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and

PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

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OF GREAT BRITAIN
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GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

(Originally founded in 1908 as the Education Committee of the National Association of Goldsmiths, reconstituted in 1931 as the Gemmological Association)

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NOTES FROM THE LABORATORY (THIRD SERIES)

By *B. W. Anderson*

New Emeralds

The appearance of a new type of natural emerald can be almost as disturbing to the gemmologist as an encounter with a new form of synthetic, since the properties and inclusions often refuse to conform with any of the established and recognizable patterns.

This certainly was the case recently when some emeralds of important size and excellent quality were submitted for test and showed many features we had never seen before. These stones were unusually free from inclusions (regrettably so, from our point of view), but in almost every case showed striking skeletal markings in radial or spoke-like arrangement, with concentric curved cracks joining the "spokes". The low-power photomicrograph reproduced in Fig. 1 shows one of the more spectacular inclusions of this type. In other stones there were just a few of these radii and curves, reminding one somewhat of the pattern produced when a stone is dropped on an iced-over puddle. Another curious feature of these stones was the presence of exceedingly thin inclusions or markings showing a hexagonal outline, and oriented parallel to the basal plane of the original crystal.

The density of these strange emeralds was found to be 2·73–2·74, and the refractive indices 1·581–1·588: in each case higher than for other Colombian stones. The absorption spectrum was

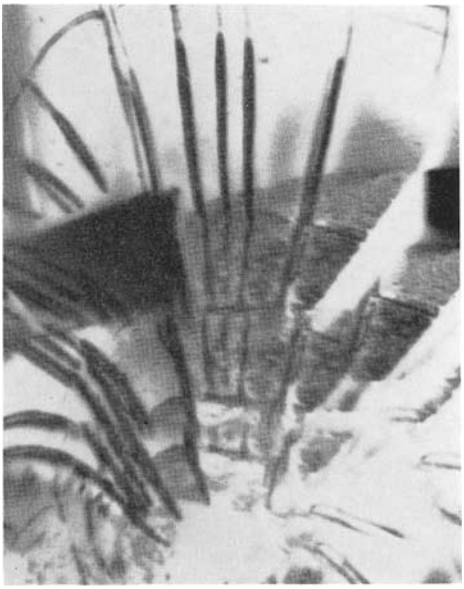

Fig. 1. Inclusions in new source of Colombian emeralds.

perfectly normal, with the distinctive chromium lines in the red which characterize emerald. Experts in Canada and the U.S.A. were so worried by the strangeness of these stones that Dr. Kurt Nassau of the Bell Telephone Labs. was called upon to record their infra-red absorption spectrum, which showed that both alkaline and acid water molecules were present—a strong indication that the stones were natural in origin. Dr. Gübelin was also consulted, and from a study of the inclusions, a subject upon which he has unrivalled skill and experience, he was quite confident that the emeralds were natural. The final seal was placed on their authenticity when the supplier was able to show us rough crystals, which were quite clearly mined material, and a number of further cut specimens, all of which showed recognizably similar features. It is claimed that the stones come from a new Colombian source, the locality of which has not yet been divulged. One hopes that eventually more exact information will be forthcoming, and that the new mine will supplement the scanty supply of fine emeralds.

Linde Synthetic Emerald

On the synthetic side, we were recently given the opportunity to examine fine samples of the emeralds manufactured by the Linde branch of Union Carbide in the U.S.A. A large crystal and a cut stone were loaned by the Company to the Gemmological Association for display at the successful exhibition of gemstones held in Glasgow.

The Linde process is a hydrothermal one, and the crystals, grown on a "seed" plate, are very different in habit from those grown by Chatham or Gilson, which resemble more closely the simple hexagonal habit of those found in the mine. The density of the Linde stones was found to be exactly 2·70, and the refractive indices 1·570–1·576, figures rather higher than those I had previously recorded from Linde material. There was a notably strong red fluorescence under crossed filters, and to a lesser extent the stones fluoresced under short and long-wave ultra-violet and under X-rays. Though these effects were less marked than for earlier Linde products, they would assist materially in differentiating these synthetics from natural emeralds. The most striking inclusions were found to be (as in former samples) showers of pointed hollow tubes, each containing a bubble, and in strictly parallel formation. To those readers who are sufficiently old to remember such antique accessories, one can say that the shape of these inclusions resembles very closely that of the old-fashioned steel gramophone needle (see Fig. 2).

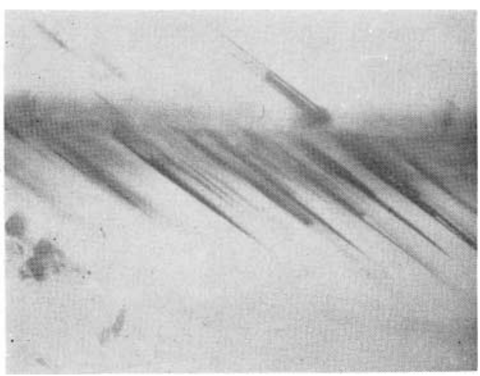

Fig. 2. Inclusions in Linde synthetic emerald.

Sapphire Substitutes

By comparison with its three more expensive brethren in the old "precious" category of gemstones, sapphire has been out of the news for quite a long time—Verneuil synthetics, garnet-topped doublets, and pastes being the most common substitutes, though I suppose the sudden appearance of blue zoisite must constitute a new factor in sapphire identification. Recently, however, two unexpected imitations of genuine sapphire have come to our notice—one as a single and rather comic example was incredibly a step-cut agate, stained blue with greenish stripes and mounted as a cluster ring. This gave an astonishingly convincing appearance of a poor-quality sapphire, the banding enhancing its "natural" appearance. It had in fact been bought and sold as such in good faith by an experienced dealer.

Far more sinister and dangerous, and apparently launched on quite a large scale, is a new doublet, in which a crown of natural Australian sapphire (green or greenish in colour) is skilfully joined to a base of blue synthetic sapphire. The line indicating where the two portions join comes just below the girdle, and can be seen only with difficulty under lens examination in a loose stone. When mounted this would be invisible. These doublets have been offered in parcels at about their apparent value of £50 or £60 per carat, and have in several cases been accepted at their face value until suspicions have been aroused. This is a clever and nasty piece of work, designed not only to deceive the eye but also to pass all but very thorough testing by a gemmologist since natural inclusions appear when viewed through the table facet and a check with the spectroscope will show the 4500Å complex in the blue very clearly—sufficient, until now, to prove the sapphire genuine. In those examined there was no difficulty in seeing their nature, especially when immersed and examined in profile. The lower parts of the stones showed the well-known Verneuil characteristics of bubbles and curved bands very clearly, and also (and this would be useful in a setting) showed the whitish fluorescence under short-wave ultra-violet which is typical of synthetic sapphire. However, the stones were unmounted and we were forewarned: we shall certainly have to keep a wary eye open for these unpleasant fakes, and so will the trade.

Gilson Synthetic Turquoise

Thanks to the kindness of Mr. M. O'Donoghue we have had an opportunity of examining a specimen of what the firm of Gilson claim to be a true synthetic turquoise. Personally I cannot see the sense of embarking on this enterprise. Whereas the synthesis of emerald may seem justified on the grounds of the scarcity and fabulous cost of fine natural stones, authentic turquoise is available in quite adequate supply. The market has already been largely spoiled by the wide-spread practice of impregnating natural poor-quality porous turquoise with wax, plastics, or silicate solutions, not to mention innumerable pressed powders of more or less the turquoise composition—and the production of yet another and more sophisticated substitute cannot fail to bring further into disrepute a gem material which has been prized from ancient until recent times. The stone examined weighed rather more than four carats and was cut in the usual cabochon form. It had a smooth, bland, glossy surface, which under the microscope showed a small-scale speckling of white, not unlike the natural turquoise in appearance. The stone was non-porous and the density was found to be 2·635, which is considerably lower than the values near 2·8 consistently given by the best Persian and Egyptian stones (now seldom seen). A flat surface polished on the base gave a good reading of 1·592 on the refractometer—again lower than that of the best natural stones. The absorption band at 4320Å, which is not always easy to see even in genuine turquoise, was hardly discernible in the Gilson sample. It would be interesting to examine a number of such stones, to see whether the above properties hold true for them all.

Synthetic Quartz

Although the synthesis of quartz has been successfully carried out on an industrial scale for perhaps a quarter of a century on account of the value of its piezo-electric properties in time-keeping and wavelength control, it has only recently impinged on the world of gem materials in the form of attractively coloured pieces. To date, these seem mostly to emanate from Russia, and the first samples seen were in blue and green shades not seen in nature and thus automatically suspect. More difficult and necessary in terms of identification is a golden yellow form, a good example of which was shown by Mr. Schiffmann at his recent lecture in the Goldsmith's Hall. He has kindly loaned the specimens to me for examination, and also pointed out a significant "mottled" effect which can be seen when these specimens are examined by the naked eye in the direction of their optic axes. In the blue specimen this curious mottling can be clearly seen in ordinary light reflected from a sheet of white paper. In the case of the yellow specimen the effect is best seen when the specimen is placed between crossed polars. That such an effect might be worth looking for was also suggested to me by a British expert in the art of crystal growing, who linked it with the coarse "cobbled" crystal surface on the basal plane of man-made quartz crystals. In natural quartz, it will be realised, the basal plane does not exist as a crystal face. It is quite possible that not all of the coloured synthetic quartzes will show this effect, but at least it is something positive to look for.

"Dialite" Doublets

One of the latest attempts to imitate diamond takes the form of a doublet in which the crown consists of synthetic white spinel and the pavilion of strontium titanate. The hope behind the production of such a composite stone is that the crown of synthetic spinel will protect the softer strontium titanate used as the base, and also modify to some degree the over-dispersive effect which makes "fabulite" so easily distinguishable from diamond.

The synthetic spinel table facet, of course, yields a refractometer reading of 1·727, and the titanate base still provides colours due to high dispersion in a manner which is excessive when compared with diamond. Viewed at the correct angle, the edges of the table facet can be seen reflected in the junction layer, somewhat as in true diamond doublets. There is more likelihood that these doublets will be wrongly identified as strontium titanate than as diamond. But they provide the jeweller and the gemmologist with one more fake to look out for and one more fancy name, "dialite", to remember (or forget). We are indebted to the Gemmological Association for a sight of this product.

