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THE JOURNAL OF GEMMOLOGY

and

PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

GEMMOLOGICAL ASSOCIATION 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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SYNTHETIC OR ARTIFICIAL

By A. E. FARN, F.G.A.

MOST gem-enthusiasts have at some time or other either attended a gemmological exhibition, or proudly shown their own collection of gems to friends and relations—always to be asked the inevitable question, " how much are they worth ? " To the keen collector, this is an irritating question, since it indicates clearly where the interest lies and how the average person reacts to such terms as gemstones or jewellery. Seldom does one meet the true appreciation of beauty or rarity, but always the eternal " how much ? "

Unfortunately certain elements in our society readily apply their criminal psychology to this materialistic interest in valuables so quickly evinced by the more greedy or gullible section of the public. Thus, when a new material came on to the market and displayed tremendous fire and attraction for a price low in comparison to diamond, it afforded possibilities which the unscrupulous were not slow to realize. The new material's trade name of fabulite seemed coined specially for word play—fabulous for the credulous ! It was not until some fairly recent occasion that I was asked by a gem-dealer, who wanted to satisfy a customer's enquiry, whether it *was* intended to simulate diamond and if it was a synthetic stone.

Answering rather quickly without very serious thought, I replied that it certainly was not intended to simulate diamond but doubtless it could be so used. It was not synthetic diamond, since its formula was $SrTiO_3$, strontium titanate, but it could be described as a synthetic stone. Since then I have had second thoughts. I began to wonder if it was correct to describe this product as synthetic, and without going into the various aspects and methods of manufacture of synthetics generally I wondered whether it was correct so to describe strontium titanate.

Being weak on etymology I could only have recourse to what I had been taught, and as far as I could remember a synthetic stone is a stone which has the same chemical composition, refractive indices and specific gravity as its natural counterpart.

If a synthetic ruby be analysed it would correspond with natural ruby and similarly in the case of sapphire. With synthetic spinel this is not quite the same, as here there is an excess of alumina in the composition and the properties are slightly higher in R.I. and S.G. than those of natural spinel. It would seem to be hair-splitting, but even synthetic spinel is not a true synthesis of natural spinel. It did not intend to propound this particular case, but it slipped in as a natural sequence.

What I really wanted to *focus* on is:—strontium titanate, is it a synthetic, since so far as is known there is no naturally occurring mineral ? Certainly it is an artifact as indeed are all synthetics, whether corundum, spinel, rutile or emerald. The Concise Oxford dictionary gives synthesis as " Combination, composition, putting together. Chemically:—artificial production of compounds from their constituents." Jarrolds' dictionary of difficult words gives synthesis as " Combination of parts into a uniform whole. Synthetic —pertaining to synthesis and adjectivally as artificial." Webster's Compendium carefully states, "Synthetic gems having similar chemical composition to natural corundum and spinel and which in physical and optical properties approximate to these gems are made in an oxy-coal gas furnace (Verneuil process)." Anderson's Gem Testing gives: " Synthetic stones, manufactured stones which have essentially the same composition, crystal structure and properties as the natural mineral they represent."

It would seem, therefore, that a concensus of opinion is against terming an artifact of no known natural counterpart as a Synthetic from a gemmological view. Incidentally, most so called synthetics which have a counterpart in nature are all certainly harder than fabulite, which has a softness too low to admit of normal jewellery usage. It would seem therefore that strontium titanate is in fact an artificial stone and should be so described.

STRONTIUM TITANATES EXAMINED UNDER A MICROSCOPE

Herbert Tillander, F.G.A.

The microscope used was an ordinary binocular microtype instrument fitted with the American Gem Society's illuminator. The pictures were taken under dark-field illumination with a magnification of 10 × and 40 × using a Leica and Peruz 17 Din film.

Basil Anderson gives in his excellent book " Gem Testing " an excellent description of how to recognize this synthetic from both diamond and other substitutes. To those who have perhaps not the sensitive feeling of an expert the "false and over coloured appearance " shows immediately under the microscope. In fact it is amazing how, properly illuminated, practically every facet seems to have a different colour, which is never the case with diamond or other white brilliant-cut stones. This unfortunately could only be shown in a colour picture. But I found many other details during my inspection of twelve stones.

1. Focused on the surface the microscope reveals faint, but very distinct scratches on practically every facet. (*Fig.* 1.)

2. The culet in practically every stone examined under 40 × shows an irregular shape, which can also be recognized under 10 ×. (*Figs.* 2 *and* 3.) Very often it is also chipped (*Fig.* 3.) The reason is obvious, the stone is not hard enough for precise cutting.

3 In several stones the girdle was found to be so heavy and rounded in shape that it could be seen from above, looking straight down into the stone. In addition it is very often polished. (*Fig.* 4.)

4. Another expression of the inexact cutting can be seen by closely examining how the various facets on the crown meet (*Fig.* 5.) *Fig.* 6 shows how some facet edges may have quite a rounded appearance.

5. Finally I have produced pictures of the " centipede-like " inclusions, which indeed are very typical and could be found in all but two of the examined stones. (*Figs.* 7-8.) I have been unable so far to find any bubbles and other typical inclusions of ordinary synthetic stones produced in the Verneuil process.

