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and

PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN
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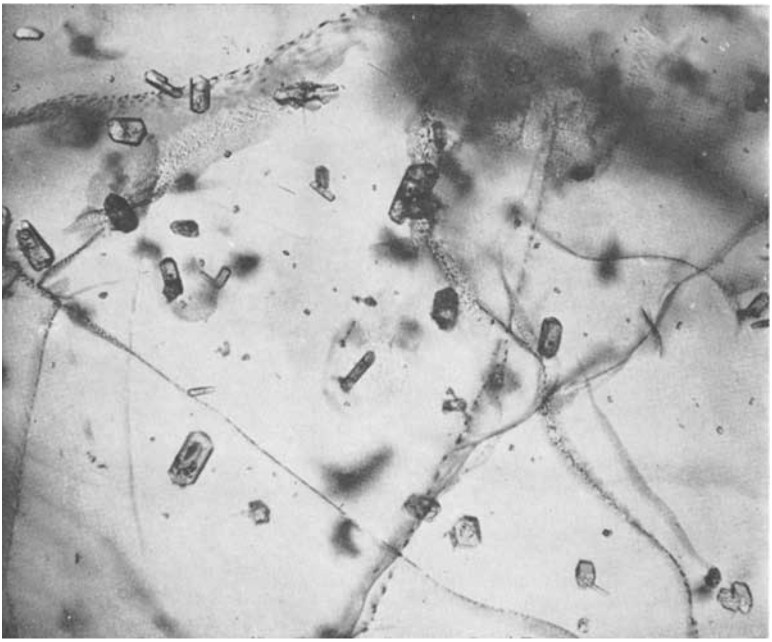
THE FRENCH SYNTHETIC EMERALD

By ROBERT WEBSTER, F.G.A.

THE synthesis of emerald has been known since 1848 when J. J. Ebelmen made the early experiments. These and the later experiments by other workers have been well recorded in the literature. However, it is the commercial synthesis made by Carroll F. Chatham of San Francisco which has been of most importance and the characters of these stones have been continuously under review.

If the Lechleitner emerald—the synthetic emerald-coated beryl—be excluded, the Chatham synthetic emerald was until recently the only synthetic emerald sold on the gem market. 1963 produced two new synthetic emeralds. One of these is a German production and the other French. The German stones are produced by W. Zerfass, of Idar-Oberstein, and the characters of these stones have been fully reported by K. Schlossmacher(1). The French synthesis is the product of Etablissement Pierre Gilson, Compagne les Wardriques, Pas de Calais, and by the courtesy of that firm two specimens of these synthetic emeralds have been made available for examination and form the basis of these notes.

The methods used by Chatham and Zerfass, in their respective syntheses of synthetic emerald, are not known for sure. W. Eppler, after careful examination of the inclusions, has suggested that the Chatham synthesis is a flux-melt process. Pierre Gilson, however,



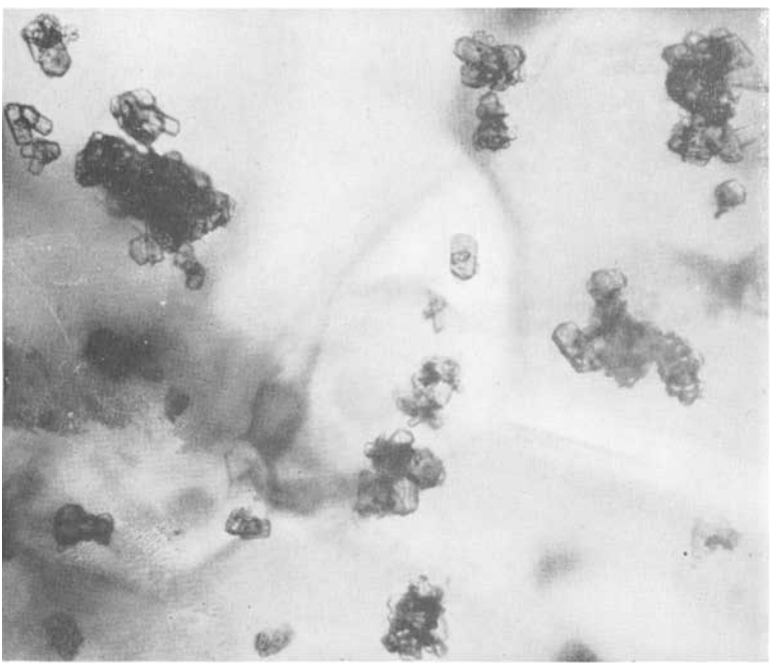
Euhedral crystals, probably phenakites, in a French synthetic emerald.

implies in his sales literature that a hydrothermal method is used for growing the French synthetic crystals.

The colour of the two stones of this French synthesis examined is a good emerald-green; perhaps more yellow than the bluer-green of the Chatham production. To the writer the Gilson stones seem to have the more pleasing colour. The cut stones examined weighed 3·38 carats and 2·81 carats and were fashioned in the usual octagonal trap-cut style, *i.e.* the emerald-cut. The maker, in his trade handout, states that the stones may be up to twenty carats in weight, but whether this applies to cut stones or crystals is not clear.

The density of the stones was found to be 2·65 and to vary from this value only in the third place of decimals. The refractive indices were determined to be $\omega = 1{\cdot}562 : \varepsilon = 1{\cdot}559$, giving a birefringence of 0·003, and the dichroism was seen to be distinct with twin colours yellow-green and blue-green. As it is the extraordinary ray which has the deeper blue-green colour, and in the case of the two stones examined the table facet was found to be cut nearly at right angles to the optic axis, this may explain the yellower-green colour of the samples seen. The absorption spectrum, typical of emerald, was found to be strong.