Blue Zoisite Imitation

For anyone to think it worth while to produce an imitation of a newcomer amongst gemstones such as blue zoisite ("tanzanite") is in some measure a compliment, as indicating that the stone in question is both valuable and popular. A cheeky example of this was sent for testing some weeks ago in the form of a blue-mauve stone mounted as a brooch accompanied by an undoubted zoisite crystal of similar colour. So similar indeed was the colour that I fully expected a reading in the 1·70 region on the refractometer, and was quite astonished to find a corundum index—synthetic, of course, and in its context clearly tailor-made to pass as zoisite with its companion crystal. This tale is told more for entertainment than for information, but it does at least emphasize the need for eternal vigilance in gem-testing in these tricky times.

Synthetic Powellite

Synthetic scheelite is a fairly well-known product, which (when suitably "doped") is used by the physicist as a laser material and can also be faceted into very attractive gemstones, which have been passed on occasion as natural scheelite for high prices to ardent collectors. A cut specimen of powellite, which is a closely-related analogue of scheelite, was loaned to me by the Gemmological Association, and can be briefly described for the record, though, being even softer than scheelite ($3\frac{1}{2}$ on Mohs' scale) it is hardly likely to find favour as a gem substitute. The stone, weighing only 0·42 carats, is pink in colour—due probably to a heavy doping with one of the rare earths which, from its absorption spectrum, would appear to be holmium. It shows a fair degree of dispersion, which might be expected from a mineral with the high indices of 1·974 for the ordinary ray and 1·984 for the extraordinary. The density is 4·34 compared with the 6·1 of pure scheelite. This is accounted for by the composition, which is mainly calcium molybdate, while scheelite is calcium tungstate, and the atomic weight of molybdenum is 96 against the 184 of tungsten. Scheelite is, of course, well-known for having a bright blue fluorescence under short-wave ultra-violet light while being unaffected by long-wave (3650Å). A similar effect is seen in the synthetic powellite, but here the fluorescence is green and can be seen in long as well as in short-wave ultra-violet rays.

Canary Diamonds

Now let us turn, admittedly with some relief, to natural gemstones. When, nearly 30 years ago, I ventured to classify diamonds in terms of their fluorescence as Blue fluorescers (Cape series), Green fluorescers (Brown series) and Yellow fluorescers (True "canaries") I did not quite realise how very rare this last category is. In fact it seems to belong to a special category of type II stones, showing none of the absorption bands typical of Cape or Brown series stones. We were recently lucky enough to have for test two of these "canaries", each over four carats and cut in pendeloque form. Under all radiations they showed a strong yellow glow, and their body colour was also a very attractive yellow. Another natural yellow diamond, in this case belonging to the Cape series, showed, in addition to the normal "Cape" absorption bands, a faint line at 5170Å, which I do not seem to have recorded previously.

Gahnite

I was glad to purchase recently a transparent green spinel which turned out to be a nearly pure zinc spinel or gahnite—the end member in fact of the "Gahnospinel" series which we discovered in the Ceylon gem gravels before the war. The density of this stone was 4·64 and its refractive index 1·798. The tourmaline-green colour was clearly due to ferrous iron as its absorption spectrum resembled closely that of normal blue spinel. The bands in fact were found to have the same wavelengths, but the effect was different as their relative strengths were decidedly not the same. The band at 5080Å between blue and green for instance was far stronger in the gahnite.

Actinolite in transparent green pieces suitable for cutting is decidedly uncommon. A pale green transparent blade shown to us by Mr. R. K. Mitchell was found to belong to this species, the figures obtained for its density (3·03) and refractive indices (1·616, 1·633, 1·641), being in almost uncanny agreement with those given by Winchell. There was a faint but clear line in the spectrum at 5030Å—a position where, when one is lucky and in good form, a similar band can be detected in the closely-related nephrite.

ARRANGING A COLLECTION

By GORDON V. AXON

A COLLECTOR faces immediately the problem of arranging his collection. In the United States, where the author currently lives, mineral and gem collecting is probably more advanced than anywhere else in the world, and the mechanical ability of Americans has been applied to the problems facing collectors. As a result, several companies provide a range of cases, cartons, trays, cabinets, stands, and gem holders.

Even so, collectors sometimes still need custom-made boxes, so even in the United States problems are still faced by collectors.

One trouble lies in the variety of acquisitions, since gems come from minerals, and minerals come in all shapes and sizes, on matrix, as separate crystals, and as "rough".

A display cabinet of the type long known in Europe is no doubt the best way to exhibit fine mineral specimens for daily pleasure. Special supports may be needed for large specimens, but, otherwise, the plastic supports commonly available should suffice for medium-sized specimens, while the varieties of "plastic-rubber" will support separate crystals. Good sparkling lighting is essential, with ultra-violet for fluorescent specimens.

Gem collectors are a breed apart, since they usually deal with much smaller items that convey a different type of pleasure and indulge distinct intellectual tastes. Specifically, gem collectors are often concerned with fairly small stones, or with stones that have unusual characteristics.

In both cases, the visual pleasure afforded by a modest collection along these lines need not necessarily be great enough to compel an open collection that can be viewed readily. It may suffice to use stone papers arranged in any way suitable for the user.

Should the visual pleasure be a factor, several facilities are available that combine in varying degree the visual pleasure with ease of access.

A wooden board could be drilled for cavities for the stones that would be protected by a sliding glass top. The trouble here is that the stones would move around and often present less than their must attractive view. Pads of "cotton" (cotton wool) or plastic foam would help.

Yet small plastic boxes that hold a single gem might prove better since they are easily stored in a cardboard box. These small plastic boxes, readily available in the United States, are hinged clear-plastic boxes often with a hard-foam lining, and a soft-foam within the lid. The gem is displayed simply by opening the hinged top. Here, of course, there is no simple visual inspection since all the hinged boxes would have to be opened each time a collection was displayed, but for valuable single gems the idea is worth considering. In a sense, each gem is treated as a ring in a box.

As a rule, foam is superior to cotton wool (known as cotton in the United States) or any other lint-producing substance, since foam provides varying degrees of support, according to type used, and does not produce the irritating strands and wisps of cotton wool.

Several stones can easily be accommodated in the larger plastic boxes complete with foam linings for base and cover. Depressions are easily made in this substance and the stones arranged as needed.

These larger boxes are suitable for several stones of the same mineral variety, or of several varieties, or of the same cut, or of several cuts. Large gems, and crystal or rough and cut to match, can also be accommodated.

Glue, of course, should not be used to fix the stones. There is no need, quite apart from spoiling the stone and the viewing.

Sometimes, gem mounting prongs are useful. These may be home-made or bought. They are suitable for most stones of any reasonable size and consist of flexible plastic or metal strands or fibres attached to a central support that can be pushed into hard foam for display.

Yet all these types of covered boxes suffer from the lack of easy viewing. There's nothing like being able to take a look at a collection without all the bother of opening stone papers or folding back plastic hinges.

One method suitable for gem collectors is the custom-made box of wood, with hinged lid, containing two trays each divided into say 50 small compartments. Each tray base and the inside of the lid are well padded to protect the stones and keep them in place. A simple opening of the box would disclose 50 stones, for instance, while the lifting of the top tray would reveal the other 50—in short, 100 gems on display almost immediately.

A method very suitable for cabochons is the wooden tray lined with foam and covered with glass that can be simply lifted by a tag and removed. These come in many sizes, ranging for instance from four inches by six, to twelve inches by sixteen. The wood, in this particular advertisement, is either pine or mahogany. The foam is blue or white.

Other firms have similar boxes, ranging up to one inch or more deep, that are filled with cotton wool, padding, or plastic foam.

Such boxes, especially the smaller ones, can be very suitable for faceted gems even though the glass exerts some pressure on the stones. This does not matter very much, of course, with cabochons, but faceted gems are another thing entirely. Even so, these trays are very useful for most gems. Those trays with glass tops have the problem of removing the glass when stones are being changed, but that is easily done. The shallow cardboard boxes with glass top in cover have the problem of removing the side pins and taking off the cover. Here again, the problem is minor although the replacing of the tight cover may upset the arranged stones. The pins simply go through the cardboard sides and keep the cover in place. The boxes range from small to large.

These are just some of the many, often ingenious, ways of displaying collections. Of interest to collectors of small mineral specimens are the display cases with rising levels complete with plastic cassettes, or holders, of the small specimens. The result is a minor football stadium, each individual "seat" being a mineral specimen.

Special cases are also available for "thumbnail" specimens and "micromounts" as well as the miniatures.

In short, in the United States, at least, there is a galaxy of choice. There's no doubt that a fine and easy way of displaying adds considerable enjoyment to a collector's pleasure.

ANCIENT IRISH PEARLS

By C. J. ROBB

THE fresh-water pearl of the bivalve *unio margaritifera*, the animated gem, the "na seod" in Gaelic, was found in the crystal-clear meandering rivers of Ireland from the mists of history. It was the prized jewel of the ancient queens, princesses, and fair ladies of those distant times and the hierarchy of the Church regarded it as a token of respect. Bishop Gillbertus of Limerick, gave the Archbishop of Canterbury, St. Anselm, a pearl as a token of his respect in 1094.

Con O'Neill, Prince of Ulster in 1493, bestowed pearls "of riches" on ladies. In 1656 the river Slaney in Co. Wexford was prolific, says Richards[1], an English writer, in fine pearls of fair lustre, magnitude and rotundity, not inferior to Oriental gems at prices from 20s. to 40s. to the silversmiths and jewellers of London. Sir Robert Reading[2] described pearls from the rivers of Co. Tyrone to the Royal Society in 1688. These gems were mostly of a pale brownish colour, some with a greenish tinge. Some of these of good quality weighing up to 36 carats were valued up to £40. A miller found a pearl in the mill-race, which he sold for £4 10s., and the buyer sold it to Lady Glenawley for which she refused an offer of £80 from the Duchess of Ormond. The Bann river, at Banbridge in Co. Down, was rich in these pearls and a small industry was established to collect, polish and sell them to the best buyers in Dublin, London and Paris. Queen Charlotte had a necklace of Bann pearls valued at £700, one of 4 carats being valued at £60. The river pearls of Ireland had thus an abiding place in the annals of gemmology.

REFERENCES

1. Description of Wexford, 1656. Nat. Library, Dublin.
2. Contained in a letter to the Royal Society dated 13th October, 1688.