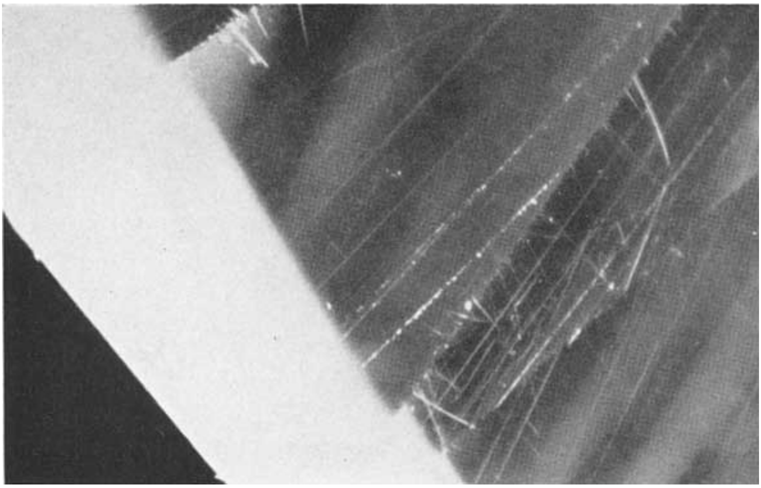

FIG. 1. *Faint scratches seen on most facets of strontium titanate*

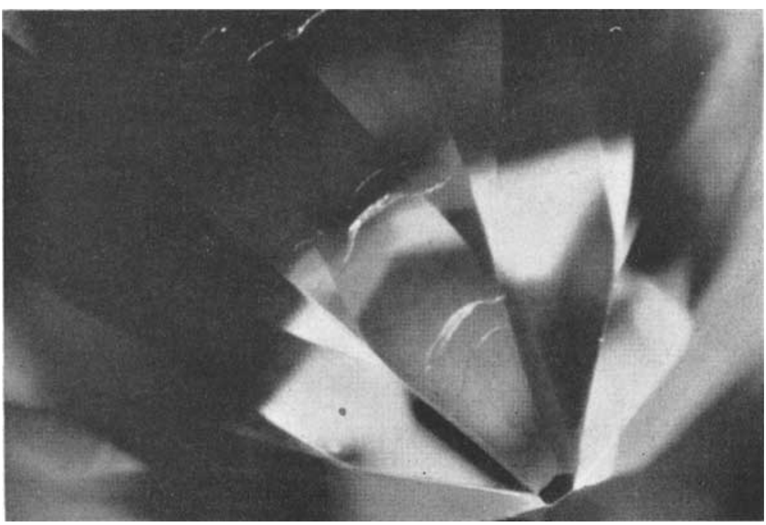

FIG. 2. *Irregularly shaped culet*

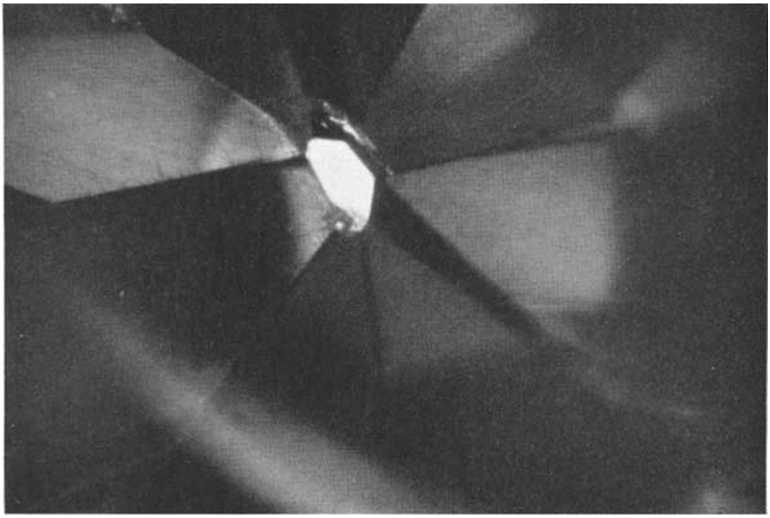

Fig. 3. *Irregularly shaped culet, showing chip marks*

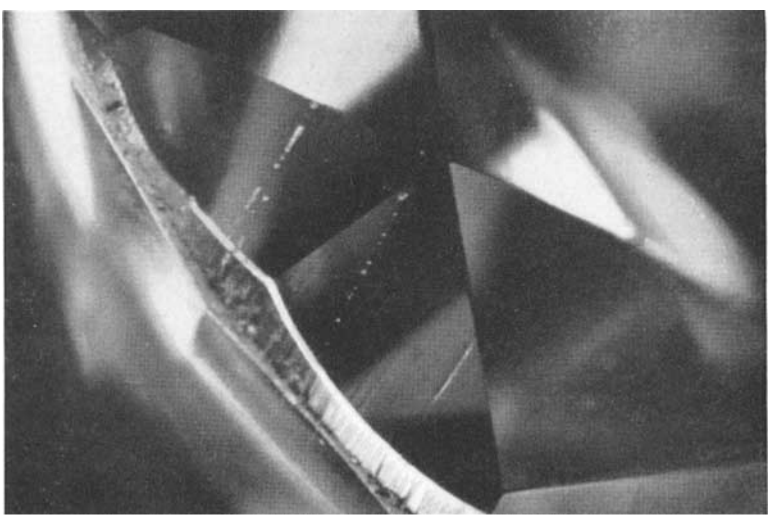

Fig. 4. *Heavy girdle, often visible when looking down into stone*

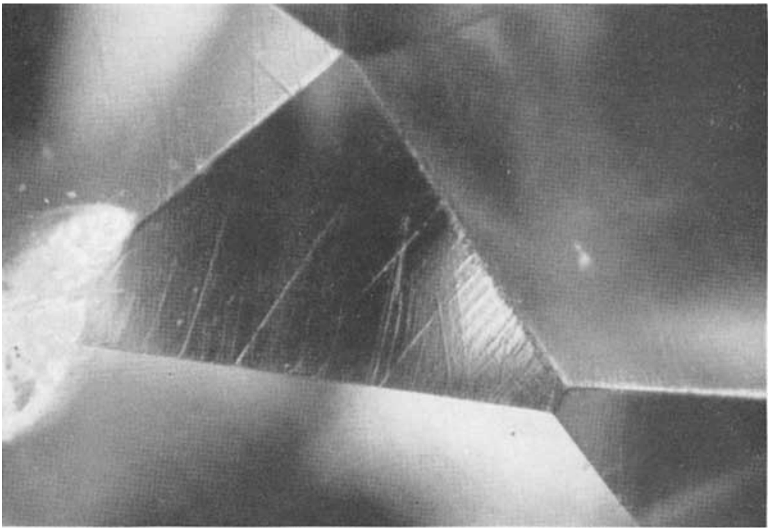

Fig. 5. *Irregular meeting of crown facets*

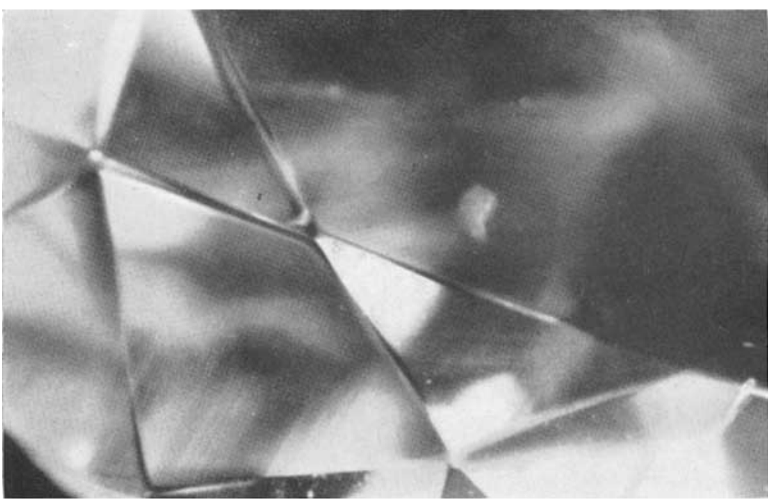

Fig. 6. *Almost rounded appearance of some facet edges*

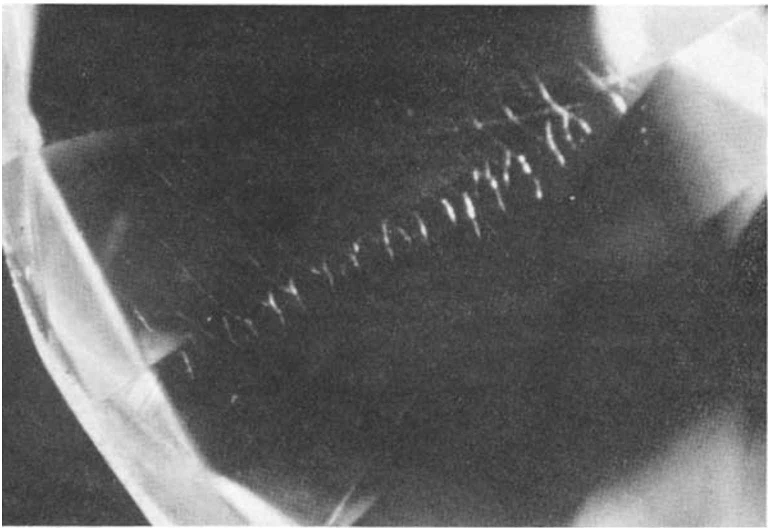

FIG. 7. *Characteristic "centipede" inclusion*

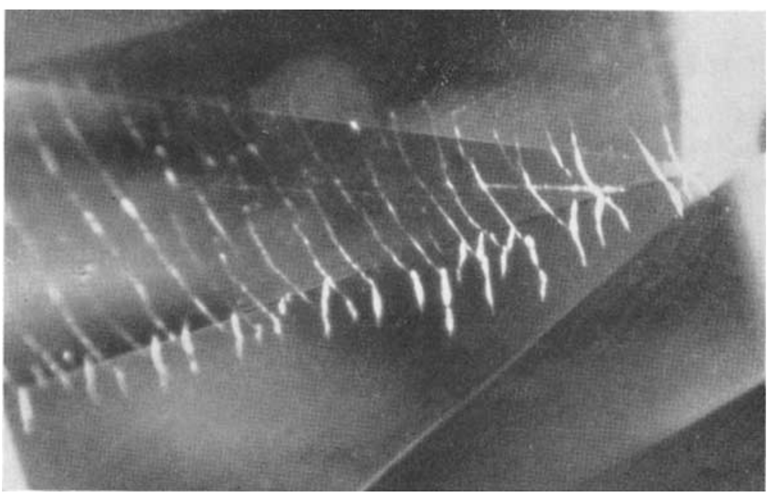

FIG. 8. *Development of "centipede" inclusion*

LUMINESCENCE OF A LARGE PINK DIAMOND

By B. W. ANDERSON

THE show-piece amongst a number of " highly important jewels " sold by auction at Sotheby's on 17th March, was undoubtedly a large pink diamond, cut as an oval brilliant. It was dramatically listed as " Lot 100," and it was sold for £46,000.

The stone weighs 34·64 carats, and it has a pleasing shade of pink—not unlike that of kunzite. One would expect a diamond of such exceptional size and colour to have a " history " and a name—but none seems to be forthcoming. It seems possible that it originally came from the old " Golconda " mines of India.

Messrs. Sotheby submitted the stone to the Laboratory for examination, and the following notes on its properties are published with their permission.

Though it is by now well established that the density of gem diamond lies within the narrow range 3·514 - 3·518, it was thought worth while to measure and record the density of so exceptional a stone. A careful hydrostatic determination was therefore made in ethylene dibromide, giving the figure 3·517.

The absorption spectrum of the diamond showed nothing notable : vague bands in the blue-green and in the middle of the blue were all that could be seen. It was in its luminescent properties that, to a scientist, the greatest glory of the stone was revealed. Under all forms of stimulating radiation (long and short wave ultra-violet light, X-rays, and even white light filtered through copper sulphate solution) the stone showed a strong orange-yellow or " apricot " fluorescent glow. After exposure to long ultra-violet or to X-rays there was also a persistent phosphorescence of the same colour. With X-rays this afterglow was remarkable in showing none of that immediate diminution when the rays were switched off which is almost universal in mineral phosphors, the glow only beginning to fade after an interval of a second or so.*

More interesting still was the emission spectrum revealed when the fluorescent light was examined through a hand spectroscope. A series of bright lines could be seen, extending towards the red end of the spectrum in diminishing strength from the end-member in the series, a clearly defined line in the yellow. The wavelength of this

* Subsequent experiments revealed that the stone has an ultra-violet transparency characteristic of Type II diamonds.

yellow line could be measured with considerable accuracy, using a Beck wavelength spectroscope, as 5750Å. The line is quite close to the mercury doublet at 5769 and 5790Å, which can be seen in the ordinary fluorescent lighting tubes used in the Laboratory, and these lines were used as a reliable standard for calibrating the spectroscope in this region. The other lines in the series were more diffuse and much weaker : the wavelength figures obtained for these, 5860, 5985, and 6185Å, must therefore be considered as only approximate. Undoubtedly at liquid air temperatures the definition of the whole series would be far sharper, and accurate values could then be obtained.

By a curious coincidence a smaller pink diamond in the same sale (but of different ownership) showed a precisely similar luminescence spectrum, though the phosphorescent glow was far less strong. This was a navette-shaped brilliant weighing 2·83 carats, listed as Lot 57. It might be thought that this was no coincidence, but merely an indication that all pink diamonds show this form of luminescence and emission spectrum. We have, over a period of years, recorded the luminescence of a number of pink diamonds from various sources, and none has displayed the same features.

