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and

PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

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GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN
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GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

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NEEDLES IN CORUNDUM OTHER THAN RUTILE

By W. F. EPPLER

RECENTLY, a paper was published with the description of inclusions of corundum in corundum(1). The stones in question are light blue sapphires with a tinge of green or brownish or purple-coloured corundums respectively. They are found in the Umba mine near the river Umba in the Northeast of Tanzania in the neighbourhood of the Kilimanjaro mountain.

The inclusions are elongated needles which, at first sight, seem to be similar to the well known rutile needles that occur in so many corundums. They are shown in Fig. 1. The picture shows that the needles follow three directions, which appear to be at right angles to each other. Fig. 2 confirms this impression, but in reality they differ from the right angle to a small but certain amount. According to the above mentioned publication, they run at right angles to the faces $(42\bar{1})$, $(\bar{2}2\bar{1})$, and $(\overline{24}\bar{1})$, which represent the faces of steep hexagonal pyramids. With an X-ray analysis it could be found that the "needles" consist of corundum and that they are in "twin positions" to the host crystal. Surprisingly, each of the needles is again twinned parallel to the prism faces of the host corundum. Furthermore, the needles are of secondary origin with respect to the surrounding corundum crystal. This and the fact that the inclusions are the cause of a considerable tension make it likely that the needles are originated by pressure. But this theory is not yet proved.

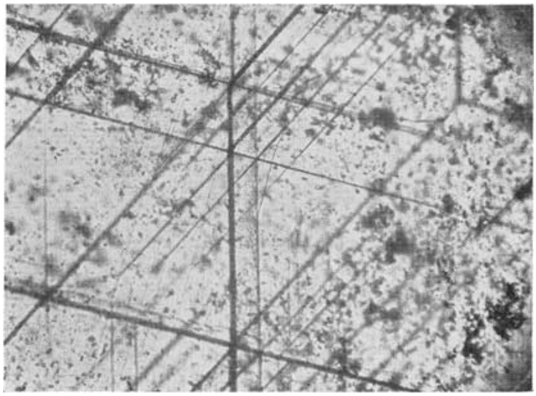

FIG. 1. Light blue sapphire from Tanzania with strictly orientated dark needles of corundum accompanied by a great number of small and rounded zircons (here out of focus). 22 ×

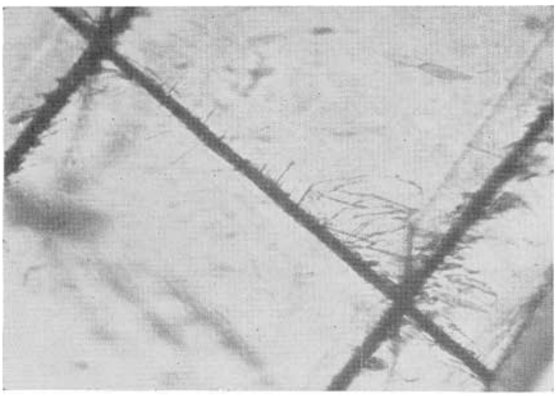

FIG. 2. Same sapphire as in Fig. 1 at a greater enlargement. The needles appear to be perpendicular to each other. 65 ×

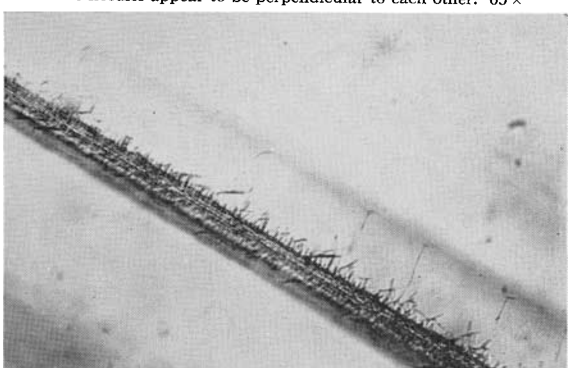

FIG. 3. A light violet sapphire from Tanzania with part of a needle and "fringes". 120 × (As Fig. 1 taken from Ref. 1)

Fig. 2 reveals some very fine cracks starting from the needles. They are shown at a higher magnification in Fig. 3 and are considered to be tension cracks. It is assumed that they are also the cause for the opacity of the needles.

The rubies and sapphires from Tanzania did not reach the market before 1960. Their particular "needles" could be considered as a hall-mark for corundums of this occurrence. But this is not possible, as rubies and sapphires from other and long-known localities include similar needles. In a small but very good coloured blue sapphire from Yogo Gulch in Montana, U.S.A., a group of the same needles could be observed, intersecting each other at nearly right angles (Fig. 4). There is no doubt that they

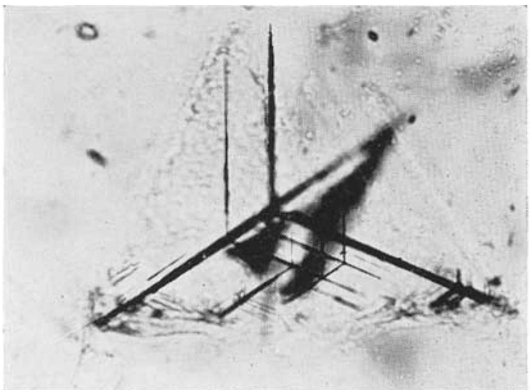

FIG. 4. Montana sapphire with a group of nearly rectangular intersecting needles. 120 ×

also consist of corundum. Even the famous "Mogok Stone Tract of Burma" has produced rubies with these particular inclusions. They are exhibited in Fig. 5. It must be confessed that these corundum needles are very small and that they can be overlooked very easily or mistaken for rutile.

Corundum, as an inclusion in corundum, was first mentioned by P. C. Zwaan(2), who described it as "some platy colourless inclusions". H. J. Schubnel(3) characterized the "needles" in the Tanzanian corundums as a kind of dislocation, an opinion which later proved to be correct.

Another rarity could be observed in a light-brown-coloured sapphire from Tanzania, as it is exhibited in Fig. 6. This needle runs parallel to the base plane of the sapphire. It is colourless and doubly refractive, with a refractive index somewhat lower than that

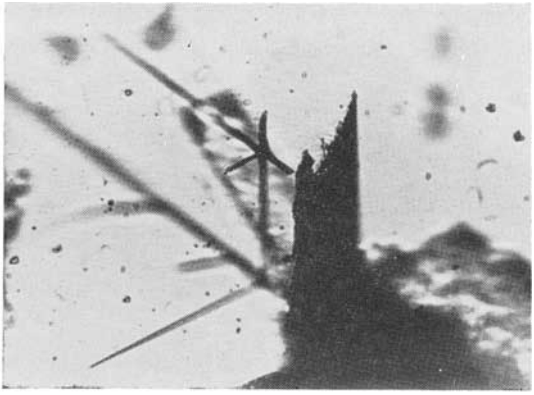

FIG. 5. Ruby from Burma with corundum needles. 228 ×

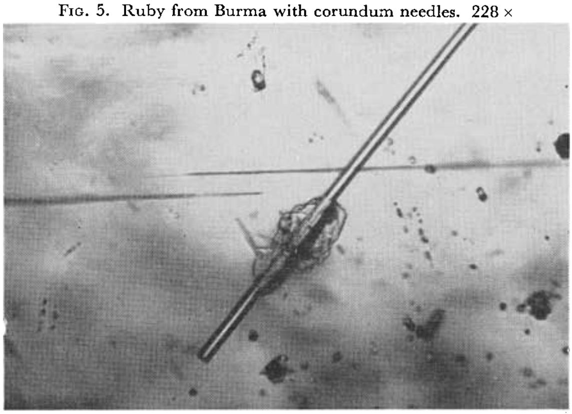

FIG. 6. A long and colourless needle (apatite ?) in a light brown sapphire from Tanzania. 65 ×

of the corundum. Therefore it is assumed, that this needle represents an apatite crystal, the mean R.I. of which is not very different from 1·64 (against 1·76 of corundum). In the lower part of the needle is a small tension crack and in the middle of the picture are two needles of corundum, running horizontal and parallel to each other.

The sapphires from Tanzania with the very interesting needles of corundum are a generous gift from Mr. R. Biehler, the owner of the firm Ernst Faerber in Munich, to whom the author owes a debt of gratitude.

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GEMS IN COURT*

By R. WEBSTER

THROUGHOUT the ages the high value of gems and jewellery has led to villainy. There are notable cases and cases of minor importance in themselves, in which the gemmologist has made a contribution either to convict a villain or to prove the innocence of someone suspected of an offence.

What is probably the first recorded use of science in forensic matters was the problem set Archimedes in the 3rd century B.C., which led to the famous principle which is the basis of density determinations.

The spoils of war rather than pure villainy was the stealing of such famous stones as the Koh-i-noor diamond and the Timur ruby when the Shah Jehan sacked Delhi in 1739. More reprehensible was the stealing of the diamond necklace by Lamotte, a piece of villainy which helped to send Marie Antoinette to the guillotine. Those troubled times in France saw the theft of the Regent and Hope diamonds from the Garde Meuble, but all of these events are part of the history of the world.

The 1880's brought the "reconstructed"—or "Geneva" rubies, stones whose genesis is still in debate. It is recorded that at this time a Berlin jeweller bought a parcel of rubies which were found, by the Paris Syndicate of Jewellers, to be small real rubies fastened together (they did not say how). The Zurich jeweller who sold the stones refused to take them back, as he said that the guarantee was only for the genuineness of the stones and not their size.

A report of 1893 referred to a dealer who had bought a ruby from a jeweller and later had suspicions that it was a doublet. An attempt was made to obtain redress through the process of law, but in those days there was no technical evidence available to guide the Court and the decision was made to cancel the contract.

The famous case (about 1911) of the Max Mayer pearl necklace, which was originally part of the Portuguese Crown Jewels, while certainly a *cause célèbre*, was purely a detective investigation and gemmology was not involved.

1921 brought the cultured pearl and with it immediate problems, for there was at this time no conclusive way by which they

* Taken from a talk given by Mr. R. Webster F.G.A., to members at Goldsmiths' Hall, London on the 25th January, 1972.

could be identified. The cultured pearl dealers wanted this—for them a happy state—to continue and in furtherance of this instigated a prosecution under the Merchandise Marks Acts against a William Bullock, who traded as O. Toshimo, for selling a "cultured pearl necklet" which was actually a shell-based imitation pearl necklet. Normally such a case should have taken little more than an hour of the Court's time. The case took three days, due to the fact that the prosecution called two experts whose main object seemed to be to emphasize that cultured pearls could not be identified unless cut open. These experts were Dr. Lyster Jameson, technical adviser to the Board of Agriculture and Fisheries, and a Mr. A. F. Calvert, a mine owner and expert on pearl culture who had written a book "Pearls and pearl culture". Bullock was fined £20 and the magistrate awarded £20 costs only saying "I have taken into account the excellent advertisement the prosecutors in this case have had".

During 1925 a Paris Court, in respect of a case brought by the *Chambre Syndicale des Negoçiants en perles et diamants* against certain cultured pearl dealers (L.Pohl *et al*), brought in a decision that cultured pearls were real pearls. This left confusion worse confounded. In this same year a William Giles was charged with attempting to obtain money by false pretences in that he passed off a cultured pearl tie-pin as a real pearl. After a preliminary hearing at Marylebone Police Court the case went to the Old Bailey, when it was found that the exhibit produced was not the same pearl pin that had been shown in the lower Court. Despite this the case was thrown out only after considerable argument on the lack of proof as to whether a pearl was cultured or not. Probably through the fact that better methods of detection had then come about the decision of the Paris Court of 1925 was reversed and cultured pearls were ordered to be sold as such and not as real pearls.