CONFIGURATION OF DISLOCATIONS IN NATURAL TOPAZ CRYSTALS

By M. S. JOSHI and R. K. TAKU

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ABSTRACT

KOH at 450°C has been used to study the dislocation contents and the configurations of dislocations in natural topaz crystals. Etch patterns on basal cleavages and on matched pairs of basal cleavages are described and illustrated. In the light of these observations it is established that non-parallel linear defects and dislocations in the form of half-loops are commonly observed in natural topaz crystals.

INTRODUCTION

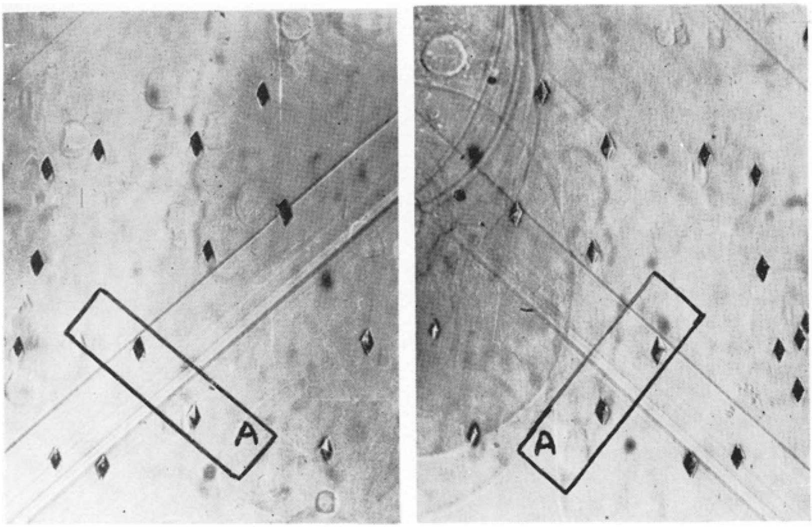
Etching technique is widely used to study defects in single crystals. Comparison of etch figures on matched cleavages gives a good deal of information about the existence and nature of dislocations. Fidelity of an etchant to reveal dislocations in crystals is proved if there is a mirror correspondence of etch pits on two matched halves and pits grow bigger and deeper on progressive etching. One to one correspondence of etch pits results when dislocations are either normal to or are all inclined at the same angle with the face[1, 2]. However, when dislocations branch or bend at or near the cleavage, mis-matching or deviation from one to one correspondence of etch pits on two matched cleavages is to be expected[3-6]. Using selective etch methods, various investigators have studied dislocations in different crystals[7-12]. From the detailed study of surface structures of various habit faces of natural topaz crystals useful information has been obtained by us in regard to development and mechanism of growth of different habit faces in particular and of natural topaz crystals in general (unpublished). A series of experiments to investigate defects in natural topaz crystals have been carried out by us. We have reported various channel-like inclusions, isolated oriented square-shaped inclusions, tree-like inclusions etc. in natural topaz crystals. By correlating etch pits with inclusions we have established that some of the inclusions are trapped at dislocation sites.[13] In the present paper the configuration of dislocations in natural topaz crystals has been worked out.

In the present investigation, matched pairs cleaved along (001) faces were etched in KOH at 450°C. Matched cleavages were selected for our etching experiments because it is easy to secure regions having less concentration of dislocations or defects on these surfaces so that when these surfaces are etched, the region yields less concentration of etch pits. The etched surfaces were thoroughly cleaned, silvered and then examined under a metallurgical microscope.

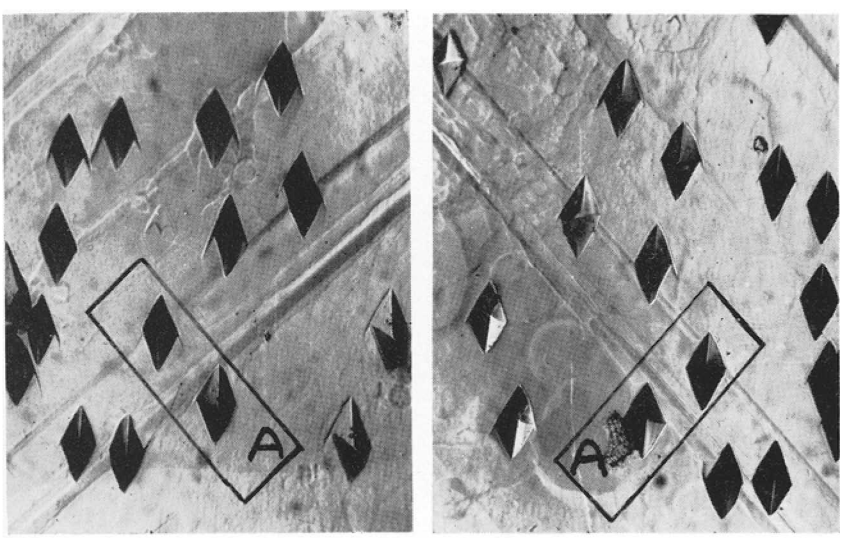
Observation and Discussion

Examination of etched surfaces revealed the presence of point-bottomed etch pits on them. Since the point bottom of an etch pit is considered to be the terminal end of a dislocation line, by following, at successive stages of etching, the tip of point-bottomed etch pits it becomes easy to map out the configuration of dislocations threading through the crystal lattice. This procedure was employed to find out the path followed by dislocation lines. Etch pits obtained on cleaved matched pairs showed correspondence in their number, shape and size and on successive etching etch pits were found to grow bigger in size and become deeper as is to be expected. A typical case of etch patterns obtained on a cleaved matched pair after 15 seconds of etch is shown in figs. 1(*a*) and 1(*b*). Comparison of etch patterns in these photomicrographs show one to one correspondence in regard to both the number and position of isolated etch pits, which means that the pits are formed at dislocation sites. A close examination of these etched faces revealed the eccentric nature of etch pits. The eccentricity observed in the structure of etch pits indicates that the linear defects are inclined at some angle with the cleavage face. This eccentric nature of point pyramidal pits should become more pronounced with the increase in the depth of pits. To investigate it, this matched pair was again etched for 30 seconds. Figures 2(*a*) and 2(*b*) illustrate etch patterns thus obtained. Here, all the pits have grown bigger in size and depth and are point-bottomed and eccentric. When etched regions in figs. 2(*a*) and 2(*b*) are compared with those in figs. 1(*a*) and 1(*b*) the following points emerge.

1. The cleavage lines are displaced relative to the pattern of pits. It is conjectured that displacement of cleavage lines by etching might be taking place as explained by Tolansky[14].

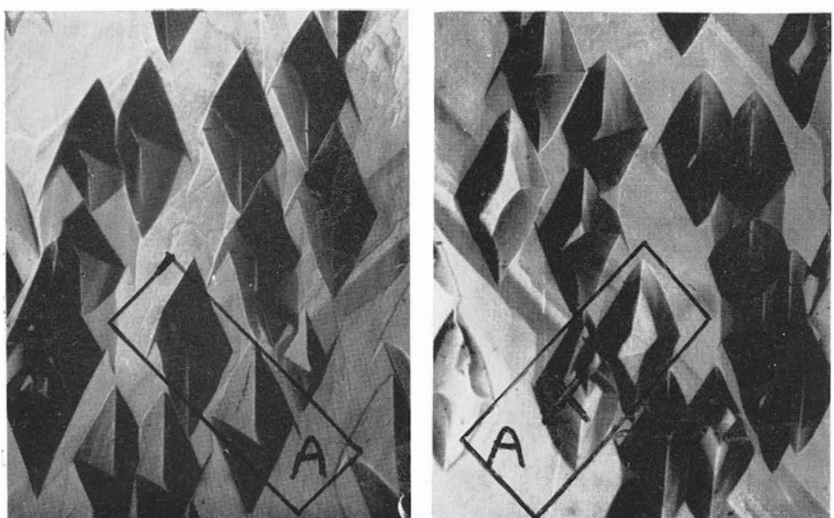


FIGS. 1(*a*) and 1(*b*). Etch patterns produced on two matched cleavage faces after an etching time of 15 seconds (× 175).



FIGS. 2(*a*) and 2(*b*). Regions of figures 1(*a*) and 1(*b*) after 30 seconds of further etching (× 175).

2. In regions mark A in figs. 1(*a*) and 1(*b*), and figs. 2(*a*) and 2(*b*) it is found that the distance between the geometrical centres of two pits is larger in fig. 2(*a*) than that in fig. 1(*a*) and it is smaller in fig. 2(*b*) than that in fig. 1(*b*). This means that two dislocation lines associated with these pits are divergent as one goes into the interior of crystal below the cleavage face of fig. 1(*a*) and become convergent as one goes towards the interior of crystal below the cleavage face of fig. 1(*b*). In order to see how and where these linear defects converge, the matched pair was again etched for 30 seconds. The etch patterns thus obtained are illustrated in figs. 3(*a*) and 3(*b*). On comparison of etch patterns in figs. 3(*a*) and 3(*b*) with those in figs. 2(*a*) and 2(*b*), we find in region A of these figures the distance between the geometrical centres of two pits in figs. 3(*a*) is larger than that in fig. 2(*a*), whereas on the other matched face the two point-bottomed pits seem to merge together (see fig. 3(*b*)). In the former case, the dislocation lines associated with two pits seem to diverge inside the lattice below the cleavage face of fig. 3(*a*), whereas in the latter case the dis-



FIGS. 3(*a*) and 3(*b*). Regions of figures 2(*a*) and 2(*b*) after 30 seconds of further etching (× 175).

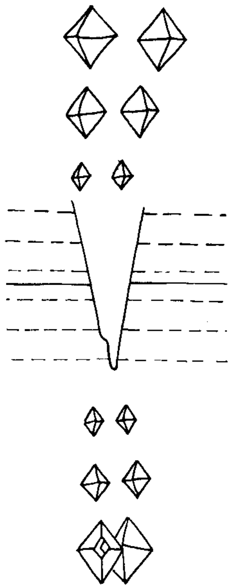


FIG. 4. Schematic representation of configuration of a dislocation half-loop.

location lines seem to converge in the interior of the crystal below the region of cleavage face of fig. 3(*b*). The two pits in region A of fig. 3(*b*) are flat-bottomed. A small point-bottomed pit is also seen inside a flat-bottomed pit marked X, formation of which may be attributed to the stepped nature of dislocation inside the crystal. At this stage it could be conjectured that this newly formed point-bottomed pit and also the flat-bottomed pits would grow wider and deeper and result into a single pit if further etching was carried out. In fact, etching of this matched half for 30 seconds more did result in a single flat-bottomed pit. Thus the dislocation lines associated with these pits converge in the interior of the crystal below the cleavage face of fig. 3(*b*), whereas these linear defects diverge inside the crystal below the cleavage face of fig. 3(*a*), thereby giving rise to the formation of dislocation half loops, schematic representation of which is given in fig. 4. It may be mentioned here that in all the schematic diagrams presented here, the solid line in the centre represents the boundary separating cleavage planes and the dotted lines represent the three stages of etching.