J. F. H. Custers has suggested, on the basis of spectrographic analyses of diamonds of different colours, that manganese may be the cause of the colour in pink diamond. If this were so, one would expect greater consistency in the absorption and emission spectra of such stones. Admittedly, traces of manganese are held responsible for the vivid green fluorescence of willemite from Franklin Furnace and the pink fluorescence of aragonite from Girgenti, in which last the spectroscope reveals a short-lived orange as well as a longer-lasting green component. But neither of these show a line emission spectrum. Moreover, the series of lines observed in these two pink diamonds is very reminiscent of the series of emission lines seen in green-fluorescing and in blue-fluorescing diamonds. In each of these latter types there is a " key " wavelength at which a narrow band may be seen, either as an absorption or fluorescence line, and this is attended by weaker bands, not all of which are " reversible." In blue-fluorescing diamonds the key position is the 4155Å band (first observed by Walter in 1891) ; in green-fluorescing diamonds the key line is at 5040Å—first seen as a fluorescence line by Crookes (1879), together with others at 5370 and 5130Å, and seen as an absorption line in 1935 by C. J. Payne. The existence of these two systems was worked out and recorded by the writer in 1943[1] and independently in 1944 by Anna Mani[2] (of the Raman school) in a much more elaborate paper.

Though yellow-fluorescing diamonds are also well-known, we have never previously seen any definite bands or lines in their emission spectra, though in some cases there seemed to be traces of a discrete structure. The emission lines in these pink diamonds seem thus, in the words of the old cliché, to " fill a long-felt want."

Though most strongly luminescent gem diamonds have a blue fluorescence there is probably always a yellow or green component in the emitted light, though it is usually masked by the stronger blue emission. This can easily be demonstrated (without using a spectroscope) by the use of suitable colour-filters, and by the fact that, at least when the stimulus is long-wave ultra-violet light, the yellow component is far more persistent than the blue and can be seen as a phosphorescent after-glow when the stone is removed from the exciting rays and observed in darkness.

E. Becquerel[3] discovered this interesting effect 100 years ago in the course of his brilliant investigations on luminescence. For this work he designed a phosphoroscope consisting of spinning slotted discs by means of which he was able to examine the spectra of light emitted by substances a fraction of a second after they had been exposed to the rays of the sun. He found that blue-luminescent diamonds appeared yellow unless the speed of the phosphoroscope was increased to a point where observations were being made at an interval of only 1/200 to 1/1000 second after the stone had been exposed to sunlight—though this brief persistence of the blue glow was not quite the same for all diamonds. The yellow component he found in general to persist for several minutes at least.

An interesting fact, established by the Raman school of workers,[4] is that the energy of the blue component, though apparently vanishing so quickly, is actually still held by the diamond, and can be seen as a bright blue thermoluminescence when the diamond is subsequently heated—even when the experiment is carried out some days after activation.

Reverting once more to the emission lines seen in Sotheby's large pink diamond—it is probable that the 5750Å line was seen among others by Crookes during his observations of the bright glow

Photograph in natural size of pink diamond.

(Courtesy of Sotheby's, London)

emitted by diamonds under Cathode rays. In his little book " Diamonds " he states (p. 97) : " Diamonds which phosphoresce red generally show the sodium line on a continuous spectrum. In one Brazilian diamond phosphorescing a reddish-yellow colour I detected in its spectrum the citron line characteristic of yttrium."