The first criminal prosecution in which a qualified gemmologist provided expert evidence was the case of John Rice (1935) who had successfully deceived pawnbrokers with zircon-set rings. B. W. Anderson gave evidence for the prosecution and for the first time used as pictorial evidence transparency pictures taken by X-rays.

The same year brought forth the "synthetic diamond" scare, when a bond Street antique dealer, Victor Jourado, got exceptional press publicity on "synthetic diamonds", which were in reality synthetic white spinels. Owing to the widespread press publicity the London Chamber of Commerce decided to allay the public's fears by radio broadcast based upon the laboratory report rather than take action through the Courts against Jourado.

About a couple of years later C. J. Payne gave evidence in a civil case where it was inferred that a sapphire in a ring had been sold as a genuine sapphire whereas it was a synthetic stone. The stone presented to the Court, which was indeed a synthetic sapphire, was found to weigh less than the weight of the stone as recorded in the jeweller's stock book, and it was denied that the stone produced was the original stone sold. Under cross-examination the plaintiff disclosed that whilst she was on holiday in the near-east the ring had been given to a local jeweller to repair, and had, therefore, been out of her hands. The case collapsed.

At the beginning of the war there were two reports on diamond doublets, Tisdall reporting on the first one (1941) and myself on the second (1943). This last stone was seen by the Officers of the Diamond Section of the London Chamber of Commerce who purchased it to take it off the market, and, further, as no litigation had occurred in either of these cases, the Board of Trade put out a warning notice. A third diamond doublet was an exhibit in a case which came before a Court at Liverpool, and in 1944 there was a case involving an alleged "painted" diamond.

There have been a number of cases where imitation pearls have been involved. The most important was the trial for murder of Neville Heath, who, after killing a prostitute in Notting Hill, went to the South Coast where he murdered a WREN at Branksome Chine, Bournemouth. The WREN was wearing an imitation pearl necklet and during a struggle this necklet broke scattering the beads, one of which fell into Heath's jacket pocket, later to be found by the police, who also recovered 27 of the beads from around the dead girl's body. These 27 pearls, and the one from Heath's pocket, were taken to the London Chamber of Commerce laboratory for examination in order to see if they matched.

The pearl found in the pocket was prime evidence and could not be damaged in any testing procedure. The pearls were compared with one another for colour and the diameter of the string holes measured and densities taken. The density was found to be 2.53 and was a value lower than recorded in literature for that type of imitation pearl. This difference was attributed to the manufacturer being unable to obtain the normal "alabaster" glass; this was just after the war when things were not normal. From the data found Anderson testified in Court that the pearls were similar..

Another case concerned a suspect alleged to have stolen a number of imitation pearl necklets from a store. the prime evidence being that a similar necklet was found in possession of his daughter. Sprectrograms taken of the glass of the beads in the necklet belonging to the daughter and those from the stock in the store showed the glasses to be different and the suspect was then released. A third case concerned the older "Roman pearls", hollow glass bead type or wax-filled type. These pearls had been burnt in a fire and for some undisclosed reason the probable date of the pearls was needed. It was ascertained that they were not made in France after about 1930, and indeed it was proved that the owner had visited Paris about that time, and had bought a necklet.

It will be readily seen that for forensic purposes a very different attitude must be taken from that usual in ordinary gemmological considerations. Not only must the nature of the bead, and indeed of the glass, be carefully determined but also the coating, for this can vary greatly, not only in the bonding used for the "fish scales" but in the "fish scales" themselves, for there are a number of synthetic iridescent compounds used. Far too little work has been done on this subject.

The 1950's brought a spate of Court cases including two which concerned burglary. The first of these involved 23 small diamonds weighing together 0.53 carat, which were presumed to have been forced out of jewellery settings with pliers. To illustrate to the Court the likelihood of this a photomicrograph of the broken edges of two stones was produced in Court. The second case concerned a large emerald-cut diamond which had been stolen from the widow of Leslie Howard. Apprehended by the police after he had tried to sell the stone to a jeweller the villain was tried and sentenced. I gave evidence as to the nature of the stone and, when I was preparing my report, Anderson to save time weighed it for me. Right out of the blue I was asked by the defence "Did you weigh the stone?". Somewhat disconcerting and a salutory reminder always to do everything yourself.

There have been several incidents where faked diamond crystals have been found in parcels of rough diamonds. Synthetic sapphire and beryl are among materials which have been cut in octahedral form.

1953 brought the German synthetic diamond fraud where Hermann Meincke and his family defrauded a group of German industrialists. When the manufacture was investigated by a scientific commission it was discovered that Meincke's neice, Edeltraub, was dropping natural diamond crystals, which she had secreted under her long finger nails, into the crucible. Miencke was tried, found guilty and sentenced to three years in jail. The decade ended with the first Court case in England where strontium titanates were used as fraudulent diamonds.

The trials which can beset a jeweller are well exemplified by the following story. A few months after having her cultured pearl necklet restrung a lady found that some of the pearls had unaccountably darkened. Seemingly not satisfied with the jeweller's reply when she went to him, for the jeweller himself could not offer an explanation, the lady went to the police. Laboratory investigation was suggested and this showed the cause to be grease, probably from cosmetic creams, which had percolated via the string to the discontinuation layer between the bead nucleus and the outer nacreous layer.

Two intriguing examples of criminal investigation were carried out by an Australian Police Officer, who is also a qualified gemmologist. The story of the first of these was that an emigrant from England informed the Australian Police that before he left England he was offered an unmounted red stone by a stranger whilst he was in London's east end. The stranger first asked £5 for the stone but no one took up the offer. The stranger said he would throw it away, but eventually gave the stone to the emigrant. This was in 1959, and some years later the emigrant's wife found this red stone among some junk and thought she would like it mounted as a dress ring. The jeweller to whom he took the stone advised him to have it insured as he thought that it was a real ruby. Several jewellers examined the stone but could not be sure of it. The emigrant became worried in case he had received a stolen ruby and took it to the Police for examination and enquiries, and mentioned that he hoped for a reward.

Sgt. Barrie Cox examined the stone and thought that it was a Siam ruby but felt he would like confirmation. He wrote to me giving me all the details he had found on this 11.68 carat stone. The details given were excellent and with the letter there were 16 35mm transparencies of the stone and its inclusions and these were excellent.

There was no doubt that it was a Siam stone. Scotland Yard were informed but despite investigation there was no report of such a stone being lost or stolen. The case was dropped, the stone handed back and that was all.

The second case in which Det/Sgt. Cox was involved was in pursuance of a murder enquiry. It was found that gravel from a suspect's clothing contained small tourmaline crystals having characteristic inclusions, and these matched similar crystals found in the gravel at the scene of the crime. This destroyed the suspect's alibi.

The preparation of pictorial evidence by X-ray photographs can provide surprises. An example of this was when a parcel of diamonds was checked by this method and was seen to contain a "foreigner" which stood out strikingly. No attempt was made to isolate this "stranger" but it was reported in evidence. Probably with a view to discrediting a witness the defence did sort through the parcel and found the piece—it was glass. Another picture revealed a break in a ring shank which had been overlooked during physical examination.

A surprising episode occurred some years ago when a merchant called at the London laboratory and asked whether a stone in a sealed packet could be identified as a diamond or not without the packet being opened. The story was that a dealer had left the sealed packet to cover a loan but that there was some suspicion that things were not quite right. X-ray pictures were taken using various stones as controls, and by the degree of transparency it was proved that the stone was not a diamond but could possibly be a spinel. However, the packet was redeemed and as both persons have died we shall never know the answer.

Another case, which could have gone to law, was the discolouration of a cornelian stone in a pair of cuff-links. Brought in by a manufacturer's agent the stone was seen to have discoloured to a pale yellow around the edges and we were asked to explain this happening. I suspected seepage from a dip bath but it was denied that such a procedure was used. Eventually by dint of questioning it was found that in this particular case this dipping in a sulphuric acid bath had been done.

Anticipating questions from an opposing counsel is a matter always worth considering when acting as an expert witness. Such questions as 'Is it a pigeon's blood ruby"? has been often asked, but here the answer is easy. Less easy to answer are such questions asking for the meaning of synthetic, artificial or imitation.

Finally, the case of the so-called "Deepdene diamond" last year is a classic example of the value of gemmological investigation, for if it had not been reported, as it was just before the sale, that the stone was artificially coloured, then no one knows what future litigation would have been in store.

THE ORIGINS OF "DIAMOND"

S. B. NIKON COOPER, B.D., F.G.A.

DIAMOND—the gem most used by jewellers, and because of that the most familiar name of any among gemstones. A name of associations; a name to conjure with; and a name also that has a pedigree stretching back to nearly 2,500 years.

Our term comes from the Greek: *'Αδάμας* (α privative = 'not'; *δαμαν* = to "subdue", to "conquer") hence: "Unsubdued", "Invincible". We find it first applied to a stone with *Theophrastus*, 4th century B.C. Greek philosopher, in his work: "*Περὶ Λίθων*"—"On Stones". Speaking of "incombustible stones", he almost casually refers to the *'Αδάμας*—which therefore by inference, would be an example well enough known to his students. Unfortunately, he does not go on to describe it, and so we are left with the "unsubdued (by fire)"—a description which could apply to many minerals at his time; but which, almost certainly, did not include our diamond.

Nor do we find any reference to "*Αδάμας*" in the Septuagint (2nd century B.C.)—the "diamond" of our English Bibles being ascribed in every case to some other Greek stone.

The next use of the term comes with *Pliny* (1st century A.D.) in his "Natural History", the letters being simply transliterated from Greek to Latin, with the resulting form: "*Adamas*"—incidentally, the most popular name of any for "diamond" through the ages: we find it occurring with Marbode (11th century); in the 13th century Lapidaries of Arnold, Thomas and Bartholomew; and even as late as 1546, with Agricola (De Natura Fossilium). With Pliny, the legend of diamond's "invincible" character is fully developed: the "hammer-and-anvil" myth, which we will see quoted time and time again by later writers, is given here. A true adamas is so hard that it will "resist the blow . . . cause the iron to rebound, and the very anvil split asunder." (Book 37: Ch. 15). It is fortunate indeed that the "warm blood of a goat" is near at hand should the stone have to be cleaved!

This departure from his otherwise exact and scientific observations can mean only one thing: the "adamas" was rare to the Romans—so rare that Pliny could not verify the stories that had been told him. But, was it "diamond"? Pliny knew of six "varieties", all of which have been variously identified. However, the fact that he labels most of them as "degenerate" would seem to imply that he knows (even at second-hand) of the true "invincible" stone.

Reverting to the name, the next development is with *Isidore of Seville* (7th century) in his "Etymologiarum", "adamas" becoming "*Adamans*". Incidentally, we can see that with the decay of the Roman Empire the diamond lost its popularity. Smaragdus (emerald) is the first stone. Diamond in fact, in his colour classification, comes after "crystal"; and most of the facts he gives are borrowed, re-told from Pliny. One feels that the diamond now is more valued for its ability to work other stones (. . . "gemmis insigniendis perforandisque.")

And here throughout the Middle Ages the name rests, either "adamas" or "adamans". The only development being with the application of its "powers". Hence by the time of *Marbode* (11th century) the magical aspect is all-important. If it is bound on the left arm it is a sure charm to make the bearer invincible. His enemies will be repulsed; likewise in lawsuits. He will be invulnerable to ghosts, false dreams at night, poisons, and even insanity!