The stones examined through the Chelsea colour-filter showed the residual colour to be a dull red, and when viewed between crossed filters (a flask of copper sulphate solution and a spectrum-red gelatine filter) the stones showed a red fluorescence. Under the Burton (fluorescent tube) long-wave ultra-violet lamp the stones glowed with a mustard-yellow colour, and under the Hanovia mercury-vapour lamp with Wood's glass filter, a lamp which gives an optimum emission at 3650Å, the fluorescent glow shown by the stones was more a greenish-yellow. When irradiated with short-wave ultra-violet light from a Mineralight lamp the glow produced by the stones was orange in colour, and the shorter wavelengths produced by X-rays induced a very dull red glow in the stones. These fluorescent characters differ from those seen in the Chatham synthetic emeralds, which show a strong red under all radiations.

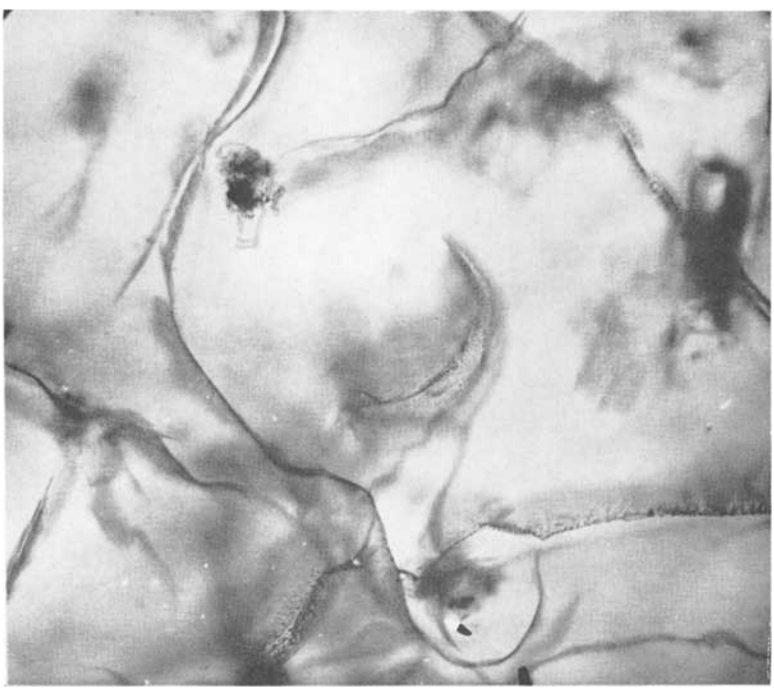


Clusters of crystals, probably phenakites, in a French synthetic emerald.

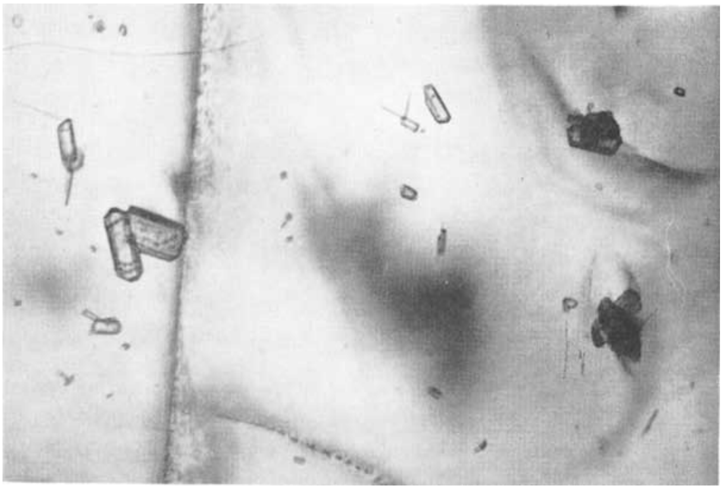
It was noticed that perceptible phosphorescence could be observed in the case of the Gilson synthetic emeralds after they had been irradiated with X-rays. This effect was also found to occur when the Chatham synthetic emeralds were so irradiated, but this effect does not seem to have been previously reported.

Some photographic experiments on the ultra-violet transmission of these French synthetic emeralds seem to show that they do not transmit as far down into the ultra-violet as do the Chatham synthetic emeralds[2]. The degree of transmission is probably more akin to that shown by natural emeralds. This lack of transparency was later confirmed by B. W. Anderson who took a spectrum plate with the aid of a quartz spectrograph.

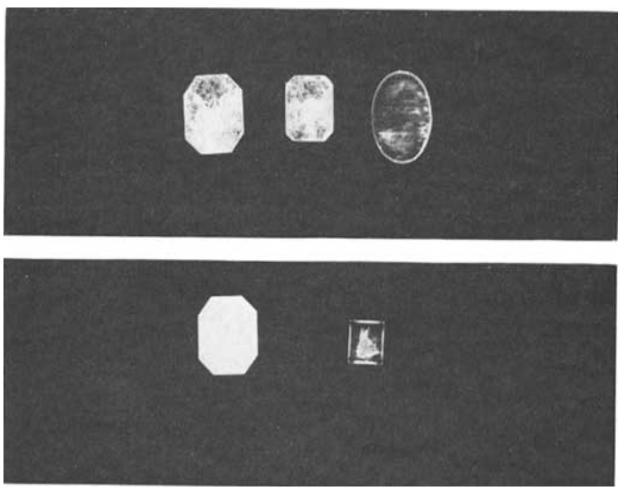
The inclusions observed in the specimens of synthetic emerald of French manufacture showed that they have many similarities to the inclusions seen in other makes of synthetic emeralds in that



Veil-like feathers in a French synthetic emerald.

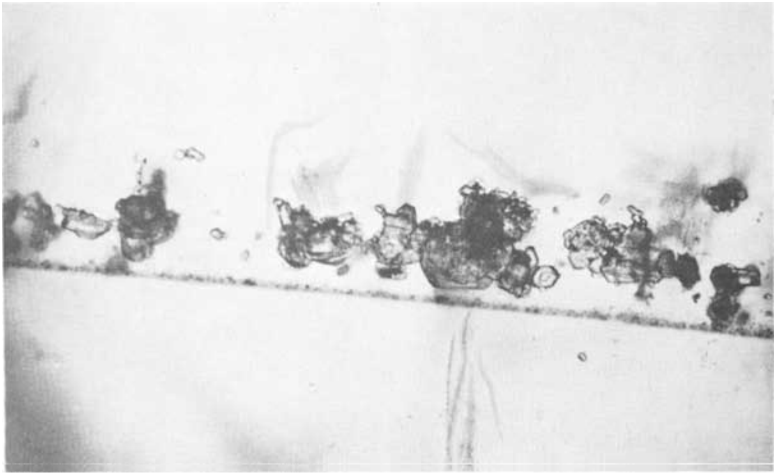


Inclusions in a French synthetic emerald.