Crookes was a pioneer with the spectroscope : he had discovered the new element thallium with its aid, and investigated the fluorescence spectra of the rare earths. He is hardly to be blamed for ascribing to definite elements any bright lines seen in the spectroscope when studying the light from his brightly glowing diamonds. The effects he noted, however, were far more probably due to structural peculiarities in the diamond itself.

Miss Mani, in the paper already cited, gives the wavelengths of several emission lines in the yellow and orange of green- or yellow-fluorescing diamonds—one of which she measured (from a photographic plate) as at wavelength 5758Å, and this may be the same line which we measured as at 5750Å in the two pink diamonds. Miss Mani describes this as part of the 5040 system, however, whereas certainly in the stones described above the 5750Å line was acting as the head and chief of its own system of lines. It was, moreover, far brighter and clearer than either the 4155 or 5040Å emission lines as seen in other diamonds, which under ordinary conditions are quite difficult even to discern.

Before concluding, reference should be made to an important paper on the fluorescence of diamond by Dyer and Matthews,[5] which the writer has only recently had the opportunity of seeing. Using 3650Å mercury light as the exciting radiation, these workers have found, in addition to the 4155 and 5040 series of lines, a system of bands at the red end of the spectrum based on wavelength 6195, with other members at 6291, 6393 and 6494Å.

These emission " peaks," however, were not resolved at room temperatures, but were studied and measured at liquid-air temperatures, i.e. at 80K or $-195°C$. The lines quoted were not associated with any corresponding absorption bands. They were found to accompany the blue- and green-fluorescing systems, and were too weak to influence appreciably the colour of the fluorescence.

Though a formidable corpus of research has been carried out on the physical properties of diamond, it is certain that much more remains to be discovered.

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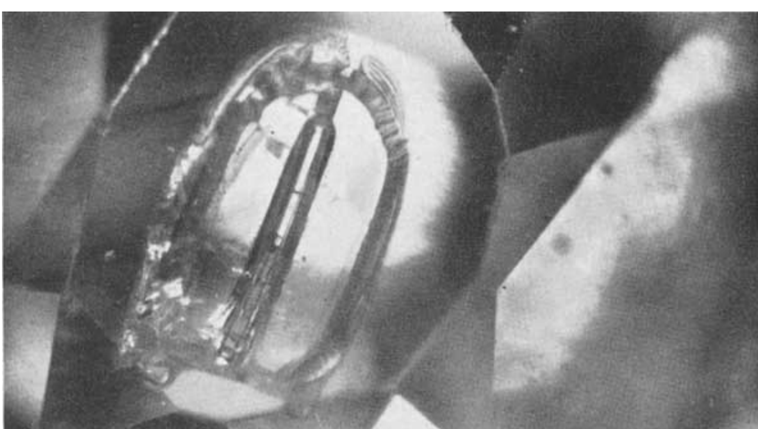
2. Mani. *Proc. Ind. Acad. Sci.*, 1944.
3. Becquerel. *Ann. Chim. Phys.*, 1859.
4. Chandrasekharan. *Proc. Ind. Acad. Sci.*, 1946.
5. Dyer and Matthews. *Proc. Roy. Soc.*, **243**, A, 1958.

DIAMOND INCLUSION

R. Webster

An interesting inclusion was noticed in the centre stone of a small diamond ring. The inclusion appeared to be isotropic between crossed nicols and has the appearance of being a cavity. There may be a libella in the centre of the central bar. The fluorescence of the stone under long-wave ultra-violet light is bright blue and the inclusion stands out dark.



A BRAZILIAN EMERALD

(A contribution to the study of crystal growth)

By W. F. EPPLER

THE final size of crystals depends on several factors, the most important of which are concentration and composition of the mother solution (or melt) and pressure and temperature during crystallization. The time-factor, too, is of some importance, although it is often overrated.

The growth conditions may change during crystallization; the growing of crystals in nature, therefore, is frequently not a steady process, but often interrupted or subject to phases. One of many good examples is certain tourmaline crystals from California, U.S.A., which display, in cross section, a pink core surrounded by green outer layers. In this case an original pink tourmaline kept adding green layers through change of the pigment-content in the mother solution.

Another example, which is just as instructive, is a crystal of Brazilian emerald from Bom Jesus das Meiras, Bahia, Brazil. Its dimensions were $24 \times 6 \times 4$ mm (about $1 \times \frac{1}{4} \times \frac{1}{6}$ in.), and its weight about 7 cts. The cross section showed it to be free from inclusions apart from a narrow outer rim. Under the microscope, when the aperture was nearly closed and an intense light-beam produced, interesting growth phenomena became visible. These phenomena are shown in illustrations 1 and 2 and are summarized in a greatly simplified sketch (Fig. 3). The illustrations show how growth developed from an hexagonal nuclear crystal, which itself started growing from a minute germ crystal (not illustrated). Bordering the hexagonal nucleus is a rather homogeneous growth phase, namely the area enclosed by the heavily rimmed dodecagon. The weak white lines (broken lines in Fig. 3) from the nucleus to the heavy dark outlines indicate that during this growth phase there were present several pyramidal faces, which disappeared later. The dodecagon was produced by the combination of the faces of the second order prisms with those of the original first order prisms.

The following growth phase shows frequent changing in the preference for the prisms of the first or second order. During this phase " islands " were developed, which are orientated in accordance with the second order prisms and indicated by Fig. 3 in

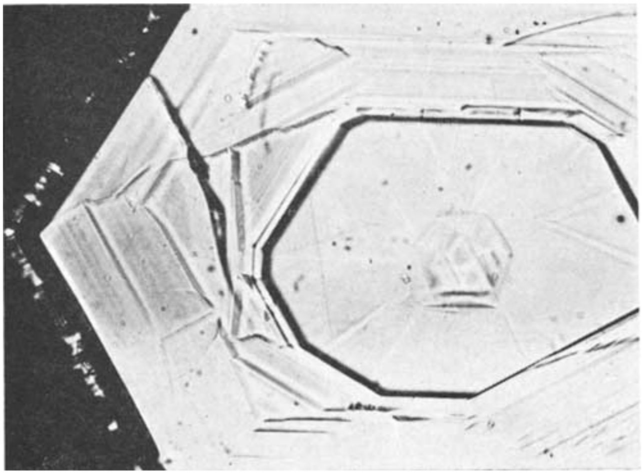


FIG. 1. *Brazilian emerald with different growth phases. Plane of slide parallel to crystal base. 22 × mag.*

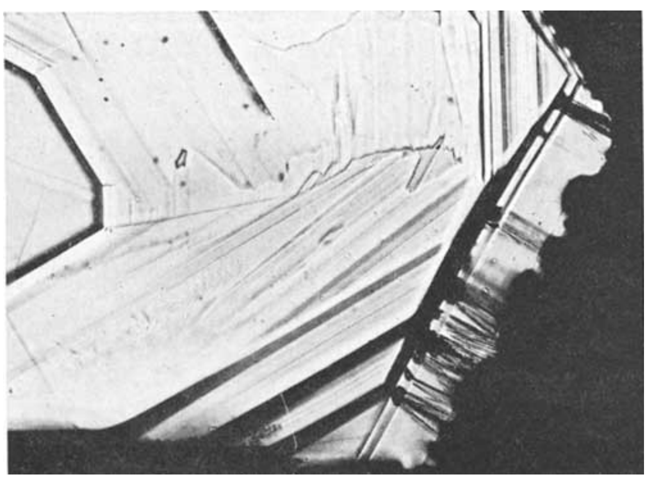


FIG. 2. *Brazilian emeralds with different growth phases. Plane of slide parallel to crystal base. 22 × mag.*