We move on now to the 15th century. This was particularly a time when spelling was of less importance. In some MS. (example: Peterborough 33) we find as many as eight different spellings for the same term. However they show a phonetic trend. Thus, in the *Peterborough MS.*, "adamans" becomes "*Adamant*", with next, the important step of the added extra syllable: "*Adyamant*". A still greater change comes with the *Douce MS.* (Douce 291)—with the dropping of the first "a" of the name. This, although it makes nonsense of the strict derivation (i.e. "diamond" now becomes "vulnerable"!) yet English euphony demanded it, and from now on, all the spellings start with a "D". So "*Dyamaunde*"; or again, even more close to our own, with the "y" becoming "i": "*Diamaunde*". Back in the Peterborough MS., the next stage follows swiftly: "*Diamounde*", and even "*Diamonde*".

Incidentally, these MSS. provide indisputable proof that they were referring to our "diamond". We read (Peterborough 33): "iiij cornered in schap"; "resonable to ye colour of cristall"; coming from "ynd" (India); and again—that faceting, for diamond, is still unknown at this time: "no man may amend him of bewte ne polissh him". To compensate for this, its magical value had now increased: to the previous long list is added the virtue of protecting you from falling off your horse or your wife from a miscarriage!

We have only one more step to take in our journey of derivations—to drop the final "e" to become the diamond of modern-day spelling. This occurs for the first time at the beginning of the next century in the "Speculum Lapidum", or "Mirror of Stones", by *Leonardus Camillus*. He writes of "*Diamond*"—our spelling and our stone. And with him, the Age of Science is almost upon us. No longer are the old statements quite so unquestioned. The first blow against Pliny's "anvil" myth is at last struck: "I have seen many broke with the Blow of a Hammer" says Camillus.

The myth died hard however. Many a diamond had yet to be maltreated in this way before its superiority would be assured for other quite different reasons. But "diamond"—the stone, and the spelling—has now reached the front of the book—the first stone to be discussed—*the* first stone of the jeweller from this time onward.

A COMPARATIVE STUDY OF RHODESIAN RHODOLITE GARNET IN RELATION TO OTHER KNOWN DATA AND A DISCUSSION IN RELATION TO A MORE ACCEPTABLE NAME.

By IAN C. C. CAMPBELL, F.G.A.

THE final remarks by B. F. Martin in his study of rhodolite garnet as published in the April 1970 *Journal of Gemmology* (Vol. 12 No. 2), that more investigation is required of this subject, has prompted me to make some form of a comparative study of what has proved to be rhodolite garnet of known Rhodesian origin. Twelve stones have been chosen for this purpose.

It is hoped that the above-mentioned author will have no objection to the reproduction here of the main points of his study. These constants will be shown again in schedule form later when comparison is made with the results of the Rhodesian stones. The data are as follows:

1. The only constants (R.I. 1·76 and S.G. 3·84) that appear to be quoted to date (apart from Martin's study) are apparently based on rhodolite from Cowee Valley, Macon County, N. Carolina. Martin did in fact measure the R.I. of a known Carolina stone and found it to be 1·758, but the only reference to specific gravity was that it (and 11 other test stones from a different source) sank rapidly in pure methylene iodide and at about the same rate. (The S.G. of methylene iodide being about 3·32–3·33).

2. The refractive indices of the 11 test stones all fell within the narrow range between 1·745 and 1·750, giving an average of 1·747. This falls near the middle of the range for pyrope. It was brought to notice that the apparent variations of the upper limit for pyrope, as given by different authors, are 1·751 to 1·76 to 1·77. (1·77, by Webster, has since been amended to 1·75 in a later edition of "Gems").

3. Definite information recorded in standard works is that rhodolite shows the absorption bands characteristic of the almandine spectrum. Martin's known Carolina stone, as well as the 11 test stones, showed similar results.

4. Difference in the habit of included apatite crystals relative to the known Carolina stone and 4 of the test stones (the others showed no distinct inclusions) suggested that the latter mentioned batch originated from a different source (possibly Tanzania).

5. References were made to the report by Webster that the composition lies between pyrope and almandine in the ratio of 2:1.

6. The important visible feature of rhodolite is that of colour which is said to be from a rose-red to pale violet.

The aforementioned are, in essence, the data extracted from the study by Martin, and would suggest that a further investigation into this variety—particularly from known sources—may assist in clarifying, or widening, the already known optical and physical constants of this variety—furthermore, perhaps even bridging the obvious gap between the previously stated values and those by Martin. The following study of Rhodesian rhodolite garnet (from a known source) appears to fit into this "gap" remarkably well.

The Rhodesian Stones

Robert Webster made available to the writer two known Macon County stones which were used for the purpose of colour comparison with the Rhodesian stones, the latter obviously falling within the qualifying colour range.

The stones are extracted from what is apparently a loose and crumbly, pale green form of biotite at a depth of between five and fifty feet from the surface (which is roughly as far down as the workings have gone to date). The garnets are said to be easily extracted and are in profusion. An interesting development, according to the owner, is that the colour of the stones appears to grade off from an extremely dark red at one end of the claim to a paler pink at the other end—the intermediate colours ranging through the reddish and pinkish to violet. The stones, as found, do not appear to have any particular form and from the batches examined are of a fragmented nature, as though red glass had been taken and broken into smaller pieces.

The test specimens are numbered R.1 to R.12 inclusive. Polished flats were put on approximately opposite sides of most stones in order to make microscopic examination somewhat easier, immersion liquids being used when required. The flats were also necessary in order to measure the refractive indices. A Rayner refractometer and sodium light source were used.

Specific gravity was computed hydrostatically with the use of absolute alcohol. The instrument used was the latest type electric Mettler H.800 C. metric carat balance, the accuracy being to within 0·002 gm. A Westphal balance was used to determine the S.G. of the alcohol at the time of the test.

These values are reproduced in graph form at the end of the article. A direct comparison is thus achieved and is perhaps represented in a more coherent form.

Comparison Tables

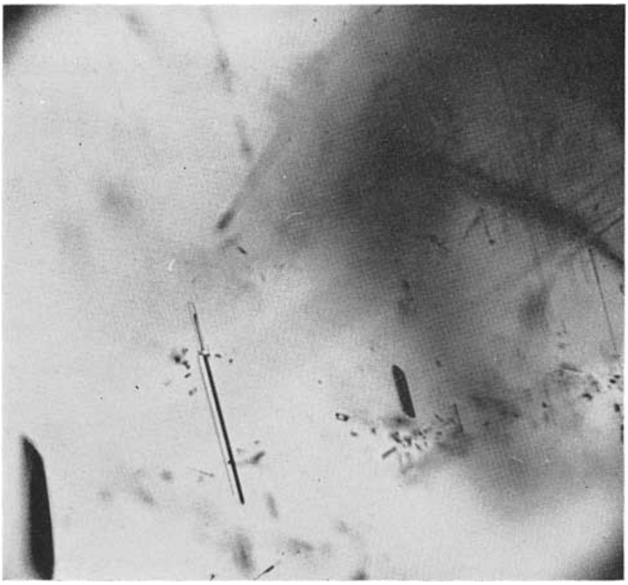
Origin	*Specimen No.*	*Wt. Metric Carats*	*R.I.* (*Isotropic*)	*S.G.*	*Reaction to:*		
					S.W.U.V. 2540Å	*Chelsea Filter*	*Almandine Spectrum*
Rhodesia	R.1	3·383	1·757	3·87	All stones inert	All stones: Colours a shade deeper	Medium
	R.2	2·646	1·758	3·89			Pale
	R.3	2·510	1·750	3·83			Medium
	R.4	1·886	1·759	3·86			Medium
	R.5	2·280	1·750	3·83			Pale
	R.6	2·540	1·755	3·86			Medium
	R.7	2·279	1·758	3·86			Pale
	R.8	2·290	1·755	3·84			Pale
	R.9	1·990	1·754	3·84			Pale
	R.10	1·318	1·750	3·83			Pale
	R.11	1·047	1·758	3·83			Very pale
	R.12	0·891	1·760	3·89			Medium
Average:	12 stones		1·755	3·85			Moderate to pale
Martin's Test Stones (Tanzania?)	2 stones 5 stones 1 stone 2 stones 1 stone	Not known	1·745 1·747 1·748 1·749 1·750	Values unknown. All stones sink in methylene iodine	Not known	Colours a little deeper but not dulled	3 main absorption bands characteristic of almandine. Moderate intensity
Average:	11 stones		1·747	In excess of 3·33			
N. Carolina: established (Av?) values	—	—	1·76	3·84	Not known	Not known	Characteristic of almandine same as above
"Martin's Stone"	—	—	1·758	Sinks in M/Iodide		Colour little deeper but not dulled	
*Webster: Cut	—	0·42	1·761	3·84	Inert.	Shade deeper.	
Rough	—	1·118	—	3·89	Inert.	Shade deeper.	
Average:	—	—	1·760	—	—	—	—

*Webster's two Macon County stones tend to slightly increase the top R.I. value of the N. Carolina Rhodolite to 1·761 and the S.G. noticeably to 3·89 in relation to previously published figures, although probably the already established figures refer to the *average*. It is realized of course that the additional Carolina values tabled above refer to only three stones.

Inclusions:

Needles:

Orientated needles in nearly all stones, typical of almandine. They run in two directions. Some include needles running parallel to each other and in one direction only. Concentrations vary in each stone, some being heavy and others light. Only one did not show needles.



Inclusions in specimen R.6.

Haphazardly arranged tubes in specimen R.7.

"Zircon" Haloes:

Similar to Ceylon garnets. Evident in four stones.

Minute, Irregular Dot-like Crystals:

Evident in half the stones and ranging from pin-prick sizes, through dot sizes to slightly larger. In varying concentrations in each stone.

Feathers:

Of irregular shape and "rough" appearance (R.9, R.10, R.11). Other feathers appearing like fine flower-type petals but these are strongly suspected as internal fractures.

Smooth Tubes with Rounded Ends:

Some orientated in one direction and comparatively small in some stones (R.10, R.11). Others, by comparison, very large and haphazardly arranged; these larger ones being grouped and in heavy concentrations (R.7).

Specimen R.6 Entirely Different to others in respect of Inclusions:

Wide variation:

(*a*) Orientated needles.

(*b*) Two-phase inclusions: typically parallelogram in profile. Similar to calcite rhomb in form with included thick tube running diagonally within.

(*c*) Thick, larger, orientated tubes of apparently same type as that which forms part of the two-phase inclusions.

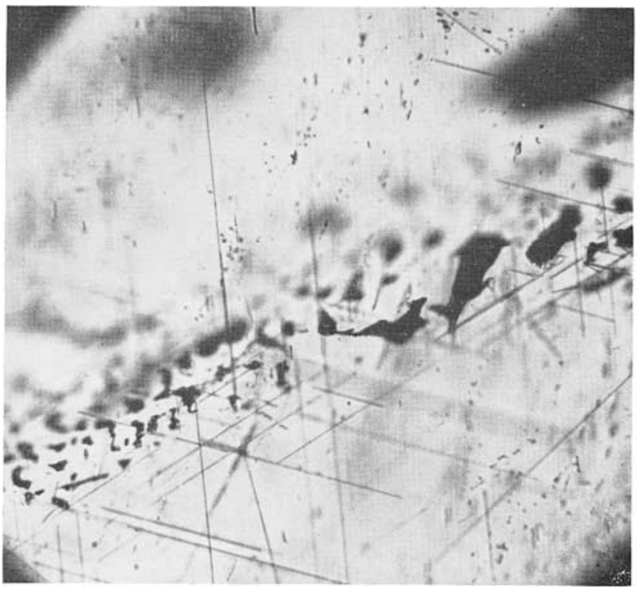
(*d*) Other irregular and geometric patterns.