The above-described observation reveals that dislocations are present in topaz crystals in the form of a half loop. A series of etching experiments carried out under the same conditions (as described above) on basal cleavages of natural topaz crystals also proved that in most of the cases the linear defects are, in fact, present in the form of half loops in such crystals. A typical observation made on a basal cleavage is illustrated in figs. 5(*a*), 5(*b*) and 5(*c*) which represent the etch patterns obtained after an etch of 15 seconds, 45 seconds and 75 seconds respectively. By comparing etch patterns in the region marked A of these figures, the following points become noteworthy.

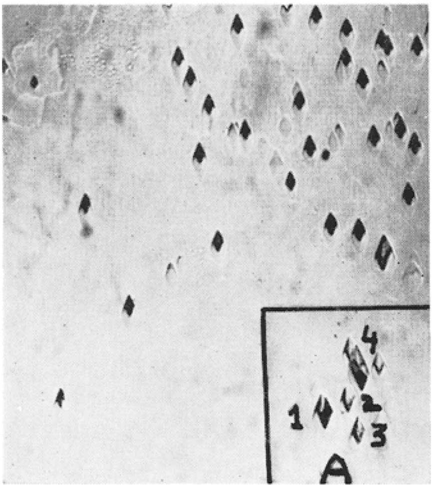


Fig. 5(*a*). Etch patterns produced on a cleavage face after an etch of 15 seconds (× 175).

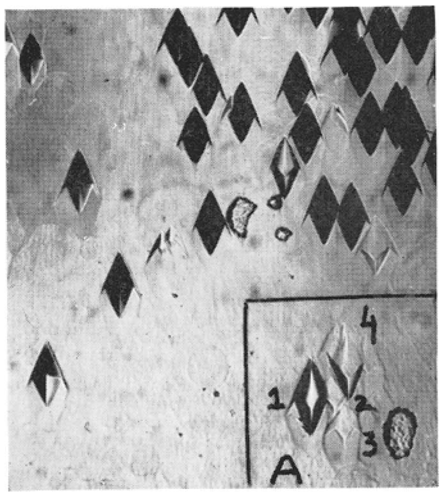


Fig. 5(*b*). Region of fig. 5(*a*) after 30 seconds of further etching (× 175).

Fig. 5(*c*). Region of fig. 5(*b*) after 30 seconds of further etching (× 175).

1. A point-bottomed pit marked 1 in fig. 5(*a*) results in a flat-bottomed pit (see fig. 5(*b*)) and then again becomes point-bottomed as is seen from fig. 5(*c*). In this case, it seems that in the beginning, the dislocation line runs normal to the cleavage face, then changes its direction to become almost parallel to the cleavage face and then bends and runs inclined to the cleavage face.
2. Pits marked 2 and 3 in fig. 5(*a*) are point-bottomed. When etched, they seem to merge together and have their bottoms flat (see fig. 5(*b*)). On further etching, they finally result in a shallow flat-bottomed pit as is observed from fig. 5(*c*). It is suggested that formation of pits in this way gives rise to a V-shaped dislocation configuration.
3. Three pits at mark 4 of fig. 5(*a*) have correspondence with three flat-bottomed pits in fig. 5(*b*). As these flat-bottomed pits grow bigger in size, due to their intergrowth two of the flat-bottomed pits result in a single point-bottomed pit and this point-bottomed pit seems also to merge with the third flat-bottomed pit (see fig. 5(*c*)). Formation of pits here indicates that dislocations associated with these pits are present in the form of half-loops.

   A schematic representation of dislocation configuration of the above mentioned three cases is given in fig. 6 as marked D E and F respectively.

One more case of etch patterns obtained on a cleavage face by etching it for 15 seconds is shown in fig. 7(*a*). Here also all the pits are eccentric and except pits No. 3 and 4, which are quite close to each other, all pits have grown at isolated places. This cleavage face was etched for 30 seconds more and the resulting etch patterns are shown in fig. 7(*b*). Here the pits have grown bigger in size and depth. It is interesting to note that pit No. 1 seems to join pit No. 2 (see fig. 7(*b*)) which means that the dislocation line associated with pit No. 1 is much more inclined to the cleavage face than that associated with pit No. 2. Also, as seen from fig. 7(*b*), pit No. 3 has merged with pit No. 4. At this stage it was felt that these pits may result in a single pit if further etching was carried out. To investigate it, this cleavage was again etched for 30 seconds and etch patterns thus obtained are shown in fig. 7(*c*). Here, as was expected, pit No. 1 has merged with pit No. 2 and

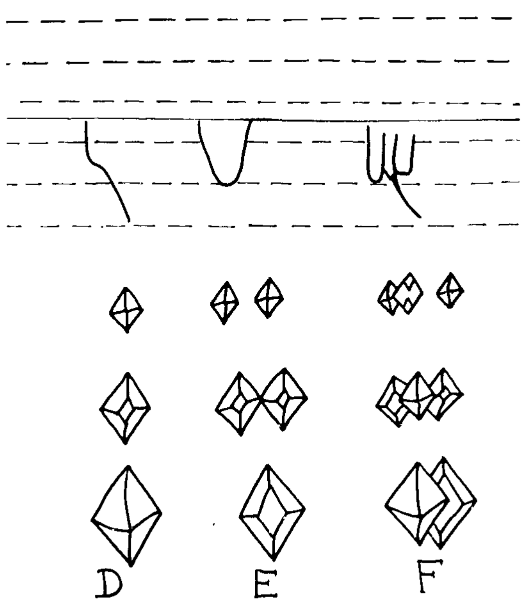


FIG. 6. A schematic diagram of different configurations of dislocations.

the same is the case with pit No. 3 and 4. Development of these etch pits is thus attributed to the formation dislocation half loops.

CONCLUSION

Etching experiments carried out in the present investigation and observations reported here reveal that dislocations in the form of half loops are common in natural topaz crystals.

REFERENCES

1. Joshi, M. S. and Kotru, P. N. *Kristallografiya,* **14,** 516 (1969).
2. Joshi, M. S. and Ittyachen, M. A. *Z. Krist.,* **126,** 321 (1968).
3. Amelinckx. *Phil. Mag.,* **1,** 269-290 (1956).
4. Sagar, A. and Faust, J. W. *J. Appl. Phys.,* **38,** 2240 (1967).
5. Hari Babu, V. and Bansigir, K. G. *J. Appl. Phys.,* **40,** 4306 (1969).
6. Joshi, M. S. and Ittyachen, M. A. *Ind. J. of Pure and Appl. Phys.,* **7,** 678 (1968).
7. Joshi, M. S. and Ittyachen, M. A. *Ind. J. of Pure and Appl. Phys.,* **7,** 624 (1969).
8. Joshi, M. S. and Vagh, A. S. *Jap. J. of Appl. Phys.,* **5,** 289 (1966).
9. Joshi, M. S., Kotru, P. N. and Ittyachen, M. A. *Kristallografiya,* **15,** 103 (1969).
10. Patel, A. R., Bahl, O. P. and Vagh, A. S. *Z. Krist.,* **126,** 225 (1968).
11. Patel, A. R. and Goswami, K. N. *Acta Cryst.,* **17,** 569 (1964).
12. Tsingerling, E. V. and Mironova, Z. A. *Kristallografiya,* **9,** 565 (1964).
13. Joshi, M. S. and Taku, R. K. *Journ. Gemmology,* **12,** 346 (1971).
14. Patel, A. R. and Tolansky, S. *Proc. Roy. Soc.,* **A243,** 41 (1957).

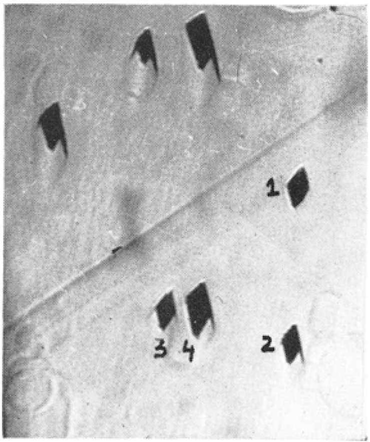


FIG. 7(*a*). Etch patterns obtained on a cleavage face after an etch of 15 seconds (×350).

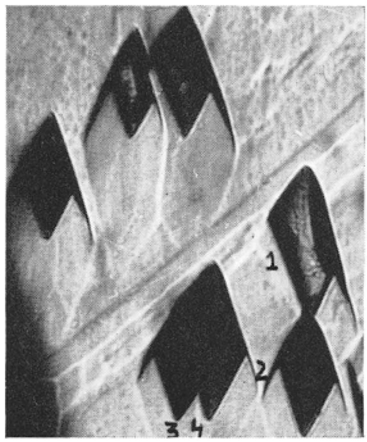


FIG. 7(*b*). Region of fig. 7(*a*) after 30 seconds of further etching.

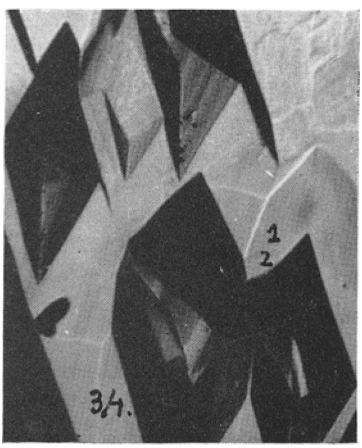


FIG. 7(*c*). Region of fig. 7(*b*) after 30 second of further etching.

GEM EXHIBITION IN SCOTLAND

UNDER the auspices of the City of Glasgow Civic Amenities Committee, and arranged by the Scottish Branch of the Gemmological Association, a "WORLD OF GEMS" exhibition was held at the Glasgow Corporation's Art Gallery and Museum at Kelvingrove from 17th September to 3rd October, 1971.