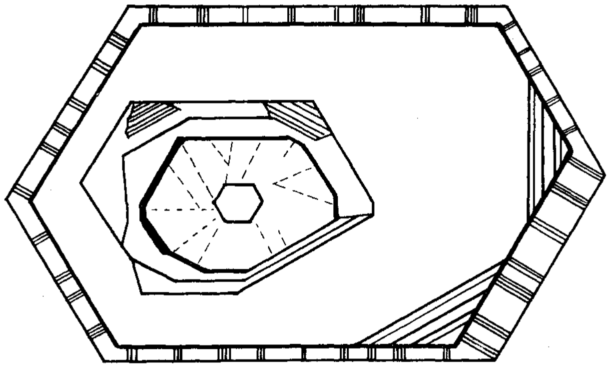


FIG. 3. *Diagram of some growth phases of the Brazilian emerald.*

corresponding hatching. Eventually the growth of this crystal ended in an hexagonal outline, the corresponding faces of which are parallel to the inner nuclear crystal and belong to the first order prism. During this last phase the crystals did not at all grow uniformly and without interruptions. This is indicated by the different fine lines, which in Fig. 1 and 2 belong to the different hexagonal bipyramids.

At normal illumination the emerald crystal appears completely uniform. This means that the individual " layers," which indicate growth-phases similar to rings in trees, vary only very little in their refractive index. These small variations in their turn are indications of a slight difference in the chemical composition of the individual layers. This shows conclusively that crystals grow in varying conditions. It can be assumed that the composition of the mother-solution changed slightly with time, or that material of differing chemical composition crystallized at different periods. It is difficult to find a definite reason for this. It may be that crystallization from the mother-solution caused a surplus of one or other component, which later was balanced by the addition of new mother-solution. It may also be possible that the mother-solution was added intermittently and that small variations in concentration caused these linear " growth striations." Finally, there is the possibility that the mother-solution was subject to certain currents, which could explain small changes in chemical composition and also in concentration. Furthermore, if one takes into consideration that possibly pressure and temperature may have changed, it becomes apparent that in this case crystal growth appears to have been a very complicated process depending on many factors.

One further interesting phenomenon shown by this Brazilian emerald is in its outer growth layer. This is the layer which can be seen on the left hand side of Fig. 1 as a dark seam with a few light spots and on the right hand side of Fig. 2 running at an angle to the edges of the illustration. In Fig. 3 the layer is depicted by irregular hatching. This layer has brush-like inclusions arranged at right angles to the prism faces (Figs. 4 and 5). They consist of a broad and darker " foot " from which capillaries extend towards the outer prism face. The " foot " consists of a hollow containing a small quantity of liquid. The shape is irregular. The capillaries, which do not always run absolutely parallel to each other, are, on the other hand, completely filled with liquid. At times they were subject to resorption by the host crystal, as can be deduced from interruptions in some capillaries. This resorption or healing process is well illustrated in Fig. 5.

The only explanation for these peculiar inclusions seems to be that the growing of the crystal was disturbed shortly before the

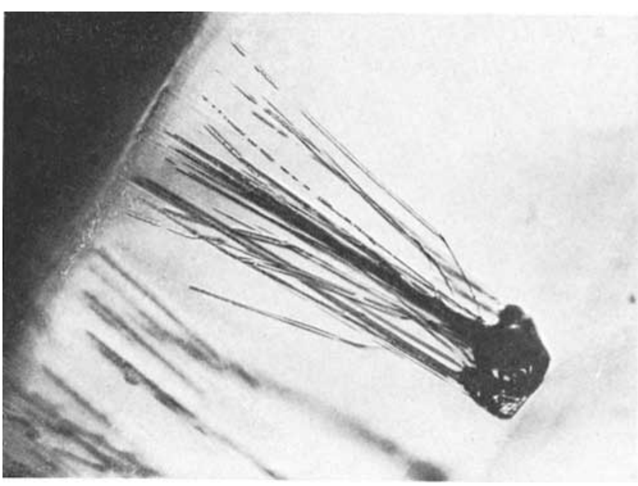


FIG. 4. *Brazilian emerald, brush-like liquid inclusions. Plane of slide parallel to crystal base.* 120 × *mag.*

FIG. 5. *Brazilian emerald. Brush-like liquid inclusions. Plane of slide parallel to crystal base.* 200 × *mag.*

layer was formed. The surface (prism face) of the emerald crystal at that stage served as a support for the " foot," which with further crystal growth developed into these brush-like formations. As these inclusions are distributed over the whole crystal, it is perhaps permissible to think of a " shock " during the growth of the crystal. Unfortunately there are no indications which would allow definite conclusions with regard to the nature of this disturbance or its cause.

Both phenomena, the intermittent growing of this Brazilian emerald crystal and the regionally limited presence of the unusual liquid inclusions, allow the conclusion that its genesis must have been full of incidents. If these phenomena should be present in other Brazilian emeralds of the same occurrence, especially the liquid inclusions on account of their peculiar shape and arrangement, they might be of value as typical characteristics.

Translated from Schweizer Goldschmied, L'Orfevre Suisse, 1960, vol. 49 (No. 1), pp. 23-27. The Association is indebted to the Schweizer Goldschmied for the illustrations.

SARKSTONE

By E. H. RUTLAND

In preparation for a recent holiday in the Channel island of Sark I decided to find out something about its geology, especially as I heard that amethyst was found there. My quest for rock specimens proved unavailing. Most surprisingly the Channel Islands are outside the area covered by the Geological Museum. I was referred to the Imperial Institute, but found nothing on display there either. An attendant tried to help by suggesting that if I would specify any particular stones I wished to see, a search would be made in the stores. However, I did not wish to put the staff to a lot of trouble with my amateurish inquiry and contented myself with reading Professor Wooldridge's most useful chapter in "The petrology of Sark," *Geological Magazine*, June, 1925.

Friends who knew the island well warned me not to expect much from the local variety of amethyst known as Sarkstone. This proved to be justified. No material that is even slightly attractive appears to have been found in recent years. There are two places where purplish quartzite is found. Both are on the south-east coast of " Little Sark," the southern part of the island. One of these is really only accessible from the sea, but I got to the other one, known as the " Pot." This is a typical " creux," a formation frequent in the Channel Islands.

Large caves washed out by the sea and often only accessible from it abound round Sark. They often extend up to 100 yards into the steep cliffs. Sometimes the roof at the back of the cave crumbles and caves in, leaving a roughly circular shaft up to 100 ft. high and with nearly vertical walls. Such is the Pot. Its floor is submerged at high tide but at low tide a broad archway connects it with the sea. The floor is strewn with boulders and pebbles, some of which are very attractive and include jaspers and chalcedonies of various kinds. Access to the Pot is by an easy path to its top rim but the descent into it calls for a scramble on all fours and not everyone will attempt it.

The Sarkstone is in a vein running vertically up the cliffside. Many veins of white quartzite permeate the rocks in this locality but only in the two places mentioned are purple pieces sometimes found. Most of the material in the Pot vein is stained brown with iron but

I hacked out some pebbles in which the brown colour had changed to a dark purplish red. This cryptocrystalline material was all I could see. There were some water-worn pebbles of it on the floor of the Pot, and I also picked up a drusy boulder containing white opaque crystals of milky quartz. From this it seems possible that crystalline amethyst may also occur, albeit not of any high degree of transparency.