Although it is not known, without expert analysis, what the above inclusions mainly are, it is obvious that there is no resemblance (except for the orientated needles) to the Carolina stones and the stones of suspected Tanzanian origin. Nevertheless, and ignoring the needles, these inclusions may well confirm the origin of similar stones of previously "unknown" origin. These come from the Beit Bridge district in Rhodesia.

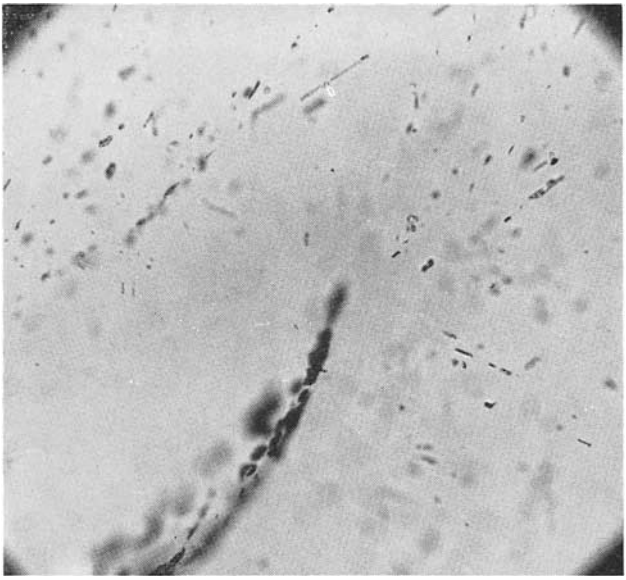
Opinions may vary in respect of what the hue of colour of rhodolite should be. It is understood that certain quarters favour the decidedly or predominatly pink colour as the correct one, other hues they say being unacceptable. Nevertheless, the description is "rhododendron-red", meaning "rose-red". This is at variance with the "pink only" opinions, although pink is part of the colour range.

In addition to the test stones (R.1–R.12) a batch of 50 faceted rhodolites have been examined by the writer. All of them, in-

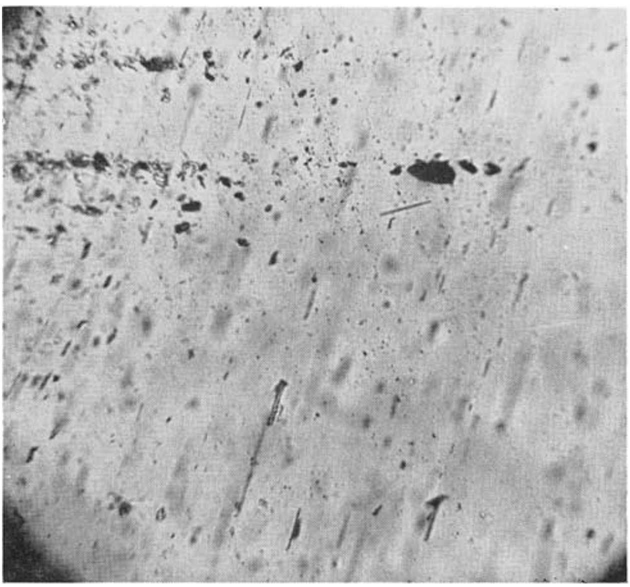
Oriented needles and tubes in specimen R.8.



Irregular shaped feathers and oriented needles in specimen R.9.



Inclusions in specimen R.10.



Irregular feathers and inclusions in specimen R.11.

cluding the test stones, were compared with the two known specimens from Macon County kindly loaned by Mr. R. Webster. This proved useful in that virtually 18 per cent of the 62 stones were practically the same hue as the Macon ones—that is to say, with a tinge of violet. The balance varied from medium shades of pink to reddish-pink (rose-red?).

The specific gravity of these faceted stones was not assessed, but the refractive indices of all stones, except one, were between 1·750 and 1·760 as indicated by the original 12 test stones. The exception gave a reading of 1·749. In view of this it is considered reasonable to accept that the range for the Rhodesian stones lies between 1·750 and 1·760.

An interesting side issue has developed in this study, in that test specimens R.1, R.2 and R.7 showed inclusions of zircon type haloes. It is understood that only Ceylon garnets showed these. Specimen R.12 exhibited a poor example of one.

It has been with considerable interest that I have read extracted reports concerning this particular variety of garnet (as well as others) from such well-known authorities as R. Webster, B. W. Anderson, E. Sarofim, S. Sinkankas, R. Crowningshield and P. C. Zwaan. I am indebted to Mr. Webster for the time he took in offering useful constructive criticism as well as encouragement as a result of having seen my initial manuscript dealing with the comparative study of these garnets from three different sources. I wish also to acknowledge with thanks the loan of the Macon County stones for colour comparisons, as well as the above mentioned extracts which were supplied by Mr. Webster. My thanks as well to Mr. Craig Smith, Keeper of Geology at the (Rhodesian) National Museum for his interest in taking the photomicrographs.

The choice of a more acceptable name and the logical difference in approach to this problem by the dealer and laboratory worker:

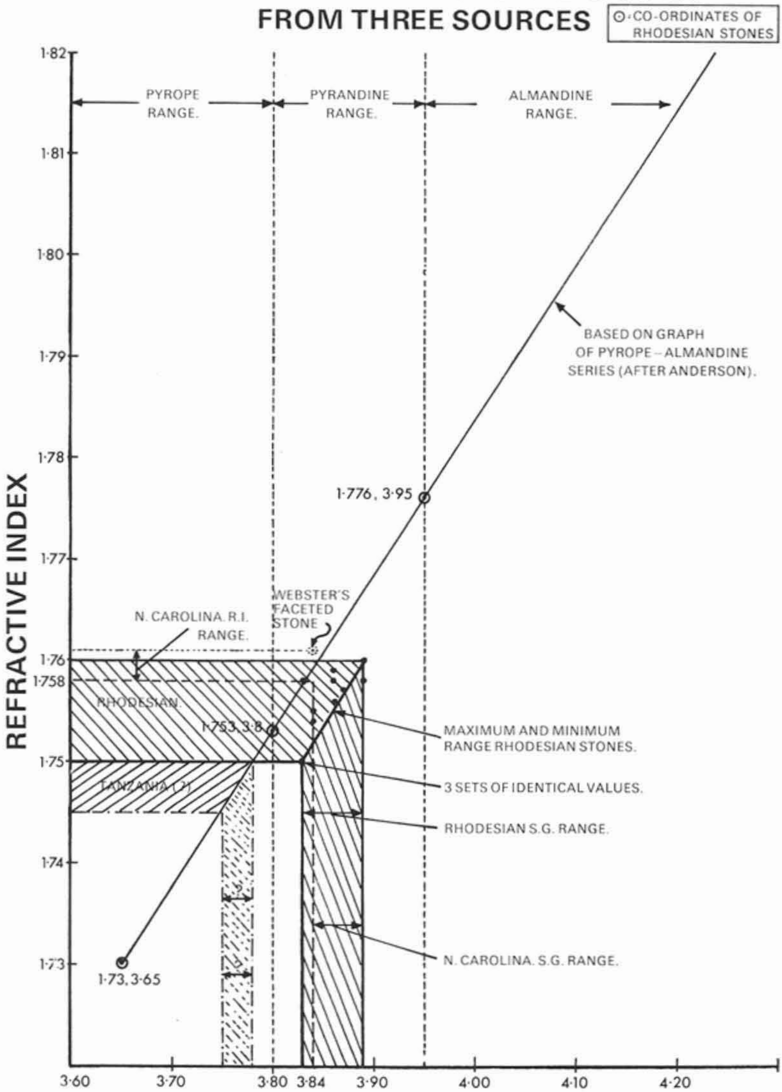
Prior to stones of fair size and colour having been discovered and mined in Tanzania, the name "rhodolite" has been designated to garnets of the rhododendron-red variety specifically from Macon County, North Carolina, in the United States. Apparently while there was only one source of any appreciable significance the name "rhodolite"—while not being suitably acceptable because it sounds too much like "rhodonite", an entirely different gem mineral—has nevertheless been, until now, tacitly accepted as such. Since the discovery of the Tanzanian stones and now those from other sources, this appears to have presented a problem insofar as the name is concerned. Prior to these new discoveries this variety was rarely encountered outside North America.

How does one go about trying to find an acceptable name for a "new" variety?—particularly when it is realised that its only difference from other garnets in the pyrope and intermediate range (with almandine at the other end) is colour and colour alone. The optical and physical constants of the garnet under discussion coincide with those in the upper pyrope to the lower intermediate (or pyrandine) range.

One obviously cannot pin a name on them in much the same manner as has been done with pyrope and almandine. These in themselves are in any case subject to what could be considered arbitary maximum and minimum constants respectively. To put this in another manner, this rhododendron-red variety is itself part of the already established pyrope to pyrandine range. In view of the fact that it is recognised that pyrope is usually blood-red in colour sometimes tinged with yellow or purple, and almandine is a darker or more intense red generally tinged with violet (the intermediate range being blood-red through brownish-red to violet-red tints) it should be recognised that a distinct variety exists also by virtue of its colour. Of course one could call it a pink or pinkish-red to rose-red pyrope or pyrandine, but who other than the interested gemmologist is going to test optical constants every time such a stone crops up in order to classify it specifically as such? An accusation would no doubt be made that hairs were being split—particularly by the dealer. Obviously a name is required which covers the whole variety in accordance with its particular colour. "rhodolite" is undoubtedly fine in this respect—if it were not for "rhodonite".

A difference in approach to a common problem may be expected to exist between two closely associated sectors in the same field but with different outlooks. Reference is made in this context to the dealer and the laboratory worker. While there appears to be no record of any real objections by dealers to the name "rhodolite" it has nevertheless been frowned upon by some in the laboratory—with good reason as already stated. Rhodonite is usually known as an ornamental stone also of rose-red colour as the name

COMPARISON OF RHODOLITE GARNET FROM THREE SOURCES



NOTE THAT, BASED ON AVAILABLE FIGURES, MIN. & MAX. S.G. VALUES OF N. CAROLINA AND RHODESIAN STONES PRACTICALLY COINCIDE, ALTHOUGH THE DIRECT RELATIONSHIP BETWEEN THE TWO IN EACH CASE IS DIFFERENT.

implies. Some suitable transparent material has even been faceted for collectors.

It is apparent that whatever name is agreed upon should have some appeal to public tastes. This is once again the whim of human nature. A well chosen name is more likely to become fixed in a person's mind and thus accepted than one which is purely scientific and possibly uninteresting (be it however well suited). This is from the dealer's point of view. The stone, when properly cut, makes a lively and interesting gem due to its paler colour in contrast to the pyrope/almandine series. After all, if it has appeal and is available in commercial quantities, the public will show more than just a passing interest in it. It has almost the same brilliance as a sapphire of the same colour.

This is not to say that this variety is something which is suddenly new, merely that it appears now to command more notice. Quite likely further sources of supply will be brought to notice due to what appears to be an increasing interest in this respect.

Bearing in mind what I have written—the approach of the dealer and laboratory worker—I would like to suggest that the name of "rhodomacon" garnet be considered. The first syllable relates to the colour (Gr. Rhodon—a rose) and the second one acknowledging the fact that this variety was first discovered in Macon County. This name has some definite meaning. In similar context one has labradorite (which was first discovered in quantity in Labrador) and the name has been accepted in spite of the fact of many other commercial deposits being later discovered elsewhere. There are other examples. Furthermore, the name "rhodomacon" is not unwieldy and is still partly based on the variety's colour.

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Gemmological Abstracts

ANDERSON (O.). *A century of sapphire mining.* Australian Gemmologist, 1971, XI, 3, pp. 11–19.