Ultra-violet transmission pictures of the new French synthetic emerald and others.

Top left: *The French synthetic emerald.*
centre: *A natural emerald.*
right: *A Chatham synthetic emerald.*
The American synthetic emerald is rather flat and does not have the depth of the other two stones.
Bottom left: *The French synthetic emerald.*
right: *An American (Chatham) synthetic emerald.*
The American stone, although appearing much smaller than the French stone has nearly a comparable depth.



Line of crystals along a crystallographic plane in a French synthetic emerald.

they contain veil-like feathers of two-phase inclusions. These feathers seem to be much more open and wider apart than those seen in the Chatham synthetic emerald. Another feature of the French stones examined was the number of euhedral crystals and groups of such crystals which were profusely scattered throughout the stones. These crystals have the habit of, and probably are, phenakite. Lines of such crystals along definite crystal planes seem to be to some extent peculiar to the French stones. Between crossed polars the stones showed coloured strain-patterns and they did not clearly extinguish at every ninety degrees.

To sum up, these samples of the French production show that, except for the anomalies of the fluorescence under ultra-violet light and the lack of ultra-violet transmission, the stones conform to the usual tests for synthetic emerald of other makes and no difficulty should be encountered in testing them.

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TREATED BLACK OPALS

By E. GÜBELIN, Ph.D., C.G., F.G.A.

SEVERAL parcels of dyed black opals have recently been offered in the European market. I am indebted to Mr. Arthur A. Wirth of Sydney, Australia, who kindly enabled me to acquire a number of treated black opals of varying quality for investigation.

To the uninformed jeweller and to the naked eye, these treated opals display a normal appearance and do not look suspicious in the least. It seems, therefore, appropriate to publish a word of warning and to inform the readers of the distinguishing features of this new product. The most reliable means of distinction is rendered by the microscope. While in white and black opals of natural colour the gelatinous body material appears rather homogeneous, the treated samples teem with granular black dots resembling black dust, which are formed by the dried residue of the artificial colouring agent. This dust is very easy to perceive even under weak magnification, and its appearance is so characteristic that distinction from undyed opals becomes quite simple. (Fig. 1).

The dye does not seem to penetrate deeply into the stone, but on the contrary is rather concentrated in the cutaneous layer, which becomes apparent in rather translucent specimens at a depth of about 2 mm, where the clean white substance of the previously white opal shines through. This confinement of the colour concentration to a thin portion at the surface may lead to a complete loss of the coloration if the artificially coloured opal is repolished. The texture of the surface, as well as the distribution of the black dots, leads to the conviction that a rather porous material with many cracks is being subjected to dyeing. In some parts of the stone the " black dust " is densely accumulated, while in other less porous areas it is much less evident, producing a cloudy look (Fig. 2). The grey and cloudy white patches thus form the sparse dissemination in which the colouring residue is especially conspicuous. In some opals of inferior quality there exist along certain cracks, veins and patches of a dense white matter (possibly agate) which remain clean and free from the dyeing agent, it being impossible for the dye to penetrate these dense areas.

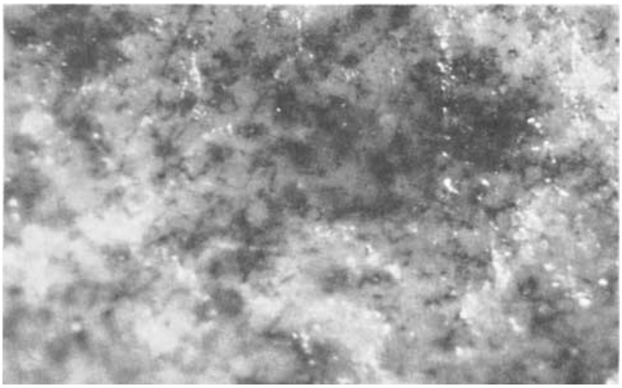


FIG. 1

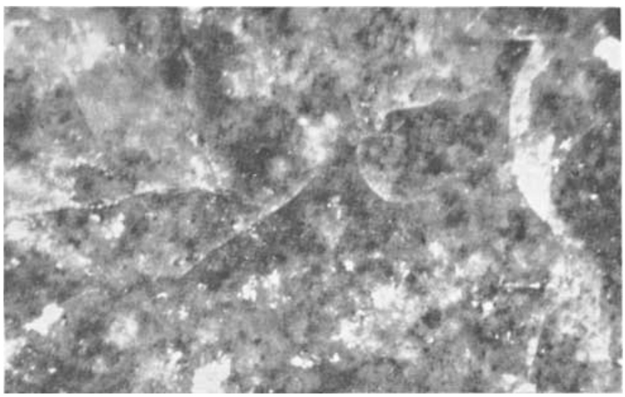


FIG. 2

The accompanying photomicrographs illustrate more adequately the appearance of these new treated opals than words can do.

The black coloration proved to be resistent against the action of any ordinary reagents such as acetone, hydrochloric, nitrous, sulphuric acid and aqua regia, as well as some organic liquids as benzene, carbontetrachloride and ethylenedibromide. The Gem Trade Laboratory in New York reported*, however, that the black substance was quickly removed by warm sulphuric acid. The possibility of removing the coloration either by chemical reaction or by recutting makes it imperative to mark these treated opals with the unmistakable designation: artificially treated opal.

*R. Crowningshield, *Black Treated Opal*, Gems and Gemology, Autumn 1962, p. 336.