Inquiry among residents and habitués of up to thirty years addiction to Sark produced the same answer : Nothing worth while had been found for a very long time. A local jeweller produced two brooches set with pale amethysts which were claimed to be of local origin. They were quite transparent but indistinguishable from any other amethyst. There were stories of necklets in the possession of old Sark families, but one got the impression that these were quite rare.

It was therefore somewhat disconcerting to see an entire jeweller's window in an adjacent island labelled SARKSTONE and displaying a large array of the most flashy violet paste. There were some large geodes of amethyst, presumably of South American origin, at the sides and a notice explaining that sarkstone owed its colour to manganese whilst amethyst owed it to iron. There was no explicit claim that the pastes were Sarkstone or that any of the material on display came from Sark, but such would certainly be the impression one would receive. A jeweller friend in London has in fact been shown a bracelet of these pastes by a customer who explained that they were Sarkstones. She seemed to think that they were natural. But then, I have met some people who thought that rhinestones were natural. Such are the dangers of proliferating the names of gemstones.

Gemmological Abstracts

SWITZER (G.). *34th Annual report on the diamond industry*, 1958. Jewelers' Circular—Keystone.

Dr. Switzer's admirable survey of the diamond industry in 1958 takes the usual pattern. World production of diamonds was the highest on record, most of the increase coming from the Belgian Congo. There was a decrease in sales, 6 per cent for gem diamonds and 33 per cent for industrials. By the end of the year demand had increased and was running at a satisfactory level.

S.P.

LEIPER (H.). *How to cut cat's-eye gems.* Lapidary Journ., 1959, 13, 604-616, 3 figs.

A general survey of the problems of fashioning gemstones which show chatoyancy. Apart from the usual gems, such as chrysoberyl, quartz, scapolite, there is reference to nephrite cat's-eyes, which are obtained from an Alaskan jade, ulexite, witherite, mesolite, and other less familiar species.

S.P.

ZAVERI (C. K.). *Gem mining in India.* Lapidary Journ., 1959, 13, 246-556, 618-628, 1 map, 1 illus.

Gemstone occurrence in India is mainly confined to the northern part. Only Madras and Mysore produce gems in any quantity in the southern states, where the mining is not so well organized and where much recovery is by hand-picking from the fields. The range of species which is found in the country is considerable, though there is need for the modernizing of mining methods.

S.P.

PENSE (J.). *Zum elektronenmikroskopischen Faserbau des Achates.* On the electron microscopical fibrous structure of agate. Zeitschr. d. Deutsch. Gesellschaft f. Edelsteinkunde, 1959, No. 27, Spring, pp. 3-4.

Electron-microscopical investigations (mag. 20,000 to 60,000 times) have shown that an individual fibre in agate consists of many quartz crystals arranged with the optical axis at right angles to the long axis of the fibre.

W.S.

BLANK (H.). *Ein neuer mondsteinartiger synthetischer Spinell.* A new moonstone-like synthetic spinel. Zeitschr. d. Deutsch. Gesellschaft f. Edelsteinkunde, 1959, No. 27, Spring, pp. 11-12.

This synthetic spinel, when cut cabochon, resembles a moonstone, but has a strange blue shiller and faint asterism not known in genuine moonstone. The back is flat and polished and has the steel-blue appearance of a bloomed lens. Under the microscope anomalous double refraction and gas bubbles could be detected. Refractive index, specific gravity and hardness are those of synthetic spinel. Under short-wave UV (2540 Å) the synthetic spinel fluoresced vividly yellow-green compared with a delicate pink of the moonstone. Under long-wave UV (3650 Å) the synthetic fluoresced reddish, whereas genuine moonstone showed hardly any fluorescence.

W.S.

ANACKER (H.). *Vorkommen und Entstehung der Achate im oberen Nahegebiet.* Occurrence and genesis of agates in the upper Nahe valley. Zeitschrift d. Deutsch. Gessellschaft f. Edelsteinkunde, 1959, Vol. 27, Spring, pp. 12-24, Vol. 28, Summer 1959, pp. 19-24.

Geological observations which may affect validity of theories relating to the genesis of agate.

W.S.

FUTERGENDLER (S. I.). *X-ray study of solid inclusions in diamonds.* Soviet Crystallography, 1958, Vol. 3, No. 4.

Garnet, olivine, diopside, chrome-spinel, and diamond were found as inclusions in diamond by X-ray methods. X-ray investigation of inclusions is claimed to be more reliable than a visual study under the microscope.

G.F.A.

SCHLOSSMACHER (K.). *Türkis, gefärbt und gehärtet.* Turquoise, dyed and hardened. Zeitschrift d. Deustch. Gesellschaft f. Edelsteinkunde, Vol. 29, Autumn 1959, pp. 11-16.

Inferior but genuine turquoise has been impregnated *in vacuo* with colourless plastics, the nature of which is a trade secret. Thus a darker, more pleasing colour is produced and a harder gem material results, which takes a better polish than the original poor material. The existing rules on nomenclature do not cover the case and there were difficulties in preventing the use of the correct but insufficient label " treated " turquoise. The author insists that a correct description would be " dyed and hardened."

W.S.

JAKOB (E.). *Die Verbrennungstemperatur von Diamantpulver.* The combustion temperature of diamond powder. Zeitschrift d. Deutsch. Gesellschaft f. Edelsteinkunde, Vol. 29, Autumn 1959, pp. 16-18.

Five test series were carried out with diamond powder of 05; 1; 3; 5 and 10 micron grain size, showing that combustion (in air) started at temperatures of roughly 350°C (662°F) when the particles were smaller than 3 micron. With bigger particles the combustion started at 700°C (1292°F). The author does not refer to other workers in this field and does not mention that sintered and other diamond abrasive tools are frequently produced in reducing or neutral atmospheres.

W.S.

SCHLOSSMACHER (K.). *Fortschritte in der Diamantsynthese.* Progress in diamond synthesis. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, No. 30, pp. 2-4. 1959/60.

Survey of the present position mentioning American, South African and Russian production.

W.S.

———. *Neues über Zuchtperlen und Blisterzuchtperlen.* News about cultured pearls and cultured blister pearls. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, No. 30, pp. 9-10. 1959/60.

For the production of non-neucleated pearls in Lake Biwar the Japanese use the fresh-water mussel *Hyriopsis Schlegeli.* Most of the pearls are of baroque shape. Similar tests were carried out in the West Australian Pearl Farms near Brecknock Harbour using the oyster *pinctada.* The Pearls Pty. Ltd. in the same district has also developed a new method of producing blister pearls, making use of the oyster *Pinctada maxima.* The blister pearls are finished in Japan in the way the first Japan pearls were made.

W.S.

SCHMIDT (PH.). *Geheimnisvoller Jaspis.* Mysterious Jasper. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, No. 30, pp. 10-12. 1959/60.

Article dealing with history and legend relating to jasper.

W.S.

———. *Zucht schwarzer perlen.* Production of black pearls. Gold und Silber, Vol. 13, No. 3, p. 21. March, 1960.

Recently a magnificent black pearl was produced artificially in Japan by exposing the interior of a white pearl to radio-active radiation. For the last two years Prof. Horiuchi of the Mie-University has experimented with the change of natural pearl colour. He found that a colour change was effected by bombarding with neutrons. Only the interior of the pearl became black, the outer pearl layer did not change its colour. The neucleus of a pearl contains small quantities of manganese, which become black if exposed to radiations for a long time, and light blue or grey at shorter exposures. The colour change of manganese is due to oxidising induced or accelerated by radiation. W. St.

Schlossmacher (K.). *Künstlich gefärbte Achatlagensteine.* Artificially dyed agate layer stones. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, No. 30, pp. 20-22. 1959/60.

