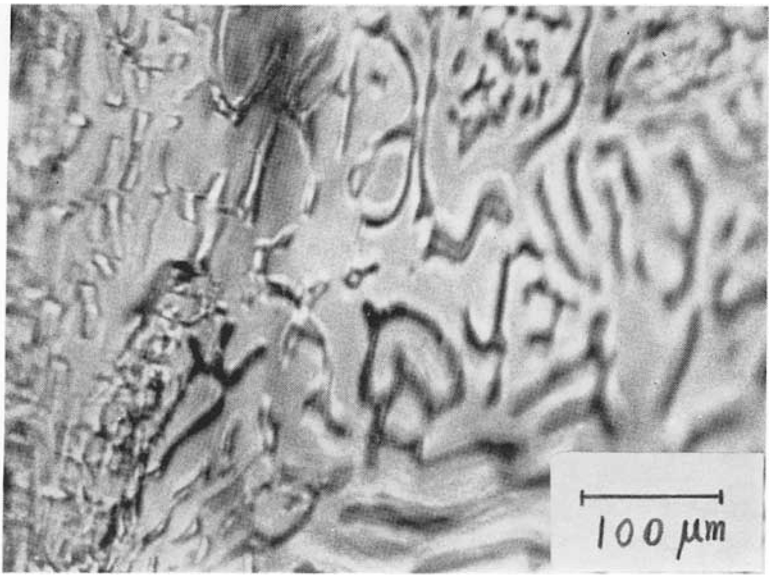


FIG. 8. Tubular fissures (transmission micrograph)

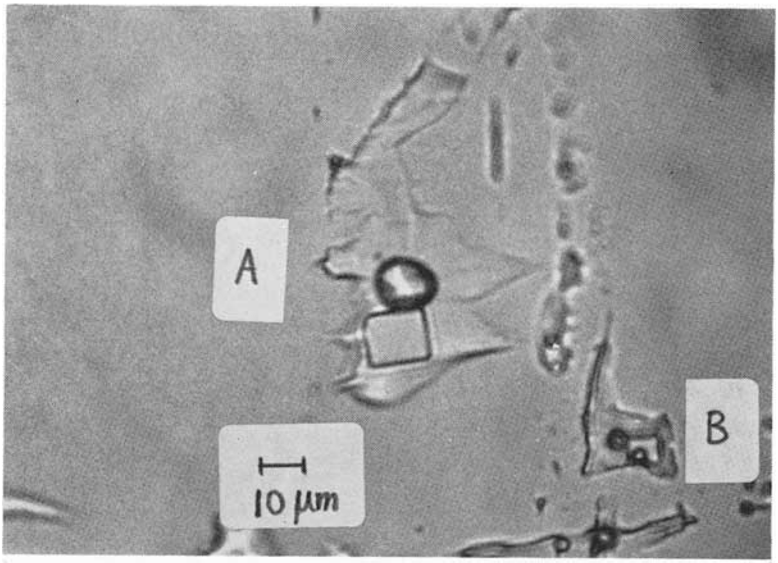


FIG. 9. Three-phase inclusions (transmission micrograph)

(ii) Veils.

These are groups of irregularly shaped tiny inclusions which look like curved veils (Fig. 7). They are non-crystalline and may appear colourless, brownish or black, depending on the angle of illumination. This type of inclusion has also been observed in beryl crystals grown by high temperature flux solution technique.(5) They are attributed to fluxes which have been trapped in conchoidal cracks of the crystals.

(iii) Tubular fissures.

Fig. 8 shows a maze of liquid-filled tubular fissures. The forming process of this type of inclusion may be similar to that of the veils, with the liquid trapped in tubular fissures instead of conchoidal cracks. In order to form the larger tubular drops the liquid in this type of inclusion has to be less viscous than that in the veils.

(iv) Three-phase inclusions.

In this case a crystallite and a gas bubble are formed in the included liquid drop so that the inclusion contains all three phases of matter. Fig. 9 shows two three-phase inclusions A and B clearly in focus. Under crossed polars the crystallite in A is extinguished whenever the host crystal is extinguished, showing that their optical axes are aligned in the same direction. The crystallite in B is grown around a seed of impurity which cannot be extinguished for any orientation of the host crystal. In the present samples all the crystallites are square or rectangular in shape. In this respect South African emeralds are similar to Colombian emeralds and are different from Russian emeralds, which have diamond-shaped crystallites.(6)

(v) Striations.

These are parallel bands of slightly different colours or refractive indices shown up as fine lines under the microscope (Fig. 10). They result from compositional variations due to fluctuations in temperature or purity of the molten salt. The striations are irregularly spaced and are perpendicular to the c-axis of the crystal. No striations parallel to the $\{10\bar{1}0\}$ faces have been observed.