SAPPHIRE FROM RIO COXIM, MATO GROSSO, BRAZIL

By W. F. EPPLER

ABOUT four years ago, Professor J. E. de Souza Campos of the University of Sao Paulo, Brazil, reported on a new sapphire from Brazil(1). He mentioned strange inclusions, unknown until now in sapphire and resembling rounded gas bubbles so typical of synthetic corundum. At the author's request, Professor de Souza Campos very kindly made available two cut stones of this sapphire and later some raw material, which could be tested more easily.

The locality of these sapphires is quoted by de Souza Campos as Jauré and Quilombo, Rio Coxim, Mato Grosso. He found the refraction for sodium light to be $n\omega = 1{\cdot}770$, $n\varepsilon = 1{\cdot}762$, and the birefringence 0·008. The dichroism for blue-coloured stones is ω = blue to violet blue, ε = green; for greenish-coloured stones ω = green, ε = yellow-green. With the hydrostatic balance he determined the specific gravity at 3·952 to 4·052.

The stones exhibit a dark blue colour but, regrettably, the transparency is considerably reduced by many inclusions. At a first sight through the microscope, many of them indeed resembled rounded gas bubbles (Fig. 1). But when using a higher magnification, it is seen that two kinds of inclusions are present: liquid and gas-filled discs (Figs. 2 and 3) and negative crystals (Figs. 4 and 5), many of them exhibiting rounded forms.

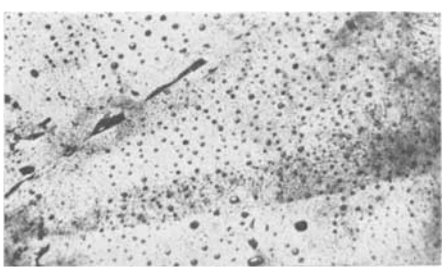


FIG. 1. *Sapphire from Rio Coxim, Mato Grosso, Brazil. Liquid discs and negative crystals in a healed fissure.* 22 ×

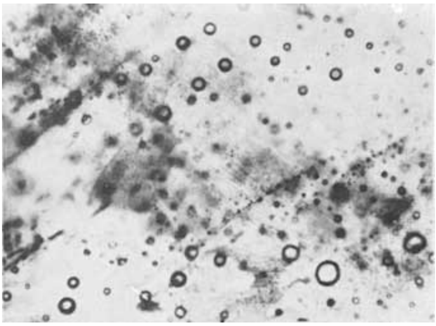


Fig. 2. *Sapphire from Brazil. Discs filled with a liquid or with a gas.* 65 ×

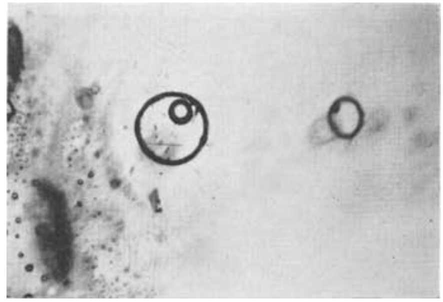


Fig. 3. *Sapphire from Brazil. Disc-like liquid inclusion with a libella.* 120 ×

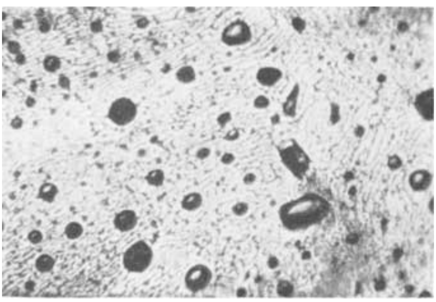


Fig. 4. *Sapphire from Brazil. Rounded gas inclusions and negative crystals in a healed crack.* 65 ×

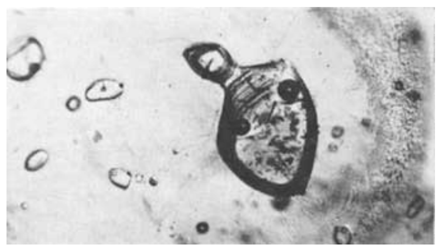


Fig. 5. *Sapphire from Brazil. A negative crystal containing needle-like crystals (most probably rutile) and a liquid with two libellae.* 120 ×

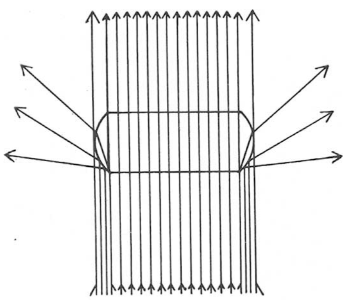
In reflected light, the discs appear in bright interference colours, which differ according to their thickness. This is one proof of the discs being flat liquid inclusions. When observing in transmitted light, another proof is given by the thin rim of the discs (Fig. 2), which demonstrates that they are flat and filled with a liquid. Therefore, they cannot be confused with ball-shaped inclusions. The final proof for the nature of these particular inclusions is shown in Fig. 3. It reveals that the disc-like inclusions by the presence of a libella are filled with a liquid.

To complete the observations, the effect of transmitted light was calculated when passing the included discs and compared with the results when the light had to pass included balls. In both cases, it was presumed that the inclusions were filled either with a liquid or with a gas.

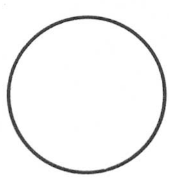
For the calculation, which in principle followed the statements of E. Klüppelberg(2), the refractive index for sapphire was taken at 1·767, for the liquid at 1·33, and for the gas at 1·00. The results are given in diagrams. Fig. 6a represents the path of light through an included liquid-filled disc seen from the side, while Fig. 6b gives the view from above, as seen through the microscope in transmitted light. The liquid-filled disc deflects on its border the incoming light less than the gas-filled disc. Therefore it shows only a small rim when observed from above, whereas the gas-filled disc exhibits a much broader rim (Figs. 7a and b).