Layer agates are used mainly in the production of cameos. " Niccolos " are the conventional stones consisting of a dyed (usually black) lower layer and a thinner upper layer, usually white, which is worked upon by the engraver. (The white layer does not absorb pigment during the dyeing process.) The most prized layer agates are those in which the two layers meet in an even plane.

Two different methods are used to imitate natural (though dyed) layer agate : (*a*) doublets—nothing new is to be said about this imitation ; (*b*) artificially produced layer agates, usually called false layer agates. An agate suitable for dying and without any natural white layer is chosen and cut into a block of twice the thickness of a " niccolo." The top and bottom faces must run parallel to the natural striation of the stone. The block is stained in a solution of chlorate of cobalt and ammonium chloride until it is completely saturated. It is then soaked in hydrochloric acid until the chlorate of cobalt and the ammonium chloride have been removed to a depth of 1mm all round. After this treatment the block is heated in potash dye. The outer layer becomes white and the inner core remains black. The block is then sawn through the centre so that two imitation " niccolos " result. In cameos worked from this sort of material the white layer may become patchy after some time. The author is concerned with the correct nomenclature for this imitation. W.S.

SMITH (W. E.). *The origin of chert.* Gemmologist, Nos. 339-340, Vol. XXVIII, pp. 184-188 ; 210-214. October/November, 1959.

A definition is given of chert and its varieties, of which jasper is one. The sources of the silica in chert are given as (1) of organic origin (sponges and/or radiolaria), (2) inorganic origin (volcanic or silica gel on the sear floor) and (3) from transported silica. These three sources are not, however, independent of one another. The whole origin of chert is discussed.

R.W.

KNOWLTON (C. S.). *Gem materials in the Taj Mahal.* Gemmologist, No. 339, Vol. XXVIII, pp. 195-198. October, 1959.

Describes the gem minerals used in the decoration of the Taj Mahal and the Fort of Agra.

1 illus. R.W.

MITCHELL (R. K.). *The largest beryl crystal ?* Gemmologist, No. 341, Vol. XXVIII, p. 228. December, 1959.

Reports and describes the finding of a non-gem quality crystal of blue beryl which measured eight feet across the prism. The crystal was found on the Muine mine at Alta Ligonha, Mozambique.

1 illus. R.W.

ALEXANDER (A. E.). *The Chatham ruby makes its bow.* Gemmologist, No. 340, Vol. XXVIII, pp. 210-204. November, 1959.

The report of an investigation into the characters of the hydrothermally-produced synthetic ruby. There appear to be two types ; crystals of Burma colour and faceted stones, which have more the colour of Siam rubies. The crystals examined showed microscopic crystals with well defined crystal forms and " finger-prints " of a variety of size and form. Silk, colour zoning and uneven distribution of colour were also seen. In some of the crystals a few metallic particles of minute size were found and it is suggested that these may be caused by particles from the autoclave lining. The darker faceted stones showed wisp-like inclusions somewhat similar to those seen in the Chatham synthetic emerald and, further, these stones phosphoresced under X-rays whereas the crystals did not.

R.W.

Martin (P.). *A musical instrument made of jade.* Gemmologist, No. 341, Vol. XXVIII, pp. 233-234. December, 1959.

Describes the set of chiming stones, called Ch'ing, used in Old China, often made of ornamental minerals of which jade was the best.

1 illus. R.W.

Smith (W. E.). *The nature of chalcedony.* Gemmologist, No. 342, Vol. XXIX, pp. 5-7 and 16. January, 1960.

The characters of chalcedony, which have considerable gem importance, are discussed. The refractive index and the density of chalcedony are compared with those of quartz and opal. It is suggested, and reasons are given, that the description of chalcedony as being a form of silica distinct from quartz, or as an intimate mixture of colloidal silica (opal), is not tenable. It is now suggested that chalcedony does not contain opal but the lowering of the refractive index and density is due to minute spherical pores (cryptopores) of about 0·1 microns in diameter, which are probably filled with dilute saline solution. Banded agates could owe their structure to rhythmic release of minute bubbles during crystallization of the silica gel, the bubbles containing dilute aqueous solution derived from the aqueous phase of the gel. This may also account for the different staining capacity of the bands.

R.W.

Bensusan (K. E.). *Lapidary trends in America.* Australian Gemmologist, No. 5, Vol. 2, pp. 9-12. November, 1959.

Amateur lapidary work in the United States commenced about 30 years ago, mainly through the activities of rockhounds who collected minerals in their various forms and took up cutting in order to bring out otherwise hidden beauty in rough material. Many rockhounds now collect with the sole idea of getting cutting material. The idea that one must start learning lapidary work by making polished flats and cabochons has now been dispelled, for those who prefer faceting may commence at once with the aid of precision machines which replace the old jam-peg. A scheme of preliminary teaching is given and the necessity of knowing the critical angle for the species is mentioned. The tumbling process is described. Six-sided drums are better for the grinding and round barrelled ones for the polishing process.

R.W.

ANON. *Gemmological exhibition in Brussels.* Gemmologist, No. 342, Vol. XXIX, pp. 1-4. January, 1960.

A report on the gemmological exhibition held at the Institut des Arts et Metiers in Brussels. Apart from the general display, demonstrations of diamond and gem cutting and of laboratory work were given. A series of lectures were also a feature. One of these was given by Thorold Jones, F.G.A., of Harwell, who spoke on irradiated gemstones. Comment is made that while the exhibition was well publicised on the Continent little or no publicity was made in the United Kingdom.

2 illus. R.W.

BENSON (L. B.). *Highlights at the gem trade laboratory in Los Angeles.* Gems and Gemology, No. 11, Vol. IX, pp. 336-340. Fall, 1959.

Reports a thin rose-cut diamond set in a gold and enamel ring with a depression under the stone, which is lined with metal foil moulded into facets of the same shape as the facets of the diamond. This gave considerable " life " to the stone. A black coral from Hawaii, which had an approximate refractive index of 1·56 and a density of 1·37, showed a radial structure and the material did not show fluorescence. An amber-like resin of rose-pink colour is another material referred to and it is said that this material responded to all the tests for amber, except specific gravity, but the facts are not given. Some notes are given on treated turquoise, and on the errors in the stencil gauges used for weight estimation of diamonds. A variable-speed spinner (0·3600 r.p.m.) in conjunction with a 100 watt zirconium arc lamp and an adjustable triplet lens is mentioned and is used for absorption spectroscopy.

6 illus. R.W.

CROWNINGSHIELD (G. R.). *Highlights at the gem trade laboratory in New York.* Gems and Gemology, No. 11, Vol. IX, pp. 341-343. Fall, 1959.

A badly worn cultured pearl necklet shows what can happen when care is not given to such necklets. The danger in using atomizers for perfume when wearing pearls is discussed. A transparent crystal of green jadeite in the mass of a piece of translucent jadeite is commented upon. Some notes are given on the so-called coque de perle and these are said to be distinguished from blister pearls by the transverse ridges seen on the surface. " French river pearls " are the section of the lip of one valve of a salt water mollusc. A black opal, on being polished, lost its black colour and became ordinary white opal. It was thought that the original black colour was due to treatment by the introduction of carbonaceous deposits along minute cracks near the surface. A coated diamond is reported.

5 illus. R.W.

GÜBELIN (E. J.). *Leucite*. Gems and Gemology, No. 11, Vol. IX, pp. 333-334 and 350. Fall, 1959.