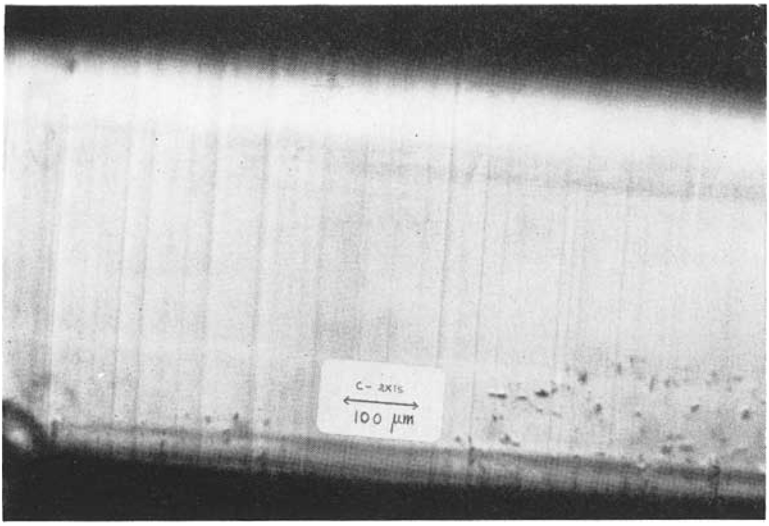


Fig. 10. Striations (transmission micrograph)

CONCLUSIONS

Growth features in thirty pieces of South African emerald crystals have been studied by transmission, reflection and interference microscopy. Four different shapes of etch pits are observed. They are thought to result from preferential etching of the emergence points of dislocation lines at crystal surfaces. The hexagonal contours of the etch pits are likely to be consequences of the hexagonal crystal structure of emerald. It is noted that in cubic lithium fluoride the etch pits have square outlines(3) and in rhombic topaz the etch pits have rhombic profiles.(7) Emerald $Be_3\ Al_2\ (SiO_3)_6$ has a honeycomb structure built up from hexagonal rings of six SiO_3 tetrahedra with Be and Al atoms between the rings.(8) Further theoretical work is being undertaken to establish a definite link between the etch pit configurations and the crystal structure. Four distinctive types of inclusion in emerald have been classified, namely, feathers, veils, tubular fissures and three-phase inclusions.

The crystalline feathers could be formed by a slow process of the dissolved impurities gradually separating from the host material. On the other hand the boundaries of the other three types of inclusions are probably formed quickly by the interface of the included liquid and the host material. In some crystals irregularly-spaced striations perpendicular to the c-axis of the crystal are also observed.

Acknowledgement

Part of the work was carried out while the author was a Leverhulme Fellow at Monash University. He is grateful to the Trustees of the Leverhulme Fellowship for the award of the Fellowship and also to Dr A. C. McLaren and Mr David Marshall of Monash University for their friendship and assistance.

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Gemmological Abstracts

Ball (R. A.) and Malin (A. S.). *Scanning electron microscopy and opals.* Australian Gemmologist, 1974, 11, 12, 16-19. 3 illus.

A description of the scanning electron microscope (SEM), how it works and what it will do. Its advantages over the optical microscope and over the transmission electron microscope are discussed. There is the result of an examination by such an instrument of a blue-green opal from Lightning Ridge, New South Wales. R.W.

Bank (H.). *Klar durchsichtige gruenliche und graue Vertreter der Aktinolith-Tremolit-Reihe aus Ostafrika.* (Transparent green and grey representatives of the actinolite-tremolite series from East Africa.) Z. Dt. Gemmol. Ges., 1974, 23, 1, 42-44.

Descriptions of actinolite and tremolite found recently in Tanzania. E.S.

Bank (H.). *Farbloser klar durchsichtiger Oligoklas aus Kenya.* (Transparent colourless oligoclase from Kenya.) Z. Dt. Gemmol. Ges., 1974, 23, 1, 45-48.

The plagioclase crystal oligoclase has been known for many years only as sunstone; it has now been found absolutely transparent in Kenya. Its characteristics are described in the article. R.I. 1·540-1·544, density 2·64, hardness just under 7. E.S.

Bank (H.) and Berdesinski (W.). *Stark pleochroitischer schleifwuerdiger Kornerupin aus Ostafrika.* (Strongly pleochroic cuttable kornerupine from East Africa.) Z. Dt. Gemmol. Ges., 1974, 23, 1, 49-51.

The material found in Greenland and in Saxony could not be cut, but kornerupine found now in Tanzania south of Handeni yielded cuttable stones, although previously stones from Madagascar had been cut. Details are given. E.S.

Bank (H.). *Alexandrit und seine Nachahmungen.* (Alexandrite and its imitations.) Z. Dt. Gemmol. Ges., 1974, 23, 1, 64-65.

The first imitations of alexandrite to be found were doublets, later alexandrite-like synthetic spinels were used. Now there are synthetic alexandrites on the market; these are made in U.S.A. and seem to have slightly lower R.I. (1·730 instead of 1·748), but in any case must be looked at under the microscope. They show wisp-like inclusions, as do synthetic emeralds and rubies which have been produced by the melt-diffusion method. E.S.

Burns (R. L.). *A member of the ugrandite garnet series found in Western Australia.* Australian Gemmologist, 1973, 11, 12, 19-20.