A slightly abridged copy of an article published in the Queensland Government Mining Journal (1971, LXXII, 832) in which the history of the Queensland sapphire mining is given. Sapphire was first found in Queensland in 1870, the price then being about two dollars (say £1) per ounce. Later the deep blue colour of the Queensland sapphires attracted the nobility of Tsarist Russia and a Russian market was opened up, whereupon the price rose to twenty dollars per ounce (say £10). This trade with Russia carried on until the fall of the Romanoffs. During the period 1922 to 1948 the market was depressed and had to be helped by the Government. To-day there is some serious mining and also some tourist attraction. The present price is much higher, but depends considerably on the quality of the crystals. First quality crystals may fetch anything from one hundred to eighteen hundred dollars (say 40 to 840 pounds sterling). Lower grades may drop to twelve dollars (£5.50). Mention is made of the types of sapphire found. Yellows are increasingly important, greens not highly valued, parti-coloured stones are subject to fashion. There is an "alexandrite" sapphire and dark star-sapphires with a golden sheen. The article tells of the associated minerals, the occurrence and production, much about the mining, prospecting and mining laws, and there is a short list of the large crystals found in Queensland.

R.W.

BANK (H.). *Neue Imitation für Chrysopras.* New imitation of chrysoprase. Zeitsch. d. Deutsch. Gemmol. Gesellschaft, 1971, 20, 3, pp. 132–133.

The author describes a new chrysoprase imitation on the market made out of glass and warns jewellers to be very careful in their examination of these stones.

E.S.

BANK (H.). *Durchsichtiger farblos-weisser bis blassgelber Petalit aus Brazilien.* Transparent colourless-white to pale yellow petalite from Brazil. Zeitsch. d. Deutsch. Gemmol. Gesellschaft, 1971, 20, 4, pp. 172–174.

The stone was found in the Minas Gerais district and at first thought to be a spodumene. It was found to be petalite, the name being formed from the word "petalon" meaning leaf, as the stone has a leaf-like appearance when cleaved. It is monoclinic, has a hardness of $6\frac{1}{2}$, D = 2. 39 – 2.40, and RI = 1.51–1.523. Chemically it is $LiAlSi_2O_6$. H_2O. The author mentions having seen some translucent petalites which were cut as cabochons and showed a cat's-eye effect. E.S.

BANK (H.). *Zoisit-Katzenaugen aus Tansania.* Zoisite cat's-eyes from Tanzania. Zeitsch. d. Deutsch. Gemmol. Gesellschaft, 1971, 20, 4, pp. 175–176.

The author describes chatoyancy in zoisite and stones showing these characteristics have a slightly lower specific gravity (3.29–3.31) caused by the inclusions. E.S.

BANK (H.), BERDESINSKI (W.), NUBER (B.). *Zu den Gitterkonstanten von Topas.* The lattice constants of topaz. Zeitschr. d. Deutsch. Gemmol. Gesellschaft, 1971, 20, 4, pp. 147–151.

Two topazes showing minimum and maximum refractive indices were examined as to their lattice structure. The colourless topaz with the minimum refractive index showed the lattice constants as described in the ASTM index. The violet stone with the maximum refractive index showed larger constants in the a and b direction and a smaller one in the c direction. Thus it was shown that the violet topaz had a larger elementary cell structure.

E.S.

BANK (H.). *Alexandrite aus Brasilien.* Alexandrite from Brazil. Zeitschr. d. Deutsch. Gemmol. Gesellschaft, 1971, 20, 3, pp. 130–131.

The author discusses an alexandrite of 14.17 cts with a good colour change, which is unusual in Brazilian alexandrites. The new stone is said to have been found in Bahia. Former stones from Brazil usually came from Espirito Santo and Minas Gerais. Bibl.

E.S.

CASSEDANNE (J.). *Les diamants de diamantina.* Bull. Assoc. Française de Gemmologie, 1971, 29, p. 7.

30–40% of the diamonds found at Diamantina in the Brazilian State of Minas Gerais are suitable for use in jewellery. The diamonds at this locality are found in association with tourmaline, quartz, disthene (kyanite), phosphates and magnetite but there is no kimberlite nor any of the other minerals usually found with diamond, such as chrome diopside, pyrope garnet and ilmenite. The diamonds are found mostly in quartzites and schists and their occurrence is illustrated with a diagram and a map. Photographs and an account of the methods of extraction leave no doubt of the scale of operations. White stones from this region have a blue phosphorescence.

M.O'D.

CHAMPION (J. A.) and CLEMENCE (M. A.). *Etch pits in flux-grown corundum.* Journ. of Materials Science, 1967, 2, pp. 153–159.

Etch pits were produced in certain planes on ruby and sapphire crystals grown from a fused lead fluoride solution, the etchants used being fused potassium hydrogen sulphate at 700°C from 20–25 seconds, concentrated orthophosphoric acid whose temperature was raised to 290°C over a period of about 75 minutes and an aqueous solution of KOH at 325°C for 10 minutes. It was found that only the $\{0001\}$, $\{1011\}$, $\{1012\}$, $\{1120\}$ and $\{1100\}$ planes would etch. Pitting was found to take place more readily in the basal plane and least readily in the rhombohedral plane. It was thought that the pitting occurred at the ends of dislocations.

M.O'D.

COCKAYNE (B.), CHESSWAS (M.) and GASSON (D. B.). *Single-crystal growth of sapphire.* Journ. of Materials Science, 1967, 2, pp. 7-11.

In an attempt to obtain sapphire crystals in a form other than thin plates which were previously the only forms possible from flux-growth, two alternative methods of growth were tried. The vertical pulling method was modified by alterations to the after-heater. Another technique involved the floating-zone apparatus which was altered to allow the use of a controlled atmosphere preventing excessive oxidation of the heater strip. Tyndall scattering is avoided and some other undesirable effects are minimized, but are not entirely eliminated. However, crystals 100mm long × 15 mm diameter have been obtained relatively free from voids.

M.O'D.

CROWNINGSHIELD (R.). *Developments and highlights at G.I.A.'s laboratory in New York.* Gems & Gemology, 1971, XIII, 9, pp. 284–288. 10 illus.

Diamonds are the main theme in these reports. Reference is made to graining in Russian diamonds. A new design in cutting intending to get rid of the "bow-tie" effect in marquise-cut stones, a cluster ring consisting of diamond doublets, identification of a black diamond and reflections of the culet in the case of an old European brilliant-cut are discussed. Two stones fashioned from red-dyed greyish pink corundum were identified by the glow from the fluorescence of dyestuff used when the stones were examined under a long-wave ultra-violet lamp. A note is given on the nomenclature of Australian opal.

R.W.

CROWNINGSHIELD (R.). *General Electric's cuttable synthetic diamonds.* Gems & Gemology, 1971, XIII, 10, pp. 302–314. 14 illus.

An important article reporting on the first investigation by a gemmologist of the properties of the synthetic diamonds of cuttable quality produced by the General Electric Company of America in 1970. Four stones, near colourless, pale blue, dark blue and intense yellow, faceted and around a quarter of a carat in weight, were examined. Three of these stones are now in the Smithsonian Museum. The stones were colour-graded and examined for inclusions, which included somewhat flattened black inclusions ascribed to the nickel-iron catalyst. Under 10-times magnification there would be nothing to excite suspicion, but under higher magnification random pin-point inclusions were seen. Stress cleavages and rod-like inclusions were observed in some stones. None of the stones was found to be fluorescent under long-wave ultra-violet light, but under short-wave ultra-violet light the colourless and pale blue stones glowed with a persistent yellow phosphorescence showing a quadrant effect with a dark cross. It is suggested that the short-wave ultra-violet lamp may be helpful if synthetic diamonds come on the market. The colourless and blue synthetic diamonds were found to allow oriented electro-conductivity. No convincing absorption spectrum was observed. A strong yellow glow with "after-glow" was seen when some stones were examined under X-rays and this may have possible significance. Little strain was observed when the stones were examined under "crossed polars". The dark blue stones showed colour-banding and were unlike any natural diamonds. This article must be read for it points to problems which may beset the jeweller in the future. R.W.

HINTZE-CHUDOBA. *Handbuch der Mineralogie.* Handbook of mineralogy. Zeitschr. d. Deutsch. Gemmol. Gesellshaft, 1971, 20, 4, pp. 179–180.

Review of the third additional volume dealing with new minerals and new nomenclature; edited by Prof. K. Chudoba, 684 pages with 60 illustrations, Berlin, de Gruyter 1968—a most useful reference book. E.S.

HUDSON (D. R.). *Gemstones in the system BeO—MgO—Al_2O_3.* Australian Gemmologist, 1971, XI, 2, pp. 5–9. 2 illus.

The minerals within this system include bromellite (BeO); corundum (Al_2O_3); periclase (MgO); chrysoberyl ($BeO\ Al_2O_3$); spinel ($MgO\ Al_2O_3$) and taaffeite ($BeO\ MgO\ Al_2O_3$). The chemical and physical characters of each of these gem minerals are given. There is information about natural occurrences as well as details of both fused and hydrothermal synthetic equivalents. R.W.

LIDDICOAT (R. T.). *Developments and highlights at G.I.A.'s laboratory in Los Angeles.* Gems & Gemology, 1971, XIII. 9 & 10, pp. 273–283: 315–324. 39 illus.

A composite stone made of a base of black star-sapphire cemented to a crown of padparadscha-coloured synthetic sapphire is described. There is a report of another type of yttrium aluminate with the formula $YAlO_3$. This variety is orthorhombic in crystallization, has indices of 1.938–1.955 and a density of 5.35 and a hardness of 1800 Knoop identical to YAG. The specimens examined, doped with rare earths as they were intended to be used for lasers, are not on the gem market but a warning is given that they might well be met with either as "freaks" for the collector or actually on the market in future. A beautiful red-orange spinel, two snuff bottles made respectively of elephant molar and pressed amber are mentioned. There is a report of a natural blue sapphire which fluoresced in short-wave ultra-violet light showing up hexagonal banding clearly. The laboratory reports an increase in the number of emeralds submitted for testing and this is ascribed to the publication of the difficulties found with modern types of synthetic emeralds and stones from new localities. Three large stones, a 25lb cabochon sapphire, a Mysore-type cabochon ruby weighing 1795 carats and a faceted green beryl of 1180 carats are mentioned. Some odd types of glasses (probably slag glasses), Tridacna pearls, an unusual cabochon of fluorite (supposedly from Thailand) and a cabochon of yellow-green idocrase are other items mentioned. A further report is given on stained black opals with very low properties. It is suggested that the treatment consists of covering the white opal with brown wrapping paper and heating with a torch until the paper chars—the smoke imparting a black colour. Experiments seem to show that this is feasible. Dyed pale violet jadeite, coated beryl, a spessartite outline, a flux-fusion ruby with a "seed" of synthetic ruby and a black spinel cabochon with a density of 3·84 are mentioned. A "synthetic opal" which turned out to be a "fire agate", a fine water-worn crystal of peridot probably from Burma and weighing 137·5 carats and synthetic quartz from Russia are discussed.

R.W.

Okrusch (M.). *Zur Genese von Chrysoberyll- und Alexandrit-Lagerstätten.* The genesis of chrysoberyl and alexandrite occurrences. Zeitschr. d. Deutsch. Gemmol. Gesellschaft, 1971, 20, 3, 114–124.

This article is a survey of literature published on this subject and has a very extensive bibliography.