Similar differences are found with a ball-shaped inclusion in sapphire filled with a liquid and compared with another ball filled with a gas. Figs. 8 and 9 demonstrate this phenomenon and they make it obvious that the rounded inclusions in Figs. 2 and 3 are not

FIG. 6. *Path of light through a liquid-filled disc, included in sapphire,*

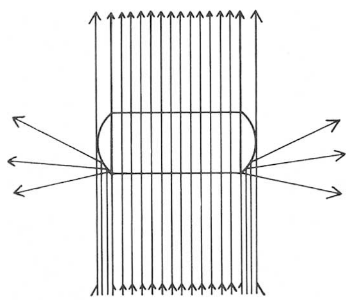


(*a*) *seen from the side,*



(*b*) *seen from above.*

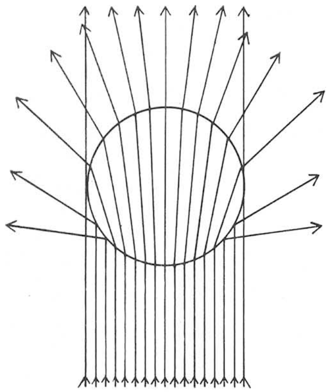
FIG. 7. *Path of light through a gas-filled disc, included in sapphire,*



(*a*) *seen from the side,*

(*b*) *seen from above.*

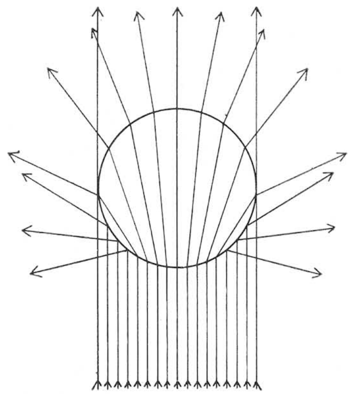
FIG. 8. *Path of light through a ball-shaped inclusion, filled with a liquid, in sapphire,*



(*a*) *seen from the side,*

(*b*) *seen from above.*

FIG. 9. *Path of light through a ball-shaped inclusion, filled with a gas, in sapphire,*



(*a*) *seen from the side,*

(*b*) *seen from above.*

ball-shaped. Of course, in Fig. 2 the broader rimmed inclusions are discs filled with a gas.

With the negative crystals, as the other kind of inclusion, it is not possible to decide in all cases whether they are filled with a liquid or with a gas. The larger inclusions in Fig. 4, which appear totally black, and those which have only a very small bright spot, are certainly not filled with a liquid, while the others with a large bright spot near the centre contain a liquid. But, as most of these inclusions deviate from the shape of a ball and are flattened also, a decision about their contents is not always certain. There are many negative crystals which are filled with a liquid, as shown in Fig. 5.

Another feature of the new sapphire consists of small healed cracks underlying a negative crystal, as seen from the side in Fig. 10. In this particular case, a twin lamella nearly coincides with the healed fissure (Fig. 11). A view from above is given in Fig. 12.

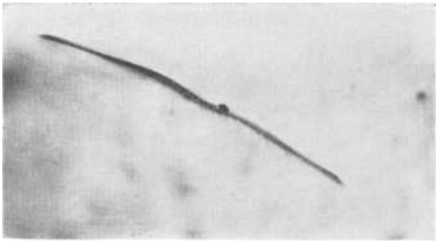
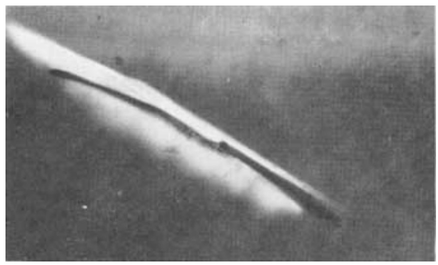


FIG. 10. *Sapphire from Brazil. A healed crack underlying a negative crystal, side view.* 65 ×

FIG. 11. *Same as Fig. 10, crossed polarizers.* 65 ×



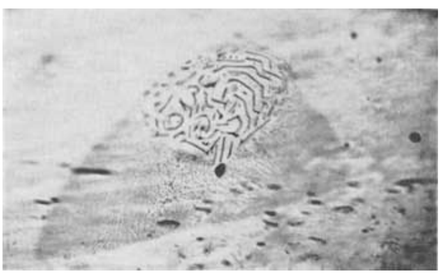
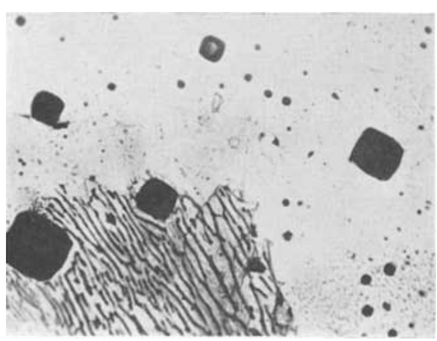


FIG. 12. *Same as Fig. 10, seen from above.* 65 ×

FIG. 13. *Sapphire from Brazil. Opaque, brown, cubic crystal inclusions of unknown nature.* 120 ×



It reveals the former crack and the now healed fissure to consist of a network of coarser and finer channels which contain a liquid. In reflected light and when properly adjusted in the correct position for a reflection, this system of inclusions appears in beautiful colours of interference indicating that the channels are flattened and very thin. Other healed cracks of approximately the same size have more rounded or oval shapes, but they always underlie one negative crystal, so that a relationship between them seems to be very likely.

Finally, small crystal inclusions must be mentioned (Fig. 13). They are opaque, brown and exhibit cubic crystal faces; they could be an ore, but their nature is not yet known.

In conclusion, it must be emphasized that the new Brazilian sapphire is a surprise with regard to its unusual inclusions. These reveal new aspects in the genesis of both the host crystal and its inclusions, particularly the negative crystals. It is to be hoped that further investigations will yield other results.

The author is indebted to Professor de Souza Campos, São Paulo, Brazil, for the very interesting material.

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2. Klüppelberg, E. *Beobachtungen an Gaseinschlüssen in Glas und synthetischen Steinen,* Deutsche Goldschmiede-Zeitung 10, 1956.

Gemmological Abstracts

HOLLAENDER (H.). *Cordierit, ein Edelstein mit Zukunft.* Cordierite, a gem with a future. Deutsch. Goldschmiedezeitung, 1963, 61, p. 661. Zeitsch. d. deutsch. Gesellsch. f. Edelsteinkunde, 1963, 43, pp. 25-26.