Details the finding and the characters of some tiny green garnets belonging to the ugrandite series of garnets. They were found during the examination of thin sections of rock taken from core drillings obtained during prospecting nickel ore bodies. These green microscopic pieces have at the moment no gem significance and only scientific interest. One small piece of about 5 mm in diameter was found to have an R.I. greater than 1·8 and a density about 3·77. R.W.

Copeland (L. L.). *The derivation of gemstone names.* Gems & Gemology, 1973, XIV, 5, 154-160.

A continuation of the first instalment now covers K to W. The first instalment was 1972/3, XIV, 4, 188-125 (abstracted in J. Gemm., 1974, XIV, 1, 30). R.W.

Crowningshield (R.). *Developments and highlights at GIA's Lab in New York.* Gems & Gemology, 1973, XIV, 5, 134-140; and 6, 172-179. 37 illus.

Much is told about jade and cat's-eye imitations in glass. Unusual inclusions in diamond are mentioned, and to illustrate this further there is an exceptionally good photomicrograph of laser drillings in diamond. Something is told of the Maxixe beryl and experiments carried out on the fading of these stones. One stone faded to a very pale pink, but it is emphasized that so far the proof of gamma ray coloration as against the possibility of natural coloration is not complete. There is some discussion of the use of gamma radiation in the colouring of quartz, topaz and synthetic amethyst. There are some notes on the Gilson synthetic opal, on fire agate and an unusual serpentine. The "wearability of jadeite versus nephrite" is discussed and a note is given on damage to a diamond. R.W.

Della Sala (J.), Fuentes (J. C.), Herrero (M.), Laserre (N.), and Viand (J.). *Contribution to the knowledge of the Argentine* *rhodochrosite*. Gems & Gemology, 1973, XIV, 5, 141-143. 3 figs., 1 table.

A study of the rhodochrosite from Catamarca, Argentina. Something is told about the geology of the area and the associated minerals. The mean refractive index was determined as 1·59 and the density was found to lie between 3·50 and 3·60. The hardness was 4½ on Mohs's scale. The fluorescence was seen to be red-violet under short-wave ultra-violet light and a black pinkish colour under long-wave ultra-violet light. There was no response under x-rays. The absorption spectrum showed a band at 5350-5360Å in the green part of the spectrum. The chemical composition is discussed. The material is used as an ornamental stone for small objects. R.W.

DOEPEL (E. H.). *Transparent tremolite from Tanzania.* Z. Dt. Gemmol. Ges., 1974, 23, 1, 40-41.

Recently, in the Lelatema grossularite deposit in the Masai district in Tanzania, a light green crystal with prismatic habit and slightly anisotropic was found to be tremolite. This is a silicate, R.I. 1·608-1·616, hardness 5-6, S.G. 3·02 ± 0·06. Transparent crystals up to 25 mm length have been found, up to 8 mm diameter. No terminated crystals have yet been located. E.S.

ELI (H.-A.). *La luz polarizada.* (Polarized light). Boletin del Instituto Gemologico Español, 1973, II, 6/7, 3-9.

Polarized light is of great value when examining gemstones. Such important features as inclusions, growth lines in synthetic stones and interference figures can be examined with its aid. The principles of its production are discussed. M.O'D.

GOODGER (W. D.). *A mineralogical club first.* Lapidary Journal, 1974, 27, 11, 1646-1667.

A party visited the tanzanite mine near Moshi in Tanzania where working on a small scale was in progress. Material on sale in Nairobi included chrome tourmaline, poor quality emerald, ruby in zoisite, transparent green grossular garnet and epidote. M.O'D

HAHN (R. H.). *Die Steinschneidekunst ueber sechs Jahrtausende.* (The art of stone cutting during six thousand years.) Z. Dt. Gemmol. Ges., 1974, 23, 1, 52-61. 36 illus.

A survey of cameos and intaglios, going back to pre-Babylonian times, reaching great heights under the Egyptians and then tracing its progress via Crete and Mycenae to Greece and Italy. After the 3rd century B.C. the art of engraving stones fell into disrepute, only to be awakened during the Renaissance. Lorenzo Medici collected cameos and intaglios already in the 15th century. The 17th and 18th centuries saw a number of famous men, such as Natter, Hecker, Barnabé and especially Pichler and his three sons, who worked in Rome from 1697-1779. Another Roman artist was Marchant (1755-1812), who later became English. The rest of the article deals with the stone engraving as practised for a long time in Idar-Oberstein. During the middle of the 19th century a few cutters went to Paris and learned the art from engravers there and have in turn produced some remarkable and beautiful works. E.S.

HEMMENWAY (K. M.). *The growing of NiO nickel oxide boules by the Verneuil flame-fusion technique.* Lapidary Journal, 1974, 27, 10, 1544-1545.

An Adamski barrel torch was used to ensure control of the flame pattern and an excess of oxygen was necessary for growing the material, which was dark green in colour. The powder used was originally $NiSO_4.6H_2O$ and was calcined to produce the boule. M.O'D.

HODGES (K.). *William Hidden's gems.* Lapidary Journal, 1974, 27, 11, 1749-1751.