The rarity of a gem is part of its attraction. The article deals with the special geological conditions necessary for the formation of chrysoberyl. The chemical composition and crystal-morphological and physical properties are listed. The R.I. is similar to that of corundum and there are two bands in the absorption spectrum. The main constituents are oxygen, aluminium and beryllium. Chrysoberyl usually crystallizes out of pegmatic melts which are supersaturated with Be; this can happen in pneumatological and hydrothermal districts, often found together with tourmaline. Chrysoberyl is sometimes found in assimilation pegmatites. The author describes in detail various finds and their geological history and then discusses the conditions necessary for the formation of alexandrite as a chromium-containing variety of chrysoberyl. Certain finds and their geology are discussed, including the Novello claims in Southern Rhodesia.

E.S.

Pough (F. H.). *Calcite.* Lapidary Journal, October 1971, pp. 958–963.

The author discusses the multiplicity of crystal faces that may be displayed by calcite and surmises that while the three distinctly different basic shapes of scalenohedron, rhombohedron and flat plates may be stable under different conditions, the many forms are attributable to static periods during growth when the faces are stationary at a stage intermediate between two of the basic shapes. Other minerals show less variety owing either to their lack of more than one basic form, their greater sensitivity to growth conditions or to their less frequent formation. Many calcite forms are reviewed; among recent discoveries are gemmy orange coloured crystals found with witherite and fluorite in Illinois, fine pink cleavages and white coated rhombs from Naica, Mexico. M.O'D.

Rösch (S.) *Was ist ein Brilliant?* Goldschmiede Zeitung, 1971, 12, p. 39. also Zeitschr. d. Deutsch. Gemmol. Gesellschaft, 1971, 20, 3. pp. 106–113.

In leaving the German title of the article untranslated in an English summary, the Editor of the Goldschmiede Zeitung comments: "This was done because any such translation as "What is a Brilliant?" would inevitably mislead the reader into believing he is about to read a straightforward discussion of the concept of "brilliant" as a noun and adjective; the implication being that this would certainly be an article based on English usage and all the linguistic aspects bound up with it.

"To be sure, the concepts of "Brillant" and "Brillanz" do have their English counterparts in such words as "brilliant" and "brilliancy". Chances are, however, that here is where the parallelism ends. In short, the present article is, of course, based not only on the two terms as such but on the whole complexity implied by them from a German usage point of view. At the same time, one can safely say that this is certainly not tantamount to common English usage.

"Professor S. Rösch's article is a thoroughly reflected and fervently dedicated plea for anyone concerned to try their best soon to reach an agreement on clear-cut definitions of these concepts, particularly so of the concept of "Brillant". Toward the end of his article, Herr Rösch offers a list of new names that might conceivably be accepted by those dedicated to achieving a greater precision of relevant nomenclature, but the article is certainly esoteric in that it presupposes on the part of the reader a gemmological knowledge and understanding such as can hardly be expected of anyone not trained in the field. Any full-size translation of the present treatise would doubtless tend to confuse the message by adding to it a host of linguistic problems obtaining between English and German modes of thought and language mentalities. Which is one way of saying that translation into English would doubtless add to the esoteric nature of the discussion instilling into it linguistic elements that would needs run counter to the author's intention.

"Translation, though feasible, has thus been considered inadvisable, while on the other hand the article as such was thought to be too valuable to be left unmentioned." S.P.

SALA (J. D.). *Laboratory of gemology and assay of materials. Banco Municipal de la Ciudad de Buenos Aires, Argentina.* Gems & Gemology, 1971, XIII, 9, pp. 270–272. 5 illus.

Describes the laboratory of Buenos Aires, which forms part of the pledging department of the Banco Municipal. The laboratory not only deals with gem materials but also investigates works of art and other valuable objects. The laboratory of gemmology consists of three sections—a well-equipped laboratory, a museum and a library—and is used by insurance companies, jewellers and the public. It is said that a daily average of 150 reports are signed by the specialized University technicians, but the number of staff employed is not given. R.W.

SCHIFFMANN (C. A.). *Farbdiamanten: natürlich oder bestrahlt?* Coloured diamonds: natural or irradiated? Zeitschr. d. Deutsch. Gemmol. Gesellschaft, 1971, 20, 4, pp. 152–171. (See Journ. Gemm. 1969, 11, 7).

The author tested 20 diamonds and found 10 of them to be artificially coloured. Exact details as to weight, colour, X-ray fluorescence and phosphorescence, UV light transparency, spectroscopic analysis and characteristics seen under the microscope are given in table form for the 20 stones, which are also reproduced as colour photographs. The various ways of irradiating diamonds are described including the van de Graaf method and the cyclotron treatment. The instruments used in this test series are illustrated. The author warns the retail jeweller to make sure of his source and take precautions to ensure that a diamond is not artificially coloured.

E.S.

SWEENEY, (J. W.). *Rhodesian sapphire deposits.* Lapidary Journ., 1971, 25, 8, p. 1076.

A crystal of 3,100 cts has been recovered from the Barauta mine in north-east Rhodesia. The colour is a fine deep blue. Crystals from the region are found as well formed squat barrel-shaped hexagons. There is often an outer skin of brown to yellow-brown oxidized corundum. Sizes vary from ¼″ to 3″ in diameter. There are two deposits at the Barauta mine, the first alluvial and the second in pegmatite. Various colour types have been found, including some of pale blue with a golden core, others a pale cream with a light blue core, as well as black star-sapphires. M.O'D.

ZWAAN (P. C.) and KORTENBOUT VAN DER SLUYS (G.). *Vivianite crystals from Haren, Noord Brabant Province, the Netherlands.* Scripta Geologica, 1971, 6.

The occurrence of vivianite in the Netherlands was first mentioned by Van Bemmelen (1896, 1897). He described the mineral as a powdery bluish substance associated with iron carbonate from a moor in Drenthe Province. No physical properties were given, nor crystallographic data. The author added a chemical analysis of impure material.

In another paper (1900) Van Bemmelen described vivianite occurring in peat deposits at Ederveen, Drenthe Province, mentioning crystal aggregates with a blue lustre and small cavities filled with crystals showing a metallic lustre. According to Van Bemmelen these crystals originated from ferro-carbonate or iron oxide through interaction with phosphates, the latter being mainly derived from animal remains. In this paper, too, no particular physical or optical data were given.

Subsequently the mineral has been recorded from numerous localities all over the country. It occurs in fossil bones as well as sediments bearing such fossils. A remarkable fact is that these deposits invariably are of a Holocene age, in agreement with Rosenqvist's observations (1970) in Southern Norway. In all these cases vivianite occurred as a powdery bluish material and no crystals could ever be seen with the naked eye.

The material described consists of numerous distinct elongated prismatic crystals up to 6mm long and ½mm thick. They are very dark bluish-green. S.P.

BOOK REVIEWS

DESAUTELS (A. E.). *The Gem Kingdom.* Macdonald, London, 1971. p. 252. Illustrated in colour. £5.25.

Paul Desautels needs no introduction to the gemmologist as he is supervisor of the Division of Mineralogy at the Smithsonian Institution, and author of a number of books including the *Mineral Kingdom*, published in 1970, and of the standard guide to the Smithsonian gem collection. At first sight the present work might appear to be an addition to the family of books dealing in a popular manner with an aspect of natural science, recompensing the serious student for its superficial treatment of the theme by the excellence of the illustrations.

Mr. Desautels' latest book excels, however, not with its illustrations but by its text. First impressions aside, this is, in fact an eminently adequate book for the gemmological student, as not only are common and less common gem stones and ornamental materials covered but there are also chapters on testing, fashioning, prospecting and mounting; this last seldom being treated in the standard textbooks. The style is admirably lucid and there are no discernible errors of fact. A bibliography would have been welcome. The chapter on the jade minerals is especially timely, for it covers some of the ground previously only to be discovered in Hansford's *Chinese Carved Jades*, that is, the working of these materials and the nomenclature of some of the standard forms.

Naturally, at this low price (for today) the ultimate in quality of illustration cannot be expected and the book is, on close examination, not among the first class in this field. Although the publishers claim that the gems are shown "with surpassing fidelity and brilliance", on the whole the examples selected are too large for the best reproduction. Too many show white or faintly-coloured reflections from very large table facets, some are apparently out-of-focus, especially the 118-carat Brazilian green tourmaline on p. 122 and the 177-carat kunzite on p. 114. One or two different species shown on adjacent pages are insufficiently distinguished from each other in colour, for example the red tourmaline and the rhodolite garnet shown facing each other on pp. 122 and 123. Some other examples are, however, very well reproduced. A personal preference would have been for more illustrations of gem testing techniques at the expense of the numerous reproductions from earlier works which are of uneven quality.

These admittedly minor criticisms apart, this is a book to be possessed by the established gemmologist and to be studied by the student particularly at the beginning of his career, where a spice of illustration often helps the more rigorous diet of gemmological theory to be digested.

M.O'D.

ANON. *Gems and Jewels.* Orbis Books, London, 1971. £1·25.

The text of this book, reviewed on page 28 of the *Journal*, 1972, 13, 1, as well as the introduction, was written by H. J. Schubnel.

S.P.

Gemstones to Jewellery. Edited by Bill James. Second edn. Bailey Bros. & Swinfen, Folkestone, 1967, pp. 184. Black-and-white illustrations. £3·50.

Although the imprint gives the date of publication as 1967 the book has only recently been released on to the British market. The greater part deals with the growing hobby of cutting and mounting gems and various qualified authors cover sections on tools, design, enamelling and ornament. The section on gemstones is found partly in the chapter headed "Earliest of Jewels" and partly under "Rainbows of Fire". In the first of these chapters the examples are selected somewhat oddly, rhodonite appearing in both. The second chapter on gems lists a number of other stones, again with no apparent basis for selection. Useful data for the lapidary given with each stone make interesting reading although there are a number of questionable assertions. It is unusual to see hessonite classed as a green stone; Brazil is not listed as a source for green spodumene, inaccurately called hiddenite; the easy cleavage of kyanite is not mentioned; Mexico is omitted as a source for sphene; balas ruby is a regrettable survival for red spinel. An interesting feature, which is repeated also for the equipment sections, is the provision of a price list at the end of each chapter. Prices should be read with caution as price lists are very hard to standardize and these relate to Australian conditions. For the Australian reader an Appendix lists public facilities for lapidary instruction.

M.O'D.

JAMES (B.). *Collecting Australian Gemstones.* Revised 4th edition, 1972. pp. 191. Illustrated in colour and black-and-white. Distributed in U.K. by Bailey Bros. and Swinfen, Folkestone. Published by Murray, Sydney. £5.

If the first chapter which deals with gemstones in legend is ignored, this is a useful book, particularly addressed to the Australian gemmologist and mineral hunter. Readers in other countries will also find much of interest. An early chapter lists the essential tools of the gem-hunter and this is followed by chapters dealing with typical gem-bearing geological formations, how to apply for licences to mine, and general hints on the dangers and difficulties of prospecting. Chapter six deals with the gemstones to be found on the Australian continent; although in the main the facts are without question, it is particularly regrettable that one of the formerly-believed reasons for the cause of the play of colour in opal is again brought out. In an Australian book bearing the imprint 1972 this is surely an oversight. This whole chapter suggests that all the facts about some gem species, whether or not they are to be found on the Australian continent, have been included. Emerald-green hiddenite has only been found in North Carolina, and not all yellow topaz fades in sunlight. Subsequent chapters are on gold panning and the fashioning of stones. Useful addenda are a table of minerals likely to interest the collector, a glossary of mining terms and maps of the Australian gem fields. The black-and-white illustrations are adequate, but those in colour of poorer quality.

M.O'D.

MAZIAREK (S.). *El mercadeo mundial del diamante.* Caracas. 1971. (Privately circulated).