An official opening ceremony was held in a lecture hall of the Art Gallery on the evening of the 16th of September. This ceremony attracted some 900 guests to hear Councillor Mrs. Constance Methven, the Convenor of the Civic Amenities Committee, with a short well-chosen speech, introduce Professor T. Neville George, Ph.D., D.Sc., D. es Sc., F.R.S.E. who formally opened the exhibition. Professor George explained in simple terms, the nature of gemstones, mainly with reference to their mineralogical aspect, with which of course he is so familiar, but he did refer also to man-made gems and those of organic origin. Mr. Dennis Hill, the Chairman of the Scottish branch replied to Professor George. The exhibition was then declared open.

The exhibition itself was displayed in the Central Hall of the Museum and Art Gallery. On entering one's eye was immediately focused onto a flood-lit case containing a very fine set of replicas of the British Crown Jewels, and on the back of the case on the reverse side were a series of colourful transparencies of the Scottish Regalia, anciently styled "The Honours of Scotland", the symbols of Sovereignty when Scotland was a separate kingdom. At the centre of this second case reposed the "Thistle jewel", an early edition of the Saint Andrew of the Order of the Thistle, this historic jewel having been graciously loaned by Her Majesty the Queen.

The centre stand forming a triangle of cases dealt completely with diamonds. Provided by the De Beers Company, there were replicas of the famous diamonds of the world, and models showing the stages of cutting a brilliant-cut diamond from an octahedral crystal. The second of the three cases showed a magnificent collection of diamond crystals and included a dish of diamond crystals of all conceivable colours. The remaining case showed the final result in a large selection of diamond engagement rings.

A most exciting exhibit consisted of a fine collection of the gemstones found in Burma. This included some excellent crystals of ruby, peridot and topaz. Cut stones were represented by many well-known species which come from the Mogok Stone Tract, particularly the corundums, but there were many less known species, such as fluorite, euclase, scapolite, kornerupine, and sinhalite. This case of Burma gems fronted another larger case containing an excellent collection of the jades, both nephrite and jadeite, and some of the minerals which simulate the true jades.

There was an exhibit of Victorian jewellery, loaned by the Victoria and Albert Museum in London, jewellery mainly set with pearls and turquoise, and also jet. In an opposite case for comparison was a case showing modern jewellery. Naturally there had to be a show of Scottish jewellery and this display on a tartan background consisted of typical Scotch pebble brooches, cairngorms and jewel-set dirks.

Of greater interest to the gemmologist and technician was the case devoted to synthetic and composite stones. Among the more unusual of these were a suite of all the colours of synthetic star-stones, many of which had not been seen in this country before. Synthetic emeralds made by Chatham, Gilson, Zerfass and Linde were on display as well as the newer synthetics, such as, synthetic rutile, strontium titanate ("fabulite"), yttrium aluminate (YAG) and some new colours of synthetic quartz. Many unusual composite stones were on display including the recently marketed doublet consisting of a base of fabulite and a crown of synthetic white spinel, a stone which has been marketed under the unfortunate name "dialite".

Various applications of gem materials to science and industry was the theme of another exhibit. In this display were shown core drills, turning tools, diamond saws, wire-drawing dies, agate bearings, quartz oscillators, record player styli and many others. Ruby and YAG laser crystals were also shown and there were specimens of "doped" calcium tungstate crystals of a blue-violet colour, which indicates coloration by the rare-earth neodymium.

Other exhibits showed "The Zircon Story" telling of the production and native treatments for the production of the popular colourless and blue zircons. Another display showed a wide range of cameos and intaglios in both stone and shell. Ivory and amber formed another exhibit, and there was shown a fine assortment of crystals and cut stones of all varieties of gem minerals. Pearls, too, were in evidence, among which was the beautiful "Abernethy pearl" fished from the river Tay.

The instruments used in the testing of gems formed another exhibit, and in this, for the first time, was displayed the refractometer with a zinc blende prism, which was the prototype which led to the modern suite of Rayner refractometers. A selection of books on gemstones showed the literary side of gemmology.

At the rear of the hall was a screen decorated with coloured pictures showing diamond recovery, sorting diamonds and their fashioning and marketing, and another exhibit demonstrated the sawing of a large block of stone by means of a diamond-toothed circular saw, and also a diamond-studded head of a rock drill. What was seen to be most popular with the visitors was a continuously operated lantern projecting coloured slides showing the diamond and cultured pearl industries.

The following Fellows of the Association gave lectures during the Exhibition:

Diamond Mining and Marketing by Arthur McRae.
Synthetic Gemstones by M. Turner.
Diamonds by D. Hill.
Pearls by I. N. MacKenzie.
Historical Diamonds by A. H. G. Armstrong.
Diamonds in Industry by H. J. Whitehead.

The organisers who put up this exhibition had to design it not only for the gemmologist but, more importantly, for the general public, and in covering this dual job they produced an excellent show. The broad spectrum of the display and the attendance at the exhibition (reported to be 28,000), showed how well they achieved this endeavour.

Gemmological Abstracts

FEININGER (T.). *Emerald mining in Colombia: history and geology.* Min. Record, 1970, 1, pp. 142-149, 4 figs.

A detailed summary is given of the history of emerald mining in Colombia, with specific reference to the Chivor district and mine, the Gachalá mine, the Muzo district and mine, and the Coscuez and Peñas Blancas mines. Also discussed are the geological setting and associated mineralogy of Colombian emeralds, mining methods employed and production figures, a review of theories on the origin of Colombian emeralds, and comments on identification.

J.A.

HORSZOWSKI (S. M.). *Thermal annealing of natural semiconducting diamond.* Journ. Phys. Chem. Solids, 1969, 30, pp. 669-675, 3 figs.

The annealing behaviour of type II semiconducting diamonds is complex, occurring by several processes with activation energies ranging from <3 to <9eV.

R.G.J.S.

LITVING (YU. A.), LISOYVAN (V. I.), SOBOLEV (YE[E]. V.), BUTUZOV (V. P.). *An X-ray investigation of artificial diamond crystals.* Dokl. Acad. Sci. U.S.S.R., Earth Sci. Sect., 1969, 183, pp. 144-147, 4 figs. Transl. from Dokl. Akad. Nauk SSSR, 1968, 183, pp. 1163-1165.

X-ray investigation shows that there are marked differences between synthetic diamond crystals of the main crystallographic types. The characteristics of the diamond crystals are discussed.

B.E.B.

POUGH (F. H.). *On names.* Lapid. Journ., 1971, 25, 5, p. 680.

An interesting comment about the confusion that exists in connexion with gemstone nomenclature. Dr. Pough refers to the prevalence of the suffix "ite" on new minerals names, which will make some older names preferable. He refers to grossular being preferred to grossularite. He agrees that the term "synthetic" is not acceptable for some of the man-made products that have no counterpart in nature. There is good reason for calling such laboratory products "man-made". (Andy why not? Far better than "created". According to one's beliefs God or Nature created emeralds, rubies and other gems. Smith, Jones, Robinson or Brown, have endeavoured to copy natural gems. Ed.)

S.P.

SEGNIT (E. R.), ANDERSON (C. A.), JONES (J. B.). *A scanning microscope study of the morphology of opal.* Search (Commonwealth Sci. Industr. Res. Organization), 1970, 1, pp. 349-351, 13 figs.

Electron micrographs of surface replicas of precious opals show that they are composed essentially of close-packed spheres of silica with a diameter of around one-half the wavelength of visible light (M.A. 17–609). Examination of freshly broken and etched samples of various types of opal by scanning electron microscope confirms that sphere-type opals have been deposited by colloidal precipitation. In other types of opal with a structure based on a disordered interlayering of cristobalite and tridymite units crystallization appears to have been the initial process. Opal from a volcanic sequence in Iceland consists of an aggregate of minute tabular crystals of cristobalite produced by reheating of a less crystalline opal by lava flows, causing recrystallization.

R.A.H.

ANON. *Diamond mining in India today—output tiny, gemstone ratio high.* World Mining, 1971, 24, 6, pp. 34-35, 1 map.

The geology of pipe, conglomerate, and secondary diamond deposits in the Panna region, central India, is briefly described. Although African kimberlites carry 0·3 to 1 carat per ton, the developing Majhgan diamond pipe carries only 0·1 carat per ton. However the ratio of gem to industrial stones in African pipes is 1:4 to 1:9, while the Majhgan pipe ratio is 4:1 to 3:1. Secondary deposits contain 0·05 to 0·1 carat per ton.

R.W.H.

BOOK REVIEWS

FIRSOFF (V. A.). *Gemstones of the British Isles.* Oliver & Boyd, Edinburgh, 1971. 152 pp., 45 line drawings, 3 maps, 4 pp. of coloured plates. £2·50.

The title of the book suggests that at last there is a volume of real value to British gemmology but the book does not appear to have attained that status. The problem the author has tackled is not an easy one, as others have found before and usually given up in despair. The reason for this is not far to seek and is due to the steady industrialization of the country, including, although to a less extent, Scotland, and also Eire. Correctly, the author has commenced his researches by studying the older literature, but some of the sites mentioned, more often for mineralogical rather than gemmological reasons, are probably now built upon and not available. Moreover, mineralogists report finds of minerals which are in very small sizes and completely unsuited for gemstones as we know them. The author has done some searching himself and has also had many recent personal communications to assist him and in this the work has a certain value.

The general text starts well and the division into areas, geographical and county, has much to recommend it. In later chapters, the more technical side of the subject fails to come up to this standard, and there are errors in this part. There is a statement that jadeite is found in the rocks of the Lizard in Cornwall, and this is attributed to G. F. Herbert Smith, but the mineral Herbert Smith states is found in the Lizard is not jadeite but saussurite, a different mineral entirely. The caption to the line drawing on page 78 should read *refraction of light in a stone*, not *reflection.* Further, on page 85 the author writes: ". . . gives diamond its lively fire, *unrivalled by the various "pseudo-diamonds" except the colourless zircon*". (Reviewer's italics.) Scheelite fluoresces only under short-wave ultra-violet light and that has not been made clear. There are plenty more errors of similar nature. The misspelling of rhodochrosite might have been a slip had it not been repeated so many times and far too many of the unacceptable older names are given, which in view of the present legislation would have been better omitted.

There are two items mentioned which interested the reviewer.