Some hiddenite is still found at the original locality though the colour is a yellow-green. Work in the area is concentrated on emerald and no effort is made to recover hiddenite. M.O'D.

LAWRENCE (M. J.). *Diamond prospecting.* Australian Gemmologist, 1973, 11, 11, 22-29. 4 illus.

In Australia the prospecting of many minerals, diamond included, is carried out by the Bureau de Recherches Géologiques et Minières, a French Government sponsored department of the Geological Survey of France. The article tells of the use of a mobile prospecting unit which this organization uses. The article also gives a general survey of the diamondiferous localities of the world, giving in most cases the dates of the discovery. Something is told of the geology of these diamond localities and of the 'indicating' minerals associated with diamond. There is a brief outline of the prospecting methods and there is a good list of references. R.W.

LIDDICOAT (R. T.). *Developments and highlights at GIA's Lab in Los Angeles.* Gems & Gemology, 1973, XIV, 5, 144-151; and 6, 180-190. 44 illus.

There is an interesting discussion on the laser drilling of diamond. A green turquoise was found to contain no copper but did contain zinc and was a zinc analogue of turquoise, a mineral which has the name faustite. There was more news of the glass called 'meta jade'. Interesting inclusions in synthetic ruby, synthetic emerald and in glass are mentioned and illustrated. A large crystal of parisite from Colombia, a mineral found as an inclusion in Muzo emeralds, has been examined. It has a striking absorption spectrum. A trapiche emerald was also examined and illustrated. The inclusions seen in synthetic emeralds, Umba river corundums, demantoid garnet, and a moving bubble in a quartz crystal are described. An unusual method of mounting diamonds is mentioned, and the original organisms in some fossilized pieces are discussed. The result of twinning on the rays of star-diopsides, unusual inclusions in opal and some gem-quality colourless barytes crystals are other items discussed. A cut specimen of jeremejevite weighing 1·51 ct was examined at this laboratory. Pale blue in colour, the refractive indices were found to be approximately 1·639-1·648, negative uniaxial but with some indications of biaxiality with a small 2V angle. The density was close to 3·30. Hollow glass spheres filled with fragments of opal have long been known but such a glass filled with emerald fragments is a new departure. There is more reported on the inclusions in synthetic ruby and in diamond. A new treatment for turquoise is discussed, but no complete decision could be arrived at owing to the nature of the setting and the time available. A canned oyster said to contain a cultured pearl was found, when opened, to have not a cultured pearl but an imitation pearl inside it. R.W.

MCLOUGHLIN (D.). *The art of niello.* Australian Gemmologist, 1973, 11, 12, 11-15.

An explanation of the nature of niello and how it is produced. A very good historical survey, much consideration being given to the Russian use of niello throughout the ages. An important article on a subject not often considered. R.W.

MALLORY (L. D.). *The fire agate mines of Calvillo.* Lapidary Journal, 1974, 27, 10, 1500-1530.

Fire-agates occur in an area of volcanic activity in the district of

El Terrero, Mexico. The rough material is sold in Queretaro or Guadalajara. Best specimens have a brown background with a play of red, yellow, green and blue. M.O'D.

NASSAU (K.) and WOOD (D. L.). *Examination of Maxixe-type blue and green beryl.* Gems & Gemology, 1973, XIV, 5, 130-133. 1 fig.*

Details the experiments carried out on the 'Maxixe-type' beryls which show an unusual absorption spectrum and anomalous dichroism. First reported from the Maxixe mine in Minas Gerais, Brazil, this material was said to be subject to fading. Recent material having the characters of Maxixe beryl has recently come on the market and there is some notion that some of this beryl has been treated by some form of radiation. This had led to the experiments now reported. The results have not been completely conclusive and experiments are proceeding. There is an appendix on *colour centres.* R.W.

O'LOUGHLIN (J. L.). *Synthetics—their production and detection.* Australian Gemmologist, 1973, 11, 11, 11-13.

The report of a paper read before the Sydney Gemmological Symposium of 1973. The lecturer adopts a general line and gives as complete a survey as possible of the types and methods of producing synthetic stones. Something is told of the methods whereby these stones may be identified. R.W.

OUGHTON (J. H.). *Stones seen and discussed.* Australian Gemmologist, 1973, 11, 12, 25-26.

Examples of badly damaged sapphires caused by heat and by ultra-sonic cleaning are mentioned, as are a number of unusual doublets. These include a stone with a synthetic colourless sapphire crown and a colourless topaz pavilion; and others had synthetic spinel tops and corundum bases. Such stones may be detected by their differential fluorescence under ultra-violet light. A quartz top and red glass doublet has also been seen. R.W.

REEVE (R. J.). *Some gem-bearing pegmatites near Coolgardie, Western Australia.* Australian Gemmologist, 1973, 11, 12, 21-22.

There are three gem-bearing pegmatites of importance within 50 km of Coolgardie. The geology of the areas and the minerals found in the pegmatites are discussed. R.W.

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*This paper was also published in J. Gemm., 1973, XIII, 8, 296-301.—Ed.