A paper covered book of 36 quarto sized pages produced from typescript by a photo-copying process. The text is in Spanish. There is a general history of diamond from Indian times, and the present marketing by the various divisions of the Diamond Corporation. There are charts showing the growth of diamond sales by the Central Selling Organization from 1953 to 1969 and the diamond production in thousands of carats in the various producing countries for the period 1961 to 1968. Short sections on the grading of diamonds, on industrial diamonds and the artificial colouration of diamonds are given. There is a section on synthetic diamonds, which is completed with a table showing the production of the major countries which are now producing synthetic diamonds, and the book is completed with a short bibliography and an appendix on the diamonds of Venezuela. Dr. Maziarek is with the Ministry of Mines in Venezuela, so this appendix on Venezuelan diamonds can be taken as authentic and is a valuable contribution to the literature. The existence of diamonds in Venezuela, was known as early as 1901, but production was not commenced until 1924 when the deposits in La Gran Sabana district of Bolivar were worked. Later finds were made, particularly around San Pedro de las Bocas and more recently in the lower zone of the Caroni river, and there are the deposits of Guaniamo in the region of the rivers Caura and Cuchivero. The production of diamonds in Venezuela from 1913 to 1969 reached 2,546,159 carats, but this does not reflect the present position, for in 1970, with the newer localities of Guaniamo opened up, the total for the year was 508,000 carats. The overseas trade in order of importance is given as—to U.S.A. (40%), Belgium, Holland, Germany, Israel, Canada and Italy etc. The appendix concludes with some consideration of the Venezuelan economy with regard to diamond trading. There is much information packed into 36 pages.

R.W.

WAINWRIGHT (J.). *Discovering lapidary work.* Mills & Boon, London, 1971. £3.60.

An excellent treatise written mainly as a guide for schools but of great use to all interested in the fascinating hobby of lapidary work, including tumbling. The book covers elementary identification, equipment and its use. Some aspects of jewellery-making are mentioned.

S.P.

BANK (H.). *Aus der Welt der Edelsteine.* Pinguin Verlag, Innsbruck, Austria. pp. 191, coloured plates. 298 Sch.

The publishers promise an English edition of this superbly-illustrated work, but even those whose German is rudimentary will wish to have it on their shelves as soon as possible. Although it must be assumed that the book is intended as much for the gemmologist as the general reader, the space given to some aspects of gem testing is insufficient for the student and perhaps too great for the average uninformed reader. The arrangement of the individual gem materials according to mineralogical classification would seem to suggest that a certain degree of familiarity with the subject is assumed.

After a definition of the gem materials Dr. Bank describes some of their chemical and physical properties and their relationship to gem testing methods. The diagrams illustrating common crystal forms are of an inferior standard of draughtsmanship to those on pp. 86–87, which themselves are unrelated to the surrounding text; it would have been preferable to have placed the two sections together. It is regrettable that more mention is not made to the use of absorption spectroscopy and that there are no illustrations of this technique nor of examples of inclusions which are more fully treated in the text.

The descriptions of the individual materials are good, although one could wish to have SG and RI figures given in addition to hardness. No mention is made of nephrite being the material from which were fashioned the Chinese archaic jades and, rather confusingly, peridot is listed under olivine in the analytical section whereas in the tables the reverse arrangement obtains; fortunately the alphabetically close juxtaposition of the two names prevents serious error. Typographically some of the headings which are marked by italicization are hard to see at a quick glance. Some good locality maps are provided. The photograph of the Russian crown facing p. 164 does not reach the very high standard set by its neighbours.

In all, this is a very fine book; certainly in some respects the best work on gems in German yet to appear. Its reasonable cost demonstrates that good illustrations need not make a book prohibitively expensive; there are a number of works currently on the market priced much higher and with manifestly inferior illustrations and subject-matter. M.O'D.

REFRACTIVE INDEX BY DIRECT MEASUREMENT

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

ENCOURAGED by the directions given on page 32 of B. W. Anderson's latest edition of "Gem Testing" the writer determined to experiment with the "direct measurement" method of ascertaining the R.I. of a gemstone.

Unless a gemmologist has access to a table-spectrometer, and the time and skill to use it, there is no other way of ascertaining the R.I. of quite a number of highly refracting gems (some of which are synthetics) unless one invests in an expensive refractometer equipped with a "dense glass" made of diamond, or zinc blende. However, by comparing the real and apparent depth of a stone by means of a millimetre gauge and a microscope, using the simple technique about to be described, a very close approximation to its R.I. may be made. As is shown in the table at the end of this article a degree of accuracy to $\pm$ 1% (approx.) would, for instance enable one of the new "doped" Yag garnets to be distinguished from a demantoid garnet; sphalerites, strontium titanates, and scheelites could similarly be identified.

The principle upon which the method depends is quite simply understood from Fig. 1. The real depth of the stone is BO = D. Rays of light emerging from the culet, O, diverge along OA and OC, and, on passing out of the stone, are refracted along AE and CF. The width of the angle AOC is exaggerated for clarity. The ray OAE makes with the normal (broken line) at A the angle of incidence i, and the angle of refraction r. OB bisects the angle AOC, and is, of course, perpendicular to the table of the stone.

Then $\angle AOB = i$, and $\angle AIB = r$.

Let the R.I. of the gem be n.

From Snell's Law n Sin i = Sin r.

(The second medium being air its R.I. is unity and is, therefore, neglected.)

$$\text{Then we have } n = \frac{\text{Sin } r}{\text{Sin } i} = \frac{\frac{AB}{AI}}{\frac{AB}{AO}} = \frac{AO}{AI} = \frac{BO}{BI} \text{ (approx.)}$$

since the angles are small.

But BO = D, the real depth, and BI the apparent depth (i.e. the culet of the stone will appear to be located at I).

$$\text{Hence the R.I. of the gem} = \frac{\text{real depth}}{\text{apparent depth}}.$$

Three stones were selected for experiment, the R.I.'s of which were all above the limit of an ordinary refractometer. No doubt was entertained as to what these stones actually were, but it seemed desirable to ascertain the practical value of the "direct measurement" method. The results would certainly have identified the stones if their identity had not already been known.

A measuring scale incorporated in the focussing mechanism of the microscope is, of course, an advantage, but it is not essential; neither is it necessary for a stone to have a flat culet through which observations are made.

There is on most microscopes a flat surface, or small flat ledge on the top end of the focussing rack (see illustration, p. 123, "Gem Testing"); below this there is a parallel flat surface on the shoulder of the microscope limb, through which passes the spindle of the coarse adjustment wheel. Differences between these levels can be measured either by judicious use of a vernier-equipped millimetre gauge (the nose of the upper jaw of which has been filed off), or a suitable depth gauge. The writer possesses one of the latter, and it is a simple matter to rest the outer edge of the gauge on the top of the focussing rack, and carefully extend the slide until it meets the flat surface above the focussing spindle. (See Fig. 2). With the usual vernier equipment accuracy to .05 mm is obtainable, and estimates may be made of even closer accuracy.

Guided by Mr. Anderson's instructions the technique was as follows: the real depth of the stone was carefully measured by placing it, table down, on the lower jaw of an open, vertically held, millimetre gauge, and closing the gauge until the other jaw touched the culet.

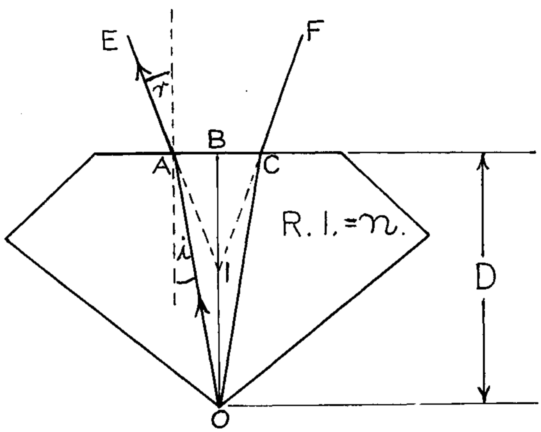

FIG. 1.

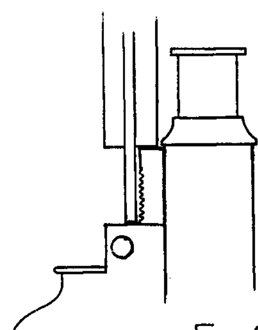

FIG. 2.

(To give unobscured view the focussing wheel is omitted from Fig. 2).

A small pillar of plasticine is pressed in upright position on a glass microscope slide, and the girdle of the stone embedded in the plasticine so that the table of the stone is parallel to the surface of the slide. A little careful manipulation will achieve a result sufficiently accurate for the purpose in hand. It is not necessary for the culet to rest on the slide. The slide is then placed on the stage of the microscope and positioned so that the stone is in the centre of the field. A $\frac{2}{3}$ objective was found to give a sufficiently critical focus. The surface of the stone was then brought carefully and exactly into focus. There are always tiny marks by which this may be done. Measurement is then made between the top of the focussing rack and the shoulder of the limb and noted down.

Next, very carefully, the focus is lowered until the culet, seen through the stone, is sharp. This may take a little time; care and nice judgement are required to ensure that whatever mark is selected on which to focus it really represents as nearly as possible the very lowest part of the stone. Again a measurement is made and noted.

If m_1 is the first measurement, and m_2 the second, then $m_2 - m_1$ = the apparent depth of the stone. And, to complete the experiment, real depth (already measured) divided by apparent depth gives the required R.I.

To focus on the table of the stone an ordinary adjustable 60-watt electric lamp raised above the stone and directed down upon it made focussing on small surface markings easy; to focus on the culet the same lamp was lowered and the substage mirror angled to direct light into the stone from beneath. Illumination can be controlled to a comfortable degree by use of the substage diaphragm.

TABLE OF RESULTS

Name of Stone	*Real Depth* (in mm)	*Apparent Depth* (in mm) (m_2–m_1)	$\frac{\textit{Real Depth}}{\textit{Apparent Depth}}$ = R.I.	R.I. (*from tables*)	% *error*
Strontium Titanate	2.65	12.40 11.31 1.09	$\frac{2.65}{1.09} = 2.43$	2.41	.83
"Yag" garnet	5.00	14.00 11.30 2.70	$\frac{5.00}{2.70} = 1.85$	1.83	1.1
Red Zircon* (no absorption spectrum)	3.80	13.50 11.55 1.95	$\frac{3.80}{1.95} = 1.95$	1.93 – 1.99	

* By inserting the analyser and rotating the microscope stage one ray of the zircon was extinguished to avoid confusion by double refraction. The figure arrived at lies between the limiting values for ε & ω; zircon is positively birefringent & the result probably represents an intermediate value for ε.

ASSOCIATION NOTICES

MEMBERS' MEETINGS

The Midlands Branch of the Association held a practical evening on the 20th January at the School of Jewellery and Silversmithing, Birmingham, by kind permission of the Headmaster, Mr. R. G. Baxendale. Members had the opportunity of testing their own gemstones as well as specimens supplied, with the assistance of Mr. F. Tisdall and Mr. R. N. Wetton.

The Scottish Branch also held a meeting on the 20th January, in Ayr, when illustrated talks were given on diamonds, gems shown at the "World of Gems" exhibition, and hallmarking. A second meeting was arranged on the 24th February at Edinburgh, when Mr. H. Whitehead gave a talk, illustrated by slides, on the "World of Gems" exhibition held in Glasgow during September and October, 1971.

A talk was given by Mr. R. Webster on the 25th January at Goldsmiths' Hall entitled "Gems in Court". A full report is given on page 45.