The first of these was mention of colourless garnet, called "water-garnet", apparently recorded by Heddle in a book dated 1901; and the second, a reference to olivine of a "fine cherry-red colour", which was taken from a book printed in 1858. Whether these could be classed as gemstones I do not know, but the reports are interesting.

The volume is completed with a fairly good index, but it is hoped that before any further edition is contemplated the script will be read by a competent gemmologist or mineralogist before publication.

R.W.

ISLAM (M. F.). *Nowratan.* Dacca, 1971. Rs. 3·50.

A short treatise about pink pearls of East Pakistan, together with brief guidance on other gems. The author is enthusiastic about the lustre and beauty of the pearls. He has discovered 11 pearl-producing districts in East Pakistan.

S.P.

Mineral Digest, Vol. 2 (undated). New York. $3·00.

A comment about the absurdity of the use of the term "semi-precious", a well argued case for the sensible naming of gems and minerals, and some outstanding colour photomicrographs of moon rock, are highlights of this sumptuous publication. There is an article on cameos and one on minerals from Tsumbe, S.W. Africa.

S.P.

ANON. *Gems & jewels.* Orbis Books, London, 1971. £1·25. Translated from French.

This is an excellent elementary treatise, with an introduction by H-J. Schubnel, of the French Gemmological Association. Its most important feature is 180 plates in colour. Some of these have appeared elsewhere, but the Orbis series is intended to open up an absorbing range of hobbies and pastimes. The colour illustrations are a great interest to the expert in this book.

S.P.

BOEGEL (H.) (edited and revised by J. Sinkankas). *A Collector's Guide to Minerals and Gemstones.* Thames and Hudson, London, 1971. £2·95 net (U.K.).

This is a superbly illustrated book which emphasizes the value of depicting gem crystals by using coloured illustrations instead of a colour camera. This book is suitable for anyone interested in the beauty and fascination of minerals and gemstones; for the beginner it is an authoritative guide and it is comprehensive enough to satisfy more experienced students. It makes no pretence of being a textbook but gives sufficient information about physical properties to make the data given in the text useful and understandable.

John Sinkankas has modified the original text to give a fuller treatment of mineral origin and to give details of a historical and economic nature of many species. The bibliography has been amended to include texts in the English language.

The 154 water-colour illustrations were prepared by Claus Caspari and the translation from the German made by Eva Fejer and Patricia Walker, F.G.A.

S.P.

RICHTER (G. M. A.). *Engraved gems of the Romans.* Phaidon Press, London, 1971. £20.

The second volume of *The Engraved Gems of the Greeks, Etruscans and Romans.* Dr. Richter has again produced a scholarly work, and the printing is of the excellent standard associated with Phaidon Press. The work is more of interest to the archaeologist than to the gemmologist, as it constitutes a supplement to the history of Roman art generally. Although agate, carnelian and chalcedony are the principal stones mentioned, the use of glass was frequent and the glass gems were evidently cast directly from stone originals and then reworked. A fascinating study for those interested in engraved gems.

S.P.

SINKANKAS (J.). *Prospecting for Gemstones and Minerals.* Van Nostrand Reinhold Co., New York, 1971. £3·50.

This is a revised and up-dated version of a book formerly published in 1961 under the title *Gemstones and minerals: how and where to find them.*

S.P.

ASSOCIATION NOTICES

PRESENTATION OF AWARDS

The chairman of the Gemmological Association, Norman Harper, welcomed successful candidates in the 1971 gemmological examinations when they attended a presentation of awards at Goldsmiths Hall, Foster Lane, London, on 23rd November. He said his introduction was very similar to his introductions in previous years, there being some 420 candidates sitting for the preliminary examinations and 307 for the diploma, which was a record. Another record was the number of different centres, 75, scattered throughout the world, and for the first time there was a candidate from Yugoslavia. The postal strike earlier in the year made the posting of correspondence students' examination papers a "nightmare" but all eventually received them. He paid a special tribute to the examiners who, each year, had to undertake a very difficult task.

He then introduced Ove Dragsted, F.G.A., jeweller to the Royal Danish Court, who presented certificates and diplomas to those candidates attending.

In his address which followed Mr. Dragsted said—

"This is a proud day for all those who have won their diplomas in gemmology and their diamond certificates and even more so for the lucky ones who have won awards. The Tully medalist is to be especially congratulated as a few years ago he won the premier award in the retail jewellers' examinations of the National Association of Goldsmiths.

"I recollect how proud and happy I was myself when I received the fine large scroll with the seal of the Gemmological Association and the signatures of Dr. Herbert Smith, Dr. Claringbull and Mr. Knowles-Brown.

"The standard set for these examinations is high, they are of university level. We are here on the site on which one of the oldest of the livery companies, the Worshipful Company of Goldsmiths, has for more than six centuries set and maintained those high standards which has made British goldsmiths and jewellers world famous for quality and integrity. They may often have been tempted to lower the standards of quality but they refrained from doing so. This is the ancestral background of the National Association of Goldsmiths. So that their members might meet the expectations of the buying public they inaugurated in 1908 an educational scheme for retail jewellers, and as far back as 1913 were held the first examinations in gemmology. The Gemmological Association of Great Britain founded in 1931 is a child of the National Association of Goldsmiths, and what a bright child. This year it celebrates its 40th anniversary—gemmologically speaking this is a ruby jubilee and imagine what has happened during those 40 years.

"Gemmology all over the world is greatly indebted to this grand association. They once set the standards and these standards are followed all over the world by the many gemmological associations which have been formed. The British gemmologists were the pioneers who planned the right way for all gemmological education, that is an outstanding achievement. Your present chairman and his committee have every reason to be proud. Also the Gemmological Society of Denmark is deeply indebted to you for your fine pioneering work and I wish to express our sincere gratitude for all the inspiration and ready assistance we have received from Gordon Andrews, the Precious Stone Laboratory under the leadership of Basil Anderson and the research work carried out by him and his collaborators Robert Webster and Alec Farn. They have accomplished unbelievable results in those very modest premises in Hatton Garden.

"The strictly scientific nomenclature adhered to by the laboratory as well as in the courses and text books prove the descendancy from those 14th century goldsmiths who met on this very site. May I mention that the Zurich Gemstone nomenclature which we completed two years ago and the Scandinavian diamond nomenclature just published are both inspired by the learning obtained through the diploma courses which you have now successfully completed. There is, perhaps, in some countries a tendency to sell certificates today rather than beauty. The enthusiasts, the lovers of gemstones would stress the beauty of the gemstones. If a lady wants a diamond she does not precisely think in terms of a 41 deg. pavilion angle to the plane of the girdle, she thinks of brilliance, of fire, of sparkling beauty enhanced by a fine jewellery setting. She may also have a conception of the magic of the stone, its long and interesting history, the hidden powers thought to be attached to this very stone and, of course. she thinks of the stone also as a token of love. There are so many facets to gemmology.

"The diploma examinations which you have now sat for is certainly not a terminus, it is an important junction from which many tracks are leading. You may follow a track leading you to research work, or the special diamond track, which many successful candidates have followed which allows you to qualify as a diamontologist. Some gemmologists polish stones in their own private lapidary shops. They gain much pleasure from that. Others construct gem testing equipment. Maybe you have built up an interesting collection. You may seek efficiency in microscopy and photography, or you may branch into the fascinating history of gemstones. You may go on studying mineralogy, or geology and go out prospecting for gem minerals. I have taken part in some thrilling excursions in Greenland in quests for new gem minerals suitable for polishing".

The vote of thanks to Mr. Dragsted was proposed by Basil Anderson, F.G.A., director of the Gem-testing Laboratory of the London Chamber of Commerce, London, who said that he counted Mr. Dragsted as one of his oldest friends in gemmology. He was a founder members of a European gemmological group in which he, Mr. Anderson, was pleased to be included. He praised Mr. Dragsted's speech as being very sincere, the like of which was not often heard today.

Before the presentation Fellows and members of the Association held a short reunion.

MEMBERS' MEETINGS

Mr. Charles Schiffmann of the Gübelin Laboratory, Lucerne, gave a talk to members at Goldsmiths' Hall, London, on the 12th October, which dealt, among other things, with synthetic ruby, Verneuil synthetic red spinel, the analysis of colour with the DIN 6164 Colour Chart, and the use of the spectro-photometer and its application to gemstones. Mr. Schiffmann's talk in article form will be reported in subsequent issues of the *Journal.*

A meeting of the Scottish Branch of the Association was held on the 19th October, 1971, when Mr. Robert Webster, F.G.A. gave a talk entitled "An Outline of Problems in Gemmology today".

On the 21st October, 1971, members of the Midlands Branch of the Association heard Mr. Michael Houghton of Mikimoto Pearls speak on the Cultured Pearl Industry. His talk was illustrated by a film.

On the 12th November Mr. A. Jobbins, of the Geological Institute, South Kensington, gave a talk to members of the Midlands Branch on "The Gems of South East Asia".

MEMBERS' MEETINGS 1972

25th January	Talk by Mr. R. Webster, F.G.A., on "Gems in Court". Goldsmiths' Hall, London, 7.00 p.m.
22nd March	Annual General Meeting, Goldsmiths' Hall, London, 6.30 p.m.
18th April	Talk by Mr. E. A. Jobbins, B.Sc., Goldsmiths' Hall, London, 7.00 p.m.
17th October	Professor S. Tolansky, D.Sc., F.R.S. "Speaking at Random", Goldsmiths' Hall, London, 7.00 p.m.
27th November	Reunion of Members, 6.00 p.m., and Presentation of Awards, 7.00 p.m., Goldsmiths' Hall, London.