Santos Munsuri (A.). *El color en el cuarzo sintético.* (Colour in synthetic quartz.) Boletin del Instituto Gemologico Español, 1973, II, 6/7, 11-16.

Synthetic quartz in varying colours has been made in the U.S.S.R. Colours include green, yellow, maroon and blue. The seed is clearly visible in the crystals which have the typical uneven growth on the (0001) face. Colour distribution was found to be uneven. Sawyer Research Products, Ohio, U.S.A., have also made quartz synthetically. In all cases the material is intended for optical and electronic use. M.O'D.

Schmetzer (K.), Berdesinski (W.) and Bank (H.). *Ueber die Mineralart Beryll, ihre Farben und Absorptionsspektren.* (About the mineral beryl, its colours and its absorption spectra.) Z. Dt. Gemmol. Ges., 1974, 23, 1, 5-39. Bibl. of 112 items.

This is a very thorough examination into the colours and absorption spectra of beryls which were not known to exist in nature, such as zoisite-blue, indigo-blue and blue-violet. The absorption spectra of the beryl group are examined according to the cause of their colour, viz., (1) iron, (2) chromium and vanadium, and (3) manganese. Aquamarines are shown to be coloured by different valence states of iron ions. The colour of heliodor and other yellowish beryls is based on the presence of iron ions and/or lattice discontinuity. Morganite is coloured by manganese ions. An orange tone is produced by the combination of yellow and pink colour sources. Emerald's colour is caused by Cr^{3}- ions. Other green emeralds may owe their green to V^{3} ions. The sapphire and indigo-blue beryls, which have recently appeared commercially, exhibit absorption spectra which cannot be attributed to any of the mentioned sources. Since the colours are not stable, it must be assumed that the colours are induced by radiation. E.S.

Schubnel (H.-J.): translated by Lapworth (P. B.). *Gems of special importance in the great museum collections.* Australian Gemmologist, 1973, 11, 12, 3-10.

An excerpt from the author's book *Pierres précieuses dans le monde.* The author tells where famous collections of gemstones can be found, seen, and what they have as special items. The division is made by the various countries. R.W.

TILLANDER (H.). *Observations on historical shapes of gem diamond.* Australian Gemmologist, 1973, 11, 11, 3-6. 3 illus.

A very good discussion on the shapes of the earlier cut diamonds and the relation of the shape to that of the original crystals. An interesting survey of an unusual subject which has been built up from a comprehensive investigation. R.W.

UHRIN (R.), BELT (R. F.) and PUTTBACH (R. C.). *The hydrothermal growth of zircon.* Journal of Crystal Growth, 1974, 21, 65-68.

Fluoride mineralizers were used to promote growth on natural seeds, using temperatures of 700°C and a pressure of 25,000 psi. Growth rates reached 0·25 mm per day. The rate was limited by small inclusions of $K_2ZrSi_3O_9$ (wadeite), which occurred when the concentration of KF, which was used in conjunction with LiF as a mineralizer, was too high at a given growth temperature. M.O'D.

WILKS (E. M.). *The resistance of diamond and other gemstones to abrasion.* Gems & Gemology, 1973, XIV, 6, 162-170. 1 graph; 1 table.

Details the experiments carried out on diamond and diamond simulants using the abrasion hardness method. Some anisotropy was found to occur in all specimens tested. The main object of the exercise was to show the vast difference between the hardness of diamond and materials which may look like it. R.W.

ZWAAN (P. C.). *Garnet, corundum and other gem minerals from Umba, Tanzania.* Scripta Geologica, 1974, 20, 1-41.

The mine is situated in the north east of Tanzania near to the Kenya border. The Umba river flows close by and the rocks of the area are metamorphic Precambrian. Garnets are almandines and rhodolites of a good colour, corundums are red, blue, deep violet and stones containing combinations of colour. An orange colour is also found. Other minerals include chrome tourmaline, a brownish orthopyroxene, green clinopyroxene, turquoise, yellow scapolite and zircon. The garnets with the lowest R.I. and S.G. had the highest Mg and the lowest Fe content while those with the highest constants had the highest almandine and the lowest pyrope content. X-ray powder photographs showed a pattern characteristic for pyrope, i.e. almost equal intensities of the diffraction lines 332, 422 and 431. The absorption spectrum was characteristic for almandine. The inclusions were not profuse; rutile was the commonest, occurring in long and short prismatic needles, either isolated or running in three directions making an angle of 60°. Zircons with haloes were observed in three specimens. The almandine garnets fell within the expected constants and displayed a typical absorption spectrum. An apatite inclusion was identified in one sample. Inclusions in the corundums included rutile, pyrrhotite, apatite, graphite, zircon, spinel, vermiculite and liquid feathers. The orange-coloured corundum displayed an absorption spectrum which appeared to combine that of ruby with that of sapphire. Individual spot analyses of the parti-coloured stones appeared to indicate a possible relationship between Ti and Cr. A detailed investigation of this relationship is shown by six continuous scanning profiles for Ti and Cr-Kα radiations across the parti-coloured corundum more or less perpendicular to the red-blue boundary.