During the last few years cordierite has changed from being a rarity to a fairly popular gem. It is found in Ceylon, Burma, Madagascar, Madras, N.W. Canada, Norway, Finland and in Bavaria. Its hardness is 7-7½, and it is called after the French geologist P. L. A. Cordier, although the name iolite is also used. Under U.V. lamp it shows no luminescence. D = 2·57-2·63, n = 1·535-1·545. The one good visible line in the spectrum is 4560 Å.

E.S.

EPPLER (W. F.). *Was ist "Bernat"?* What is "bernate"? Deutsch. Goldschmiedezeitung 1963, 61, pp. 662-663.

Bernate is a plastic, not very easily distinguished from amber. This imitation can also be charged electrically by rubbing it, and will then pick up bits of paper just as amber does. It is sold with natural inclusions, i.e. parts of plants and insects, which of course are recent. If real amber is touched with a very hot pin-point an aromatic smell is produced. When bernate is treated thus, the smell produced is disagreeable and somewhat "chemical". A safer method of differentiating is the specific gravity, which is 1·08 for amber, but 1·22-1·23 for bernate. The R.I. (1·54 for amber, 1·54 for bernate) does not help in distinguishing the products.
4 illus.

E.S.

BANK (H.). *Zoisitamphibolit mit Rubin aus Tanganjika (Ostafrika).* Zoisite amphibolite with ruby from Tanganyika. Zeitschr. d. deutsch. Gesellsch. f. Edelsteinkunde, 1963, 44, pp. 4-11.

A map shows the occurrence of the stone. It is shown to consist of hornblende, feldspar, zoisite, mica, rutile and corundum. 4 illus. bibliography.

E.S.

WILD (K. B.). *Das Steinschneide—bezw. Edelsteingraveurgewerbe in Idar-Oberstein.* The stone cutting and engraving craft in Idar-Oberstein. Zeitschr. d. deutsch. Gesellsch. f. Edelsteinkunde, 1963, 45, pp. 20-31.

Very interesting review of the engraving industry in Idar-Oberstein, dealing with the historical development of the cutting of cameos and intaglios and the carving of animals and flowers out of agate and other stones.
5 illus.

E.S.

BALFOUR (I.). *Die Bedeutung eines geordneten Systems für den Absatz von Diamanten.* The importance of systematic organization for the sale of diamonds. Zeitschr. d. deutsch. Gesellsch. f. Edelsteinkunde, 1963, 45, pp. 5-14.

Review of the founding 75 years ago and the workings of the " syndicate " as a central selling organization for diamonds.

E.S.

GÜBELIN (E.). *Spektrolith—ein neuer Schmuckstein.* Spectrolite—a new gem. Zeitschr. d. deutsch. Gesellsch. f. Edelsteinkunde, 1963, 44, pp. 2-4.

This stone was found by the Finnish professor Laitakari. It is a type of labradorite found on the Finnish-Russian border, and shows on its polished sides all the colours of the spectrum, from green and blue to yellow and orange to red. Most of the material is used in the building industry, and good material for cabochons or small plates is rare, perhaps 5 kg per month.

E.S.

THEISEN (V.). *Die beiden " Taeuscher " Apatit und Phenakit.* The two deceivers, apatite and phenakite. Zeitschr. d. deutsch. Gesellsch. f. Edelsteinkunde, 163, 44, pp. 11-15.

The names of both these stones are derived from the Greek and both mean " deceiver "; both are not easily distinguishable. Apatite is often thought to be tourmaline, beryl or spodumene, but recognized by its small double refraction and its low hardness. It has also very little dichroism. Phenakite is often thought to be topaz, beryl, spodumene, rock crystal, sapphire or colourless tourmaline. If any colour is present, the dichroism is strong.

E.S.

THE SCIENTIFIC GEMMOLOGIST

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

THE purpose of this article is to examine the current status of gemmology, to make a few comments thereon, and to report a minor research project on distinguishing man-made from natural crystals.

There seems to be a general feeling among active gemmologists that gemmology as a science is somehow up against a brick wall. There is a great deal of useful, interesting, and informative writing, but there is a tendency to spread the well-known techniques over a greater area instead of developing new techniques to deal with problems which currently are without solution or present considerable difficulty even to experienced and highly regarded gemmologists.

Thus to a newcomer, such as this writer, there seems a tendency to emphasize the obvious, to repeat the well-known, and to avoid facing up to the fact that gemmology as a science needs a new structure in its intellectual basis—perhaps, in fact, a radical decision to recognize the existence of two types of gemmologists. These are, of course, the ordinary trade gemmologists and those who by reason of their training, interest, and experience are, in fact, scientific gemmologists whether they are in the trade or not.

Gemmology, to-day, is rather like a snowcap on a mountain. It is the most interesting part of the mountain. It sparkles in the sun like so many diamonds. It attracts mineralogists and geologists quite apart from members of the trade and trade laboratories, and hobbyists. One can well understand its attraction. But so many of those interested in the snowcap have never bothered to understand why the snow is there, and why it stays there. They are content to play with the snow and have a good time. They are simply not interested in understanding the massive structure on which the snowcap rests.

The result is that many in the gem field are walking around on intellectual stilts and might topple over at any time. They would be hard put to explain why no chromium is found in the feldspars, and why fluorine and hydroxyl ions are found in silicate minerals such as topaz and tourmaline.

This is not to criticize: it is merely to point out that gems are delightful things to study and handle, and that quite apart from this the vast majority of gemmologists are not engaged in any full-time capacity in the gem field. Even those who have qualified seldom dig deeper into the intellectual basis of gemmology.

Of equal importance is the fact that gemmology has long been regarded as a step-child of mineralogy. The basic reason for this, of course, is that the most valuable substances used as gems are minerals, and that, without minerals, gemmology and the jewellery industry would be very much the poorer.

Yet since time immemorial many of the substances used in jewellery have been man-made. Ancient civilizations have yielded very many examples of man-made gems; they have yielded only a few valuable natural gemstones. Yet because the natural gemstones are by far the more valuable, and because natural gemstones are the flowers of the mineral kingdom, gemmology has had to be content with playing second fiddle to mineralogy.