ANNUAL GENERAL MEETING

The 42nd Annual General Meeting of the Association was held at Goldsmiths' Hall, London, on Wednesday, 22nd March, 1972. Mr. Norman Harper, Chairman, presided. Among the members present were two Fellows from overseas, Frau Katharina Schneider of Hanau and Dr. Roland Berger of Ludwigsburg, W. Germany. In commenting upon the work of the year, the Chairman said:

"Although referred to in the annual report, I must again mention the splendid exhibition that was organized in the autumn by the Scottish Branch of the Association. Our thanks to all those concerned can well be repeated this evening. It was an extremely well worthwhile undertaking, and rewarding both to those who attended and those who arranged it.

"I must also mention the July 1971 issue of *The Journal of Gemmology*, which was a 70th birthday tribute to Basil Anderson. B. W. Anderson has done so much for gemmology. He retires as Director of the Diamond, Pearl and Precious Stone Trade Section of the London Chamber of Commerce at the end of this month. I shall be adding to these words in some other place and on an occasion other than an annual meeting. So far as the Association is concerned, we are glad that he will be continuing as our senior examiner. In the meantime we give him our good wishes and sincere appreciation for all he has done for gemmology. We wish him well in his retirement and extend our good wishes to his successor, Mr. Alec Farn.

"In connection with *The Journal of Gemmology*, the Association is greatly indebted to Mr. John Chisholm, who does so much in casting his eagle eye over the proofs and thereby helps to maintain the high reputation which the *Journal* enjoys.

"Our examinations were again well supported and again there was considerable interest from overseas. To the course instructors and examiners our grateful thanks. Mr. Robert Webster has joined us as a correspondence course instructor. In fact he seems just as busy as when he was at the Laboratory. Our Secretary will not entirely be lost to us as he will be responsible for the Sir James Walton Library in about a year's time. He created the library, and it is fitting that his long connection with the Association (he was first appointed a member of the Council in 1931) should be maintained in this manner.

"We held a reception for Fellows in this Hall and may well repeat it next year or the year after.

"Both our Branches organized interesting events and we are grateful to all those who helped to maintain the keen interest in gemmology in the Midlands and Scotland.

"Several people made gifts of various kinds ranging from a modest piece of gem mineral to a binocular microscope from the Gemmological Association of All Japan. A gift of gems and gem minerals from the Gemmological Association of Australia was unfortunately lost in transit—we shall never know about the treasures we should have received".

Mr. Robert Webster, in seconding the adoption of the Annual Report and Accounts, said it would give great pleasure to the Association to know that Mr. H. Wheeler would be succeeding Mr. G. F. Andrews as Secretary in April 1973. In view of Mr. Wheeler's long connection with the National Association of Goldsmiths and the Gemmological Association, the secretarial work would be in good hands.

Dr. G. F. Claringbull, B.Sc., Ph.D., was elected as President of the Association in succession to the late Sir Lawrence Bragg. The Chairman recalled that Dr. Claringbull had served the Association as an Examiner from 1938 to 1970. Mr. B. W. Anderson welcomed the election of Dr. Claringbull and he knew that it would give members much pleasure to welcome him into office. Mr. Anderson felt sure that Dr. Claringbull would maintain the scholarship and enthusiasm for gemmology that had been shown by previous Presidents.

Mr. Norman Harper was re-elected as Chairman; Mr. Douglas King as Vice-Chairman and Mr. F. E. Lawson Clarke as Treasurer. Messrs. Maurice Asprey, Thomas Bevis-Smith and David Kent were re-elected, and Messrs. Eric Bruton and Michael J. O'Donoghue, M.A., 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 our disposal for meetings. The Wardens readily respond whenever it is convenient and the Association was greatly indebted to them.

COUNCIL MEETING

A meeting of the Council of the Association was held on the 18th January. Mr. Norman Harper, Chairman, presided. Mr. H. Wheeler was appointed Assistant Secretary of the Association and designated to succeed the Secretary at the end of March, 1973. Mr. D. Wheeler was appointed a Director of Gemmological Instruments Ltd.

Appreciation of the work of the Scottish Branch of the Association in connection with the "World of Gems" exhibition held in Glasgow during September and October, 1971, was recorded.

The following were elected to membership:

FELLOWSHIP

Allum, Christopher J., Radford, Nottingham. D. 1971
Appleyard, John T., Wakefield. D. 1971
Baker, Ann, Witney. D. 1971
Barrett, Garry Sydney, Sittingbourne D. 1971
Bjøndalen, Jan, Oslo, Norway. D. 1971
Brook, Doreen M., Allerton, Liverpool. D. 1971
Burgin, Derek A., Radcliffe-on-Trent, Nottingham. D. 1971
Butcher, Kathleen M., Sudbury. D. 1971
Carballal Cirici, Carmen, Tron de Dalf, Spain. D. 1971
Cartland, Anthony J., Leamington Spa. D. 1971
Chalk, Christopher S., Walmer, Deal. D. 1971
Christie, Rosalind S., London. D. 1971
Farley, Peter F., Dorchester. D. 1965
Fowler, Susan E., Hong Kong. D. 1971
Gartner, Heinz R., Schmissberg, W. Germany. D. 1971
Geyer, Adrian M., Handsworth, Birmingham. D. 1971
Gillings, Michael, Stretford, Manchester. D. 1971
Harvey, Roger S., Hull. D. 1971
Hiley, Hazel, Baildon, Shipley. D. 1971
Hinchliffe, Brian, Sheffield. D. 1971
Holden, Andrew N., Walsall. D. 1971
Holt, Robert A., London. D. 1971
Irwin, Margaret, Chester. D. 1971
Jenner, Peter C., Tunbridge Wells. D. 1971
Johnston, Iain H., Dumbarton, Scotland. D. 1971
Keeling, Judith M., Stoke-on-Trent. D. 1971
Kirkpatrick, David J., Kenilworth. D. 1971
Kivimaki, Kauko O., Hämeenlinna, Finland. D. 1971
Koskinen, Aito K., Helsinki, Finland. D. 1971
Krieger, Rolf, Huddinge, Sweden. D. 1971
Leino, Terttu, Lahti, Finland. D. 1971
Lewis, Roger A., Wallasey. D. 1971
Lopez Verge, Ramon, Barcelona, Spain. D. 1971
Lowe, Christopher E., Newhall, Staffs. D. 1971
Mones Roberdeau, Luis, Barcelona, Spain. D. 1971
Monte Domenech, Joaquin, Barcelona, Spain. D. 1971
Mueller, Edith E., Frankfurt, W. Germany. D. 1971
Murray, David E., Stratford-upon-Avon. D. 1971
Narayanamurthy, Keecha, Bentong Pahang, W. Malaysia. D. 1971
Naumanen, Pertti O., Helsinki, Finland. D. 1971
Olieff, Peter M., Doncaster. D. 1971
Peranko, Pyry K., Lahti, Finland. D. 1971
Poynder-Meares, Christopher F., Brookthorpe, Glos. D. 1971
Pyykonen, Kaarina, Matinkyla, Finland. D. 1971

Rajah, Sinnathamby S., Ipoh, Malaysia. D. 1971
Ratnasekera, Wakumburage A., Ratnapura, Ceylon. D. 1971
Roca Cusachs, Juan, Barcelona, Spain. D. 1971
Rogan, Liv S., Oslo, Norway. D. 1971
Rorvik, Trine, Mosjöen, Norway. D. 1971
Ryan, David C., Dublin, Eire. D. 1971
Saddington, Tom F., Woking. D. 1971
Schneider, Katharina, Hanau, Germany. D. 1971
Shepherd, Naomi, Reading. D. 1970
Skinner, Ramon, Epsom. D. 1958
Spiers, Richard, Redhill. D. 1971
Tortosa Calveras, Francisco, Barcelona, Spain. D. 1971
Van Dam, Rudolf A., Curaçao, N.A. D. 1971
Van den Berge, Gerard, St. Amandsberg, Belgium. D. 1971
Walker, Thomas, Sunderland. D. 1971
Walton, Edith M. E., Prescot. D. 1971
Williams, Anthony M., Moseley, Birmingham. D. 1971
Windsor, Christine, London. D. 1971
Woolf, David H., Johannesburg, S. Africa. 1971
Woold, Michele D. London. D. 1971
Wrangel, Anna S., Bromma, Sweden. D. 1971
Wroblewski, Tradeusz, Selly Oak, Birmingham. 1971

TRANSFERS FROM ORDINARY MEMBERSHIP TO FELLOWSHIP

Ahmad, Syed Vaqar, London
Allum, Peter D., Shaftesbury
Andres Barbera, Manuel, Valencia, Spain
Backshall, Henry G. R., Hainault
Baker, Kenneth R., Hensingham, Whitehaven
Berlage, Peter-Jurgen, Osnabruck, Germany
Binns, David G., Hastings
Bradford, Kenneth J., Westcliff-on-Sea
Comely, Christopher N., Dorchester
Cotton, John A. D., London
De Bruin, Alphonsus G., Heemstede, Holland
De Meillon, Laura, Durban, Natal, S. Africa
Domenech Bisbe, Juan, Barcelona, Spain
Dyer, Wilbur E., Joiliet, Illinois, U.S.A.
Fernandez Gil, Enrique, Valencia, Spain
Fukabayashi, Hirokichi, Sapporo, Hokkaido, Japan
Gardiner, Anthony C., Abadan, Iran
George, Michael C., Southborough, Tunbridge Wells
Giles, Roy, Sydney, N.S.W., Australia
Gooding, Diana J., Eastbourne
Green, Adrienne, Wembley
Grim, Roy I., Laurel, Md., U.S.A.
Hanna, Neil R., Aukland, New Zealand
Hilbourne, Anthony C., Twyford, Berks.
Hirohata, Tomoko, Toyonaka-city, Japan
Jackson, Lilian I., Reynella, S. Australia
Kaneko, Maseo, Tokyo, Japan
Maslen, Grant L., Nairobi, Kenya
Moran, John, Blackpool
Naim, Edward, London
Navarro Bort, Rodolfo, Valencia, Spain

Nemoto, Yoshio, Iwaki-Shi, Fukushima-Pref., Japan
Nittel, Lothar, Freiburg, W. Germany
Norton, Charles L., Conyngham, P.A. U.S.A.
Oates, Harold A., Glen Ellyn, Illinois, U.S.A.
Ogden, John M., London
Peris Bataller, Francisco, Valencia, Spain
Peyerl, Wolfgang, Knights/Tvl., Rep. of S. Africa
Pie De Masso, Rosa Maria, Barcelona, Spain
Power, John J., Quebec, Canada
Pratt, David, Bradford
Ramon Rius, Carlos E., Barcelona, Spain
Riuttala, Alexander N., Toronto, Ont., Canada
Rosich Chova, Francisco, Valencia, Spain
Sanchis Estrems, Jose, Valencia, Spain
Sendon Gimenez, Pedro, Barcelona, Spain
Silverthorne, Richard Leigh, Johannesburg, S. Africa
Stephens, Arthur L., London
Terry, Robert J., Lakewood, Ohio, U.S.A.
Thomson, Ian, London
Torres De Goytia, Rafael, Valencia, Spain
Trossarelli, Carlos, Torino, Italy
Uchida, Sumiko, Nagano-Ken, Japan
Van Eik, J. J., Buren (Gld.), Holland
White, D. W., Tenterden
Winstead, Frances F., Eugene, Oregon, U.S.A.
Woo, Shun Wai, Causeway Bay, Hong Kong
Woolgar, Michael, Durban, Rep. of S. Africa
Zook, Theresa F., Alexandria, Virginia, U.S.A.

Ordinary

Adams, David, New Malden
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