The emerald-green tourmaline showed strong dichroism with colours yellow-green and deep bluish-green. The absorption spectrum showed a weak line at 6995 with a doublet near 6765. A broad absorption band centred between 6105 and 6070 and a general absorption of the violet were also seen. Orange and brownish tourmalines were also strongly dichroic in tones of pale yellow and yellow-orange. They fluoresced a dull yellow under short-wave ultra-violet light. The S.G. varied from 3·053-3·057. All tourmalines showed characteristic liquid inclusions. The scapolite showed dichroism with colours straw-yellow and almost colourless; it luminesced weak reddish-orange under long-wave ultra-violet light with a stronger glow of the same colour under short-wave radiation. A powder photograph indicated that the stone was close to marialite. Needle-like hollow tubes could be seen. Densities of the zircons, which were reddish brown or pale yellow-colourless, varied from 4·667-4·684. The absorption spectrum was characteristic for high type zircon and the stones were almost free from inclusions. Veins of turquoise were embedded in limonite-bearing clay which alternated with sandy layers. Grains showed a mean R.I. of 1·64 and a mean S.G. of not far above 2·63.

M.O'D.

BOOK REVIEWS

GÜBELIN (Eduard J.). *Internal World of Gemstones.* ABC Edition, Zurich, 1974. Illustrated with 360 colour pictures and three in black and white. pp. 236. £25.

From a lifetime's study of the internal features of gemstones, born out of the delight in the patterns he saw through his microscope, Dr Gübelin is the one person who could write a thorough book on gemstone inclusions. This is not the first endeavour to produce a volume on such a single gemmological subject, for in 1953 this same author wrote "Inclusions as a means of gemstone identification", a book, out of print for a number of years, which was considerably consulted for reference and has been very much missed.

After twenty one years Dr Gübelin has presented the world's gemmologists with a thoroughly revised volume on the same subject. Entitled "Internal world of gemstones" this new production has to some extent a similar lay-out to that of the earlier edition but the scope is much wider. Following a preface by Prof. Dr W. F. Eppler and a foreword by the author, there is an introductory chapter which deals with the beauty of the inclusions in gemstones, what they are and their value to the gemmologist. The history of the knowledge and examination of inclusions from the time of Ancient Rome to the present day with its modern microscopes and electron probe is discussed in this chapter.

The second chapter gives a general discussion of how the inclusions in gemstones are formed, classifying these into three groups—those which were present before the growth of the host crystal which in growing enveloped them, such inclusions being called 'protogenetic inclusions'; the 'syngenetic inclusions', which formed at the same time as the growing host crystal; and lastly the so-called 'epigenetic inclusions', which have come about by various causes after the host crystal has formed. A different classification which, as the author points out, the gemmologist may find more practical, is to divide the inclusions into those which are solid, those which are liquid, and those which have cavities filled with gas. This aspect the author covers in the following chapter.

This next chapter treats of the inclusions predominant in the various gemstones and covers those in diamond, corundum, emerald and the beryls, the feldspars, garnets, peridots, quartz, spinel, topaz, tourmaline and zircon. The more unusual gemstones are not individually discussed although in some cases, in other chapters, their inclusions are illustrated to show types of inclusions.

Then follows a chapter on the inclusions seen in synthetic and man-made stones, including glass. Something is told of the various methods of crystal growth in relation to the type of inclusions seen in these artificially grown crystals. It might be questioned whether the Czochralski 'pulling' method of crystal growing is really a development of the diffusion method, or is, as is more generally accepted, a growth from a pure melt. The discussion on synthetic emeralds, the inclusions of which are such an important diagnostic feature, is particularly interesting, as it is stated that the 'nail-like' inclusions may occur in flux-grown synthetic emeralds. The reviewer always considered this type of inclusion to be a sure sign of hydrothermal growth. Frightening, too, is the remark that three-phase inclusions are possible, or have been observed, in synthetic emeralds. The inclusions seen in man-made stones and in glass conclude the main text. The book is completed with a very good glossary of terms and a bibliography. There is no index.

Written in such a charming manner, which is so typical of Dr Gübelin's style, the book is extremely well illustrated with colour plates of gemstone inclusions which are of exceptional merit. It is a *must* for all discerning gemmologists, for the knowledge of inclusions is of paramount importance in the identification of gemstones. The book may appear expensive, but it must be remembered that the cost of printing, and especially colour printing, has increased alarmingly in recent years. The size of the volume (approx. 11 × 9 inches = 28 × 23 cm) makes it appear that the publishers had a dual purpose in mind; that of an excellent text book and a readable and attractive book for the table. R.W.

KESSEL (Joseph). *La vallée des rubis.* (The valley of rubies). Gallimard, Paris, 1974. pp. 274. Price on application.

An account of the author's visit to Mogok, centre of the ruby trade. The narrative is lively and reminiscent of Louis Kornitzer. Although styled as an adventure, a fair amount of information is given on ruby and other associated topics. M.O'D.

MASON (Anita). *An illustrated dictionary of jewellery.* Osprey Publishing Ltd, Reading, 1973. pp. 389. Illustrated in black-and-white. £5·95.