Plainly, this is no longer acceptable. It is not only that natural gemstones, especially the finest, are becoming increasingly rare, but that the substances used as gems are increasingly varied and increasingly difficult to distinguish. To-day, gemmologists, having relied probably for far too long on mineralogists, are faced with having to reconstruct the intellectual basis of their profession. The problem is basically one for the scientific gemmologists.

Clearly, the first approach must be to shift the intellectual basis of gemmology away from the glittering and inviting snowcap to the uninviting and less glamorous rock base. There is a need for a far more fundamental approach to the study of gemmology. It should surely start with the formation of the universe, the development of the elements, the formation of the earth, and how the elements came together to form various substances known as rocks, minerals, and crystals.

As some gem material is of organic origin, there should be at least some attempt to explain, as far as possible, the development of organic from inorganic life, and the organic structure of the various organic gem materials.

To-day, the gemmologist is faced not only with a wide variety of man-made substances used as gems, but also with an increasingly wide range of man-made crystals. Only those gemmologists who have had time to look into this growing field of man-made crystals can fully appreciate its extent. Not only is there a vast variety of crystals in element and compound form, but many of these crystals may be doped by other substances for various scientific and industrial purposes. It would be almost impossible for gemmologists to keep up with developments even if they had the time. As for distinguishing the man-made from the natural crystal material, it will obviously become more rather than less acute.

Even though many of these man-grown crystals are not suitable for use as gems, the intellectual problem remains. In the United States, especially, there are thousands of amateur lapidaries who are only too willing to test their skills on anything they can put their hands on, from man-grown crystals to coprolites. Sooner or later, these curiosities find their way to the gem trade laboratory.

It was with the intention of discovering any new techniques that inquiries were made of some two dozen crystal-growing firms and scientists in the United States. The idea sprang from a comment on Carbon 14 in correspondence to this writer from J. R. Jones of Sydney, Australia. It was thought that if techniques were so advanced in one field, perhaps similar techniques (without destroying the material, of course) could be applied to the gem field. There must surely be some differences between natural crystals, say sixty million years old, and crystals being grown this minute in factories and laboratories.

The enquiries yielded a meagre harvest. Some of the comments received are listed below mainly out of curiosity. Only in one case, dealt with later, was a basically new idea (at least, new to this writer) advanced.

1. Synthetic quartz crystals cost about twelve times as much as natural quartz.
2. Synthetic quartz crystals often have complete faces whereas natural quartz crystals often have many faces missing.
3. Synthetic crystals are much purer as a rule.
4. Synthetic production techniques often use no water, whereas natural crystals have often been produced by hydrothermal forces. Thus they contain microscopic water pockets (partially filled vacuoles). Unfortunately, analysis techniques destroy the material.

5. The majority of man-made quartz is grown in a sodium hydroxide or sodium carbonate solution. Thus the sodium content is usually higher in the synthetic.
6. Synthetics show fewer absorptions when analysed by infra-red spectrographic methods.
7. X-ray analysis, neutron activation, and electron and neutron diffraction, were also given as possible methods.
8. X-ray diffraction topography will show a greater concentration of dark lines in the synthetic when measured against a natural crystal. Spectrographic analysis, which requires the grinding of some of the material, usually shows a greater concentration of some elements in the synthetic.

Of particular interest is the electron paramagnetic resonance spectroscopy (EPR) developed by Varian Associates, Palo Alto, California, U.S.A. Unfortunately, the instrument costs some $30,000 (nearly £11,000), and the fee quoted tentatively for each spectrum was $25 (about £9). Although one test may not suffice for full identification, such a test may be able to establish that a gemstone was not natural.

The basis for EPR lies in minute chemical and structural anomalies. The extremely complex instrument is an extremely sensitive, non-destructive way of detecting impurity levels in crystals. A synthetic would be relatively pure. The result is basically a graph showing straight and jagged lines, hills, and valleys, which vary according to the structural perfection and molecular structure of the material analysed.

According to the material supplied by the company, it is now possible to use the magnetic properties of *electrons* (as well as of nuclei) to reveal chemical structure and bonding characteristics.

Just as nuclei have charge, mass, angular momenta, and magnetic moments, so do electrons, and it is upon this that EPR depends. If the electron has not only an intrinsic magnetic moment along its own spin axis, but also one associated with its circulation in an atomic orbit, the electron will possess a total magnetic moment equal to the vector sum of these magnetic moments. The ratio of this total magnetic moment to the spin value is constant for a given atom and environment, and is called the *gyromagnetic ratio* or *spectroscopic splitting factor* for that particular electron. The fact that these ratios differ for various atoms and environments and the fact that local magnetic fields depend on the structure of matter permit the spectral separation and study according to the method of Electron Paramagnetic Resonance Spectroscopy.

It must be emphasized that not all atoms and molecules are susceptible to such study. There must be a resultant electronic magnetic moment associated with the atom or molecule under investigation; for example, effects may be observed for electrons in unfilled conduction bands, transition element ions, odd molecules and free radicals, biradicals, colour centres, radiation damage sites, impurities in semi-conductors, and triplet electronic states.

The principal components of the EPR Spectrometer are an electromagnet, a sweep generator, a stable microwave oscillator, a resonant cavity, a bolometer or crystal detector for demodulating the microwave power reflected from the resonant cavity (for the sample), an audio amplifier and a phase-sensitive detector, and a graphic recorder.

Possibly, this instrument has not been used much, if at all, in gemmology, but the description given above may plant a seed in minds better prepared in gemmology than that of this writer. Certainly the idea is of great theoretical interest in the crystal field, and it seems to offer possibilities to the gemmologist. It is becoming quite impossible to determine, by ordinary gemmological methods, the nature of all crystals. If the synthetics and man-made can be weeded out and certified as man-made, it should then at least be easier to concentrate on determining the nature of the natural crystal material.