GEM DIAMOND EXAMINATION

There were 32 entries for the 1971 Gem Diamond Examination arranged by the Association. The following is a list of successful candidates, arranged alphabetically:

Qualified with Distinction

Torres De Goytia, Rafael, Valencia, Spain

Qualified

Ahmad, Syed Vaqar, London
Allardyce, Anthony S., Twyford
Andres Barbera, Manuel, Valencia, Spain
Burke, Winifred Mary, Bexleyheath
Carr, Malcolm Stuart, Addington
Domenech Bisbe, Juan, Barcelona, Spain
Dougan, Reginald William, London
Driver, Olive, Bexleyheath
Fernandez Gil, Enrique, Valencia, Spain
Holmes, Brian Michael, London
Jones, Claire Patricia, London
Lewin, David Alexander, Loughton
Lewin, Persephone, Loughton
Lopez Soler, Angel, Barcelona, Spain
Mark, Malcolm David, London
Mendis, Cynthia Marguerite, London
Navarro Bort, Rodolfo, Valencia, Spain
Nuttall, Miranda, London
Peris Bataller, Francisco, Valencia, Spain
Pie De Masso, Rosa Maria, Barcelona, Spain
Ramon Rius, Carlos Enrique, Barcelona, Spain
Reich, David K., Tunbridge Wells
Rosich Chova, Francisco Luis, Valencia, Spain
Sanchis Estrems, Salvador, Valencia, Spain
Sendon Gimenez, Pedro, Barcelona, Spain
Snipper, Alison Bernice, London
Wilson, Robert Henry, Caterham
Wood, Robert Matthew, Peterborough

EXAMINATIONS IN GEMMOLOGY, 1971

In the 1971 examinations in gemmology organized by the Gemmological Association of Great Britain, 420 candidates sat for the preliminary examination and 307 for the diploma. Centres were again established in many parts of the world and the number of entries for the diploma examination was the highest in the history of the Association.

Upon the recommendation of the examiners the Tully Memorial Medal has been awarded to Mr. Jonathan Brown of Derby.

The Rayner Prize has not been awarded.

The following is a list of successful candidates, arranged alphabetically.

DIPLOMA EXAMINATION—HOME

Qualified with Distinction

Brown, Jonathan Philip, Derby
Lewis, Roger Anthony, Wallasey
Ogden, John Mullen, London
Olieff, Peter Michael, Doncaster
Pratt, David, Bradford

Qualified

Acker Holt, Robert, London
Adams, Michael E., Middlesbrough
Allum, Christopher John, Nottingham
Allum, Peter Dennis, Shaftesbury
Appleyard, John Trevor, Wakefield
Backshall, Henry George Robert, Hainault
Baker, Kenneth Robert, Whitehaven
Barrett, Garry Sydney, Sittingbourne
Binns, David George, Hastings
Bradford, K. J., Westcliff-on-Sea
Brook, Doreen May, Liverpool
Burgin, Derek Arthur, Nottingham
Butcher, Kathleen Mary, Sudbury
Cartland, Anthony John, Leamington Spa
Chalk, Christopher, Deal
Christie, Rosalind Seaton, London
Comely, Christopher Norman, Dorchester
Cotton, John Alan Day, London
Crossley, Roy, Halifax
George, Michael Christopher, Tunbridge Wells
Geyer, Adrian Michael, Birmingham
Gillings, Michael, Manchester
Gooding, Diana Janet, Eastbourne
Green, Adrienne, Wembley
Harvey, Roger Sweyn, Hull
Hazelden, John Norman, Worthing
Hilbourne, Anthony Charles, Maidenhead
Hiley, Hazel, Shipley
Hinchliffe, Brian, Sheffield
Holden, Andrew Neil, Walsall
Irwin, Margaret, Chester
Jenner, Peter Charles, Tunbridge Wells
Johnston, Iain Henry, Dumbarton
Keeling, Judith Mary, Stoke-on-Trent
Kirkpatrick, David John, Kenilworth
Knight, Irene, Liverpool
Lowe, Christopher Edward, Burton-on-Trent
Moran, John, Blackpool
Murray, David Ernest, Stratford-upon-Avon
Naim, Edward Youssef, London
O'Regan, Simon Barry, Doncaster
Poynder-Meares, Christopher Francis, Gloucester
Rajah, S. Senathi, Durham
Ryan, David Christopher, London
Saddington, Tom Frederick, Woking
Slusarczuk, Peter, Stourbridge
Spiers, Richard Anthony, Redhill
Stephens, Arthur Leslie, London
Tattersall, Paul Lawrence, London
Thomson, Ian, London
Walker, Thomas, Sunderland
Walton, Edith M. E., Prescot
White, Donald William, Tenterden
Williams, Anthony Martin, Birmingham
Williams, Robert, Birmingham
Woolf, Michele Debra, London
Wroblewski, Tadeusz, Birmingham

DIPLOMA EXAMINATION—OVERSEAS

Qualified with Distinction

Altaba Artal, Maria Dolores, Barcelona, Spain
Berlage, Peter Jurgen, Osnabruck, Germany
Hirohata, Tomoko, Osaka-Prif., Japan
Maslen, Grant Lewis, Nairobi, E. Africa
Mueller, Edith E., Frankfurt, W. Germany
Norton, Charles Leslie, Conyngham, Pa., U.S.A.
Peyerl, Wolfgang, Knights, Transvaal, S. Africa
Riuttala, Alexander Nikolai, Toronto, Ont., Canada
Rogan, Liv Solnor, Oslo, Norway
Schneider, Katharina, Hanau, Germany
Thant, Myo, Rangoon, Burma

QUALIFIED

Alforja Matoses, Enrique, Sueca, Valencia, Spain
Alm, Eila, Riihimaki, Finland
Andres Barbera, Jose, Valencia, Spain
Baker, Ann, Lucerne, Switzerland
Bjorndalen, Jan, Oslo, Norway
Carballal Cirici, Carmen, Barcelona, Spain
De Bruin, Alphonsus Gerardus, Heemstede, Holland
De Meillon, Laura, Pietermaritzburg, S. Africa
Dyer, Wilbur E., Joliet, Illinois, U.S.A.
Fowler, Susan Elizabeth, Hong Kong
Fukabayashi, Hiroyuki, Hokkaido, Japan
Gardiner, Anthony Cluff, Abadan, S. Iran
Gartner, Heinz R., Schmisberg, W. Germany
Gelaberto Vilagran, Enrique, Barcelona, Spain
Giles, Roy, Sydney, Australia
Grim, Roy Ivan, Laurel, Md., U.S.A.
Gyi, Ma, Rangoon, Burma
Hanna, Neil Randle, Auckland, New Zealand
Harris, Marian Margaret, Cape Town, S. Africa
Jackson, Lilian Isabel, Reynella, S. Australia
Kaneko, Masao, Tokyo, Japan
Kivimaki, Kauko, Hameenlinna, Finland
Koskinen, Aito, Helsinki, Finland
Krieger Rolf, Huddinge, Sweden
Lehtola, Maire, Helsinki, Finland
Leino, Terttu, Paimio, Finland
Lopez Sabater, Jose Antonio, Valencia, Spain
Lopez Verge, Ramon, Barcelona, Spain
Macleod, Helen L., Washington, D.C., U.S.A.
Maik, Shwe, Rangoon, Burma
Malvarez Martinez, Francisco, Alicante, Spain
Mones Roberdeu, Luis Barcelona, Spain
Monte Domenech, Joaquin, Barcelona, Spain
Narayanamurthy, K., Pahang, Malaya
Naumanen, Pertti O., Helsinki, Finland
Nemoto, Yoshio, Fukishima-Ken, Japan
Nittel, Lothar, Freiburg, W. Germany
Oates, Harold A., Glen Ellyn, Illinois, U.S.A.
Peranko, Pyry, Lahti, Finland
Power, John Joseph, Rosemere, Quebec, Canada
Pyykonen, Kaarina, Espoo, Finland
Ratnasekera, Wakkumburage Ariyawansa, Ratnapura, Ceylon
Ritvanen, Hannu, Helsinki, Finland
Roca Cusachs, Juan, Barcelona, Spain
Rorvik, Trine, Mosjoen, Norway
Salmona Delque, Ana Maria, Barcelona, Spain
Silverthorne, Richard Leigh, Johannesburg, S. Africa
Sole Barneda, Domingo, Barcelona, Spain
Swe, San, Rangoon, Burma
Terry, Robert J., Lakewood, Ohio, U.S.A.
Tortosa Calveras, Francisco, Barcelona, Spain
Trossarelli, Carlo, Torino, Italy
Uchida, Sumiko, Tokyo, Japan
Van Dam, Rudolf Alexander, The Hague, Holland
Van Eik, Jacob Johannes, Utrecht, Holland
Winstead, Frances F., Eugene, Oregon, U.S.A.

Woo, Shun Wai, Hong Kong
Woolf, David Hirsch, Johannesburg, S. Africa
Woolgar, Michael, Durban, S. Africa
Wrangel, Anna Stina, Bromma, Sweden
Zook, Theresa Fuetterer, Alexandria, Va., U.S.A.

PRELIMINARY EXAMINATION—HOME

QUALIFIED

Alexander, David, Harold Wood
Anderson, Carole, Sandhurst
Atherton, Stanley, Chorley
Banford, William David, Liverpool
Bennett, Frederick Charles Lewis, Manchester
Benson, C., Bangor, N. Ireland
Berry, Herbert, Wallasey
Blayney, Vivien Ingrid, London
Blundell, Raymond Louis, Liverpool
Boddington, William Cecil, Rayleigh
Booker, Peter Edward, Grantham
Burnett, Brian David, Formby, Lancs.
Butterworth, Joan Louise, Rochdale
Campbell, Alan J., Birmingham
Clark, David, London
Clarke, Roger David, Maidstone
Clear, Carol Ann, Dorking
Coulter, Peter, Northwich
Cranton, Keir, Surbiton
Crombie, J. M., London
Davies, Beryl Anne, Rhayader
Davies, Gena M., Pontypridd
De Graft-Hayford, Julian E. S., London
Doman, Eleanor Margaret, Ilford
Faulds, Matthew Christopher, London
Finch, Stephen Reginald George, Cuxton
Fogan, Eleanor Frances Alison, London
Fountain, Alastair John, Glasgow
Frampton, Derek Nigel, Bognor Regis
Frost, Julia Josephine, Cambridge
Frost, Richard Henry John, Northfleet
Garbiakova, Krystina M. J., Reigate
Gardner, Roy Roger, Reading
Gardner, Wilfred Charles, Reading
Gascoigne, Beryl, London
George, Michael Christopher, Tunbridge Wells
Gilchrist, John, Chesham
Gill, Royston Henry, Kidderminster
Golding, Derek Charles, Redhill
Gould, Robert, Southsea
Green, Margot Isabel, Stonehaven
Hammonds, Robert Newcastle-on-Tyne
Hanrott, Michael Richard, Banstead
Harwood, Harvey Anton, Southport
Hayesmore, Linda, Tenterden
Haywood, Stanley Edward, Liverpool
Hemachandra, Ranjith T., Birmingham
Herdman, Peter Robin, St. Boswells
Houlgrave, Peter Baron, Solihull
Howarth, David Harry, Mirfield
Hudspith, Thomas William, Chester-Le-Street
Hughes, Carolyne Sasah, Ilford
James, David John, Sidcup
James, Julia Jacqueline Ann, S. Nutfield
Johnston, Peter, Wallasey
Jones, Claude Barrington, Northampton
Jones, David Lewis, Orpington
Jones, Michael John Bewsey, Sevenoaks
Jones, Michael Noel, Tredegar
King, Michael James, Brighton
Knowles, Leslie Allan, Liverpool
Leaver, Herbert Charles, Virginia Water
Lee, Keith, Hartlepool