A first-class book which will enlarge the gemmologist's knowledge of the terms and techniques of jewellery and improve the gemmological background of the jeweller and craftsman. I could find no fault with the exhaustive gemmological information included and a large number of outmoded terms are clearly set out as obsolete. The drawings, by Diana Packer, are skilful and imaginative. There is a short bibliography. M.O'D.

PAGEL-THEISEN (Verena). *Handbook of Diamond Grading.* Frankfurt/M, 1973. English (4th) edition. pp. 214. Illustrated in black-and-white with one colour plate. £8·50

The first ever handbook devoted almost entirely to diamond grading was Diamanten-Fibel in 1968; it now appears in English under the title above. The German of Verena Theisen (now Frau Pagel-Theisen) was translated into English by Patricia B. Lapworth of Australia. Pagel-Theisen holds three countries' qualifications in gemmology and has been assistant to Dr K. Schlossmacher in Germany, Dr E. Gübelin in Switzerland, a worker in the G.I.A. Los Angeles laboratory, head of another gem lab. in Germany, and head of one of her own. The book can be recommended for its four exhaustive sections on the four elements of diamond grading. Quality of reproduction of the photographs of diamonds indicating standards of quality among the 360 illustrations is excellent. They are arranged for convenience in a single 34-page section. Grading is based on the R.A.L. (German Standards Association) draft of "individual terms for description of cut diamonds for jewellery purposes", first recorded in 1935. Except for the lowest grades they are almost identical to those used in the U.K. E.B.

ROGERS (Cedric). *Pebble polishing and pebble jewellery.* Hamlyn, London, 1973. pp. 80. Illustrated in black-and-white and in colour. £1·25.

A clear account of the methods of fashioning pebbles and crystals into simple jewellery, this book in no way adds to our knowledge on any aspect of the subject. The market must be well over-subscribed by now. However, the material is unexceptionable, although the author is in some confusion over the terms silica and silicates. Sphene and peridot are given as harder than or as hard as quartz; the spelling of "chrysopaze" seems an unnecessary whimsicality. Diamond is said to be 4 times harder than corundum. With these reservations the book is well-produced and the illustrations, some from the Geological Museum, are good. M.O'D.

ASSOCIATION NOTICES

MEMBERS' MEETINGS

ANNUAL GENERAL MEETING

The 44th Annual General Meeting of the Association was held at Saint Dunstan's House, Carey Lane, London, E.C.2. on the 25th April, 1974 at 6.00 p.m.

The Chairman, Mr Norman Harper, welcomed members and commented:

"The branches have been very active during the year and I would like to thank all those persons who have lent support and made the branch meetings most successful occasions. After the summer the Nottingham Branch of the Association was formed and it got off to a very good start. Fellows have helped by giving talks throughout the year, in particular Mr Basil Anderson, Mr Eric Bruton, Mr Alan Jobbins and Mr Robert Webster."

Mr Harper expressed the Association's thanks to Mr John Chisholm who had done an excellent job during the year as Editor of the Journal of Gemmology.

Entries for the examinations were once again very high and the Tully Medal was awarded to Dr George Hamel, of Holland, and the Rayner prize of instruments to Mr Patrick Daly, of Chelmsford. In the Preliminary examination the Rayner Prize was awarded to Miss Lorraine Fish, of London.

Unfortunately during the early part of the year the Association lost the greatly valued services of Professor S. Tolansky, who died on the 4th March. He had been an examiner of the Gem Diamond Course for many years.

The Chairman said that although Mr Gordon Andrews retired as Secretary at the end of March we did not lose him completely, because in November he came out from his country retreat into London to present the awards gained in the 1973 examinations. Members may have read about the special dinner held at the Goldsmiths' Hall in conjunction with the National Association of Goldsmiths in March to honour his retirement. Gordon Andrews was instrumental in building up the Association to the strong position in which it finds itself today and the dinner was a fitting occasion to mark such a long period of work for the benefit of gemmology.

"Among the gifts to the Association", the Chairman continued, "I must mention that the Gemmological Association of Australia was good enough to send a large collection of Australian gem minerals which had been donated by its members. This collection is particularly interesting because almost every item gives the mining locality. This is the second time of making this gift. Regrettably the first collection of specimens was lost in the post, but the Australian gemmologists were not to be daunted and set about getting together the second collection.

"Once again Gemmological Instruments Ltd had a successful year and could have sold many more instruments, if Rayners could have improved production. Nevertheless we do thank Rayner and Keeler Ltd for their generosity in continuing to give prizes in connexion with the Association's examinations.

"The Annual report has been circulated and I have only elaborated on some of the important work that has been done during the year."

The Treasurer commented that membership had improved considerably during 1973, which had resulted in a larger surplus at the end of the year. However, the volume of work had increased and it was necessary to increase the staff. This would result in a larger payment to the National Association of Goldsmiths in 1974 to cover the extra cost.

Mr Robert Webster in seconding the Annual Report and Accounts expressed pleasure that it had been a most successful one and thanked the Secretary and staff for all that they had done.