ASSOCIATION NOTICES

MEMBERS' MEETING

There was good company, rare gem stones and fine surroundings to make successful the London social evening at the Goldsmiths' Hall on 31st January. Treasures collected by the gemmologists vied with the collection of the Worshipful Company. Members had come from as far as Scotland for the occasion and the gathering was graced by more than one Tully medallist, including Mr. C. M. L. Carr who gained award No. 1. Even a television personality was there, in the person of Mrs. J. Thomas-Ferrand, who has made so many screen appearances in the Eastern counties area.

There was much to see and much to talk about. Dr. Ernest Rutland had sprung a delightful surprise with a collection of very unusual stones, including a specimen of delicate rutile, which must have been extracted with loving care from its rocky bed, and a transparent example of rhodochrosite. More surprises were a clear, white brazilianite and a fine white example of scheelite of more than nine carats, though where size was concerned a 122·2ct. blue topaz took the prize for magnificence.

Africa provided a large number of the exhibits. There was a varied range from Rhodesia and a collection of grossular garnets of all colours from the Transvaal. Nearer to home was an example of pectolite, from Scotland, a fine translucent stone. A crystal of diopside brought confessions of ignorance from some, but Mr. R. Webster was on hand to bring them up to date in their knowledge.

A case holding nearly 110 varied gems was itself an exhibit, because it showed how a collection can be attractively shown, yet be already cased for transport and have the details of the collection inscribed on the lid of the case. Finland provided the source of another varied collection of interesting stones, but perhaps for sheer beauty these were overshadowed by a collection of water opals.

MIDLANDS BRANCH

An interesting evening was held by the Branch on the 10th January 1964 at the Imperial Hotel, Birmingham. Various members of the trade spoke briefly on topics connected with the jewellery trade. Mr. W. A. Peplow spoke about Bateman silver and Mr. J. Davis posed the question of prospects for youth in the future of the trade. The subject of valuation of gemstones, and particularly of diamonds, was stressed by Mr. J. Batty. Other speakers included Mr. P. Spacey, who talked of his experience gained in Ceylon; Mr. C. Houchin, who gave a discourse on the history of pawnbroking; and some of the difficulties encountered in grading and matching diamonds in the course of the normal duties of a diamond merchant, were explained by Mr. D. Marshall.

There were many lively questions and members agreed to hold a similar meeting in the future.

TALKS BY MEMBERS

Blythe, G., " Gemstones ", Rayleigh Round Table, 3rd January; Hawkwell Women's Institute, Hockley, 6th January; Salisbury Club, Southend, 8th January; Blenheim Townswomen's Guild, 9th January; Southend Round Table 106, Westcliff-on-Sea, 13th January; " Diamonds and their substitutes," Rotary Club of Basildon, 10th January; " Gems ", Basildon Business and Professional Women's Club, 20th January, 1964.

Cozens, J. R., " Diamonds ", Bishops Lydeard Women's Institute, 9th January, Taunton Branch United Commercial Travellers' Association, 24th January; Bridgwater Young Conservatives, 4th February; South Petterton Women's Institute, 24th February; Taunton and District Welsh Society, 26th February; Taunton Young Farmers' Club, 5th March; West Buckland Women's Institute, 10th March, 1964.

Hudson, F. N., " Gemstones ", St. Margaret's Association, Dunfermline, 10th March, 1964.

Gillougley, J., "Pearls", Glasgow South Soroptomist Club, 24th February, 1964.

Caffell, E. W., "Gemstones—Decorative and Abrasive", Slough Branch of the Purchasing Officers' Association, 10th March, 1964.

Langton, E. G., "Diamonds and other gems", Literary and Arts Society, Muswell Hill Presbyterian Church, N.10, 11th March, 1964.

INDIAN ACADEMY OF SCIENCES

B. W. Anderson, B.Sc., F.G.A., who has been in charge of the Diamond, Pearl and Precious Stone Laboratory of the London Chamber of Commerce for 35 years, has recently been elected to an Honorary Fellowship by the Indian Academy of Sciences.

This is an honour given to only 3 or 4 people each year, and Mr. Anderson owes it to his work on precious stones, and especially diamonds. Sir C. V. Raman, a former President of the Academy, is well known for his own diamond studies, and has expressed his interest in Mr. Anderson's work.

WEST OF SCOTLAND BRANCH

On 30th January, 1963, members and guests of the West of Scotland branch had the pleasure of hearing Mr. James Gillougley, F.G.A., F.B.H.I., lecture on pearls.

Mr. Gillougley started with a brief description of the anatomy of the oyster, and of the structure of its shell, and with the aid of an excellent diagram showed the areas which secreted each of the shell and pearl producing substances. He then considered the whole range of pearl bearing molluscs, giving details of their habitat and the type of concretions they produce.

Following this general survey the production of cultured pearls in Japan was treated in considerable detail, this portion of the lecture being illustrated by means of a colour sound film. Mr. Gillougley pointed out that the film gave a somewhat romanticised picture of some aspects of the industry, for example the removal of pearls from the oysters, and he told members of the much more practical, if less attractive, techniques actually employed.

Before and after the lecture members were invited to examine a most comprehensive series of exhibits. Mr. Robert Webster had kindly lent a selection of wild pearls of various colours, and Mr. Wallace Allan a number of Scottish River pearls and a shell of the mussel which produces them. A most impressive selection of strung cultured pearls ranging in price up to £115 (retail) per strand had been provided by Messrs. Bolton and Redfern, whilst Mr. S. G. Ritchie had lent some very beautiful multiple strand necklets of black (dyed) and white cultured pearls.

There was no doubt that those present enjoyed a most interesting and informative evening as they showed by their enthusiastic response to a vote of thanks proposed by Mr. W. C. F. Butler.

GEMMOLOGICAL INSTITUTE OF AMERICA

The Institute has announced the retirement of Dorothy Jasper Smith, who joined the staff in 1932. She had served the Institute for a longer period than any other person. Her departure constitutes a real loss to the organization for she efficiently handled the duties of bookkeeper, registrar and the varied tasks of executive secretary.

OBITUARY

Henry Newton Sprague, aged 69, a director of John Bull & Co. (Bedford) Ltd., died in January 1964. He gained his Fellowship diploma in 1928.

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