Leon, Bernard, London
Linley, W. H., Birmingham
Lyall, Linda, Alloway
Lynch, Eric, Wallsend-on-Tyne
Macaskill, Malcolm M., Glasgow
McCallum, Nina M. W., Motherwell
McCarthy, Christopher, Liverpool
Markowski, Robert W., Gravesend
Marriott, Anthony George Eyre, Chesterfield
Massie, George Alexander, Sheffield
Miller, G. J., Chesham
Moser, Peter Bernhard Stuart, Manchester
Neale, Brian, Middlesbrough
Needham, Brian, Ilford
Nightingale, Stephen, North Wembley
Noble, Patricia Warrington
Page, Michael John, Claygate
Paterson, Katherine E. T., London
Peacock, Pamela Mary, Stourbridge
Penny, Christopher, London
Peter, Stephen J., Leeds
Phillips, Ceinwen Rosalind, Cardiff
Popperwell, Elizabeth, Stockport
Popplewell, Wilfrid, Bristol
Rajah, S. Senathi, Durham
Reeve, R. D., Tunbridge Wells
Renel, Ronald Cecil James, Southampton
Reynolds, James Ian, Mexborough
Richmond, Philip Simon, Leeds
Rogers, Hazel, Sheffield
Rose, Philip Michael, Bournemouth
Sayer, Glynis, Rochester
Schapiro, Simon, London
Scott, Gillian Margaret, London
Scott, Owen Seymour, Welwyn Garden City
Seed, Stephen James, Preston
Speed, Graham Clive, Windsor
Stevens, Peter, London
Sweeney, John Michael, Rowlands Gill.
Taylor, Clive, Gravesend
Taylor, Michael Philip, Enfield
Thompson, Evelyn, London
Ward, Michael, Grimsby
Whitaker, Peter William, Southport
White, S. C., Sutton
Willcocks, Geoffrey Brian, Eastbourne
Wood, Kathleen Alice, Sheffield
Woods, Cecil Clifton, Hailsham
Wright, Frank Simeon, Billingham
Wright, Peter Stephen, London
Zacks, S., Barnet

PRELIMINARY EXAMINATION—OVERSEAS

Abeynayake, Chandani, Mount Lavinia, Ceylon
Alvarado Moro, Odorico, Barcelona, Spain
Amarasuriya, Sunil Tissa, Idar-Oberstein, W. Germany
Anderson, Alice, Toronto, Ont., Canada
Aparicio Miguel, Rafael, Valencia, Spain
Baker, Ann, Lucerne, Switzerland
Baker, Nancy Jane, Manotick, Ont., Canada
Bayarri Bosch, Federico, Barcelona, Spain
Berlage, Peter Jurgen, Osnabruck, Germany
Besteiro Rafales, Josefina, Barcelona, Spain
Bezuidenhout, Mary Elizabeth, Stellenbosch, C.P., S. Africa
Bishop, Paul L., London, Ont., Canada
Bros Font, Ana Ma., Barcelona, Spain
Buijvoets, Marie Louise, Velp (GLD), Holland
Butler, Michael John, Toronto, Ont., Canada
Cameron, Elinor, Ottawa, Ont., Canada

Carbonell Pujol, Rafael,
Barcelona, Spain
Chetty, Samuel Francis Casie,
Upplands Vasby, Sweden
Chikayama, Yoko, Tokyo, Japan
Cook, Marian Esther,
Victoria, B.C., Canada
Cuevas Diarte, Miguel Angel,
Barcelona, Spain
Cummings, Bruce Willard,
New York City, N.Y., U.S.A.
Custer, John J.,
Flushing, N.Y., U.S.A.
Del Monico, Anneliese
West Haven, Conn., U.S.A.
Doole, Rhumina Sukanthi,
Colombo, Ceylon
Dube, Rene Adrien,
Halifax, Nova Scotia, Canada
Eason, John Robert,
Manurewa, New Zealand
Espinosa Gonzalez, Jose,
Marbella, Malaga, Spain
Felix, Karen Hilde,
Schoonhoven, Holland
Ferrandiz Torrents, Pedro,
Barcelona, Spain
Fisher, Emmett W.,
Houston, Texas, U.S.A.
Fowler, Myrtle Winifred Alice,
Gymea Bay, N.S.W., Australia
Fraser, Edith,
Unionville, Ont., Canada
Gaarder, Kjerstin,
Blommenholm, Norway
Gamalath, Shiranie,
Padukka, Ceylon
Gangoso Guillo, Rafael,
Barcelona, Spain
Gans, Louis Benjamin,
Amsterdam, Holland
Garcia I Ainoza, Joan,
Barcelona, Spain
Garcia Cuevas, Joaquin,
Granollers, Barcelona, Spain
Gartner, Heinz R.,
Schmisberg, W. Germany
Gerryts, Petronella,
Stellenbosch, C.P., S. Africa
Girones Manzano, Manuel,
Barcelona, Spain
Gnanaratna, Welihinda Badalge,
Mount Lavinia, Ceylon
Goodger, William Donald,
Don Mills, Ont., Canada
Granda Uson, Ma de Fatima,
Barcelona, Spain
Greig, Donald Hugh,
Auckland, New Zealand
Gunasekera, Dunil Palitha,
Ratnapura, Ceylon
Hagen, Tore W., Oslo, Norway
Halvorsen, Inger, Lierbyen, Norway
Harris, Marian Margaret,
Harris, Marian Margaret,
Cape Town, S. Africa
Jackson, Lilian Isabel,
Reynella, S. Australia
Jayendran, Ariacutty,
Khartoum, Sudan
Juul, Erling, Skien, Norway
Kapp, Hans R.,.Basle, Switzerland
Karunarathna, Kahandawala
Mudiyanselage P. S., Colombo,
Ceylon
Karunaratna, Avanti Yasmin,
Kandy, Ceylon
Korevaar, H. J., Amsterdam,
Holland
Kurash, Edward,
Toronto, Ont., Canada
La Due, Martha J.,
Middlesboro, Kentucky, U.S.A.
Lopez Barroso, Miguel,
Barcelona, Spain
Lowe, Peter Eric,
Windhoek, S.W. Africa
McCarthy, Dorothy Lovell,
Greenbelt, Md., U.S.A.
Maehlum, Lottie,
Sandvika, Norway
Magnussen, Rita Helene,
Drobak, Norway
Mahavitane, Krishna Manel,
Katubedde-Moratuwa, Ceylon

Marin Calvo, Ma Luisa,
Barcelona, Spain
Maymo Mas, Jaime
Mataro, Barcelona, Spain
Melvin, Ena M.,
Lincoln, Mass., U.S.A.
Mueller, Edith E.,
Frankfurt, Germany
Myluaganan, Jeyakumar
Pakiyajothy, Colombo, Ceylon
Naing, Than, Rangoon, Burma
Newbold, Leslie John Claude,
Tusmore, S. Australia
Nogues Carulla, Joaquin Ma,
Barcelona, Spain
Obiols Mundet, Agustin
Barcelona, Spain
Ohguchi, Hideki,
Kanagawa Pref., Japan
Plotzeneder, Josef,
Salzburg, Austria
Ponsa Aguilar, Jose,
Tarrasa, Barcelona, Spain
Poot, Joost Rogier,
Schoonhoven, Holland
Proussalidis, Efthimios,
Willowdale, Ont., Canada
Rajamuthu, Anthony Nelson R.,
Colombo, Ceylon
Ratera Oliva, Jaime,
Barcelona, Spain
Rehtijarvi, Pentti, Helsinki, Finland
Robinson, John Bruce,
Palmerston North, New Zealand
Romeu Larios, Jose Jaime,
Barcelona, Spain
Rosal Paneda, Ma Jose,
Oviedo, Spain
Roth, Albert L.,
Denver, Colorado, U.S.A.
Rovira Rabell, Manuel,
Barcelona, Spain
Rughini, Enrico, Bordighera, Italy
Sabina Stenson, Ann P.,
Ottawa, Ont., Canada
Sanchez Llorens, Jose Francisco,
Castellon de la Plana, Spain
Sanchez Llorens, Juan Fernando,
Castellon de la Plana, Spain
Sanchez Pinazo, Octavio,
Valencia, Spain
Santala, Ulla Riitta,
Valkeakoski, Finland
Schneider, Katharina,
Hanau, Germany
Schulze, Heinz, Austin, Texas, U.S.A
Senti, Yves Andre,
Geneva, Switzerland
Smidt, Maria Josephina Antonia,
Salisbury, Rhodesia
Soler Serra, Alejandro,
Barcelona, Spain
Straatman, Eduard Karel Victor,
Bussum, Holland
Sukapaa, Ilse, Kauniainen, Finland
Sundqvist, Reijo, Helsinki, Finland
Swe, San, Rangoon, Burma
Thein, Sein Toe, Rangoon, Burma
Tilakaratna, Welihinda Badalge,
Mount Lavinia, Ceylon
Tomas Castelltort, Santiago,
Barcelona, Spain
Vadnal, Dusan,
Ljubljana, Yugoslavia
Van Dam, Rudolf Alexander,
The Hague, Holland
Van Der Pol, J., Utrecht, Holland
Vives Martinez, Silvia,
Barcelona, Spain
Walter, Charlotte A.,
Miami, Florida, U.S.A.
Webb, Ronald John,
Auckland, New Zealand
Westby, Eli, Strommen, Norway
White, James G.,
Rockville, Md., U.S.A.
Wijesuriya, Indrawathie
Swarnalatha, Ganemulla (W.P),
Ceylon
Will, Richard Arnold Franz,
Salisbury, Rhodesia
Wobito, Rudi,
Scarborough, Ont.. Canada

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