Dr G. F. Claringbull, B.Sc., Ph.D., was re-elected as President of the Association and Mr Norman Harper and Mr Douglas King were re-elected as Chairman and Vice-Chairman respectively. Mr F. E. Lawson Clarke was re-elected as Treasurer. Messrs T. H. Bevis-Smith, M. Asprey and D. J. Ewing were re-elected to serve on the Council.

The Chairman announced that Messrs Watson Collin & Co., Chartered Accountants, had signified their willingness to continue as Auditors.

In concluding the meeting, the Chairman took the opportunity of expressing the Association's thanks to the Goldsmiths' Company for the ready willingness of the Wardens to place various rooms at Goldsmiths' Hall at its disposal for meetings. The Wardens readily respond whenever it is convenient and the Association was greatly indebted to them.

London

An entertaining talk on his travels in diamond- and gem-producing countries was given by Mr Eric Bruton, member of the Council, author of "Diamonds" and initiator of the gem diamond classes in London.

Held at the Goldsmiths' Hall on 26th March it was illustrated from his collection of some 400 slides.

Starting with Guinea in 1960, it covered Lesotho, Botswana, South Africa and the South West coast, together with Ceylon and Thailand.

Many of the pictures illustrated historic aspects of diamonds, such as one showing the monument erected at the spot where the first alluvial stones were found in 1869, and the preserved buildings of Kimberley. Mining was still being carried on in the old manner by individual diggers in an area held by De Beers, he said, though the numbers working the ground had shrunk from hundreds to about a score. There they still used the rotary paddle washers which were similar to those used at the mines, though the Diamond Research Laboratory, which was studying them, still did not understand exactly how they worked.

In the Vaal River area there was a glacial pavement some 250–300 million years old carrying a bushman's engraving 2,000 years old. The bushmen were believed to have been the true discoverers of African diamonds, having been found carrying them from very early days.

He described even more primitive mining methods in Ceylon and Thailand, where one man would work in temperatures of 100°F in a hole from which he would excavate passages. Beer bottles were being used to form Leclanché cells in one "plating shop" he saw.

A photograph of a 10 foot high golden Buddha in Thailand drew murmurs of admiration. He said it had been covered with plaster for 300 years and was thought to weigh 5½ tons. "I reckon it must be worth £10 million", he said.

At the end of the talk he showed some interesting stones including a tetrahedral diamond of about 1 carat, which he had found in a De Beers "junk box". "It had been thrown there because it did not fit into any known category", he said, "and is the only known crystal of its kind in the world. It is being studied by Professor Andrew Seager, of the Geological Department of Birkbeck College, who plans to write a paper on it".

Midlands

On the 22nd March, 1974, an evening was spent by Midlands Branch members at Warwick University, near Coventry. Dr P. W. MacMillan gave a talk illustrated by slides, followed by a tour of his laboratories. Dr MacMillan, the country's leading authority on research into toughened ceramics for industrial use, has produced, as an unexpected by-product of his research, several synthetic gemstones, notably synthetic kunzites.

A talk was given in Birmingham on the 3rd May, 1974. Mr Alec Farn, F.G.A., who succeeded Mr Basil Anderson in charge of the Gem Laboratory in London, spoke on the work of the Laboratory, with the accent on pearl testing.

The Annual General Meeting of the Midlands Branch was also held on the 3rd May. Mr John Marshall was elected Chairman, Mr M. Kirkpatrick Vice-Chairman, and Mrs Susan Spence Secretary. Thanks were expressed to Mrs S. Hiscox and Mr G. Porter, the retiring Chairman and Secretary respectively. Messrs G. Millington, D. Morgan, C. Hundy and G. Porter were elected members of the Committee.

Nottingham Branch

Mr M. J. O'Donoghue, M.A., F.G.A., gave a talk entitled "Gemstones of Central Africa" on the 8th April, 1974, in Nottingham.

On the 27th May members of the Branch visited the Institute of Geological Sciences, South Kensington. This trip was arranged with the co-operation of Mr E. A. Jobbins, B.Sc., F.G.A.

GIFTS TO THE ASSOCIATION

The Council of the Association is indebted to Mr M. Sevdermish, Wembley, for specimens of synthetic diamond, 40/50 mesh, G.E.C., U.S.A., and borazon II, cubic borazon nitride mesh 60/80, nickel-coated.

OBITUARY

Mr Louis C. Siedle, Hong Kong, Tully Medallist 1952, died suddenly on 16th April, 1974, aged 51 years. In 1969 Mr Siedle moved from Ceylon where his family had been prominent members of the gem trade for three generations.

Mr Vernon G. Kirk, Ferring by Sea, Sussex. D. 1930. died on the 10th March, 1974.

EVENING CLASSES IN GEMMOLOGY

At the Poole Technical College, North Road, Parkstone, Poole, an evening class in gemmology is being set up to commence this coming autumn. A lecturer is required and anyone interested should communicate with Mr A. J. Pittam, Lecturer in Charge Geology/Gemmology, at the address given above.

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