Describes the occurrence and provenance of the cubic mineral leucite. Transparent material of this species has been cut into faceted stones. Leucite is found in igneous rocks, particularly in young lavas, and hence crystals are found in areas of past or present volcanic activity, such as Italy, the Eifel district of the German Rhineland and in the United States of America. The hardness is said to range from $5\frac{1}{2}$ to 6 and the density, from the specimens examined, varied from 2·46 to 2·48. The mean refractive index, usually displaying a weak birefringence of not more than 0·001, was found to vary from 1·504 to 1·509. The dispersion is 0·008. Polysynthetic twinning is common. Considerable investigation has been made by the author on the inclusions seen in the specimens he has examined. From experiments entailing moderate heating the author has deduced that the crystals of leucite consist of orthorhombic twin lamellae.

R.W.

WEBSTER (R.). *The prized chrysoberyls*. Gemmologist, No. 339, Vol. XXVIII, pp. 190-194. October, 1959.

The mineral species chrysoberyl is discussed in general terms. The varieties, the physical constants, luminescent effects and the absorption spectra of the different varieties are mentioned. The reason for the colour change of the alexandrite variety is explained, and the types of inclusions seen in this species are noted. The cat's-eye effect is in chrysoberyl due to a multitude of relatively short needles parallel to the vertical axis of the crystal. Localities where found and the styles of cutting most commonly used for the species are given.

2 illus. P.B.

JADE STORY—AMERICAN (3)

By ELSIE RUFF

TWO factors have added very considerably to our knowledge of both Mexican and Central American jade—the Tribute Roll and the several inventories that captors drew up to accompany loot to their native land. The Tribute Roll was a document of the native American economy. Taxes were not paid in coins, they were paid in the valuable products of the day, such as gold, skins, plumage and precious stones. Foremost among these valuables was *chalchihuitl*, an Aztec word derived from *zali* (jewel) and zihuitl (green).

Our knowledge of the Tribute Roll is due largely to the research, and a subsequent paper, by Zelia Nuttall, a well-known archaeologist.[1] This work not only defines the districts which were expected to contribute jade but in many instances specifies the quantity and occasionally the form it should take, such as beads, pebbles, rolled pieces or single boulders. Occurrences must have been known to the Aztec Treasury, since it was useless to demand large pieces from an area where only an occasional pebble was found. This paper, written as long ago as 1901, may yet be used as a guide for occurrences of jade still eluding us. Boulders and rolled pieces were, of course, carried down by streams. But almost certainly the ancient Mexican and the Maya knew where to obtain the mineral *in situ*. Each Ruler or King seems to have been responsible for his own Tribute Roll and that of Montezuma gave a full list of the towns from which *chalchihuitl* was demanded. A copy of this document was despatched by Cortés to his king, Charles V. In Chiapas, a province of Mexico, Montezuma expected tribute from no less than nine towns, six of these towns lying near the Pacific coast and Guatemala. Yet an inland town, G. Kunz pointed out in *Gems and Precious Stones of Mexico*, not listed. in the Tribute Roll, bears the name of *Chalchihuitan*—"*the land of chalchihuitl*." The result of this careful survey shows that the main contributors of *chalchihuitl* as tribute were located in several states of Mexico and in Guatemala. (Journ. Gemmology, 1959, VII, 4, 143.)

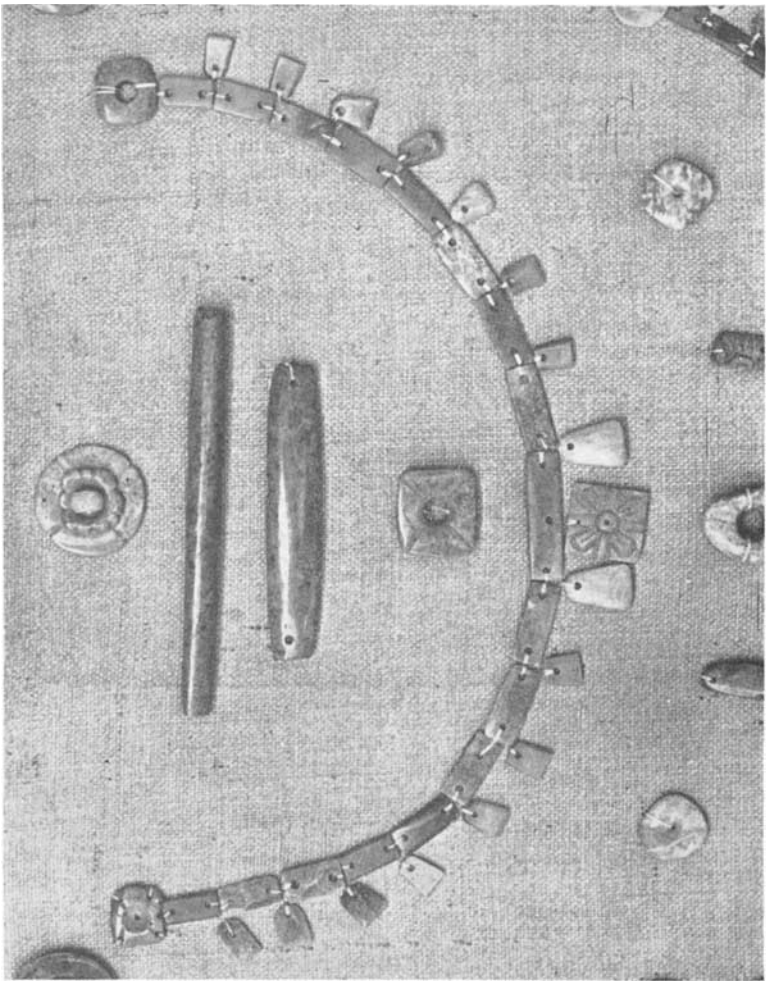
It was not until Francisco Hernandez de Córdova returned to Spain after his discovery of Yucatan that the Spaniards awoke to the fact of a New Spain rich indeed. Later, many cargoes of valuables found their way to the home country—and many never reached it. Inventories were made, some of them extant, that tell of this rich loot.[2] The Spaniards were primarily interested in gold and emeralds, and under the heading *emeralds* were unquestionably many beautiful *chalchihuitls*. What has happened to them is anybody's guess. Some of these articles were definitely described as *chalchihuitl*, often combined with gold, or with other gems. Many such pieces were merely listed *Greenstone*, and since those responsible for the inventories were more likely to have recognized emeralds, with which they were familiar and certainly anxious for, it is likely that such pieces were also of *chalchihuitl*, perhaps of inferior quality or at least of a shade of green not commonly associated with emeralds. Articles of *chalchihuitl* were worked up into such trinkets as bells, trees, shells, beads, medals, hearts, collars, birds, cicadas, crabs, snakes, butterflies, heads of humans or near-humans, monsters; even rings set with *chalchihuitls* or other gems were sometimes included.

Marshall H. Saville writes:[3] " It has been demonstrated by the statements of Bernal Diaz[4] and especially by a study of the lists of the great Aztec loot, that by far the greater part of the gold treasure gathered by Montezuma for the invading Cortés and his fellow Spaniards went at once to the crucible to be melted into bars for immediate division. Of this the King of Spain received his royal fifth and certain other small proportion of the spoils, the greater part being retained by Cortés and his companions. Of all the priceless relics of ancient Mexico, such as gold, jewels, stone mosaics, and the unique feather mosaic-work, which were not destroyed but sent to Spain as treasure or curiosities, probably fewer than two score of these objects are to be found in Europe. During the passing of four centuries, the melting-pot, careless hands, and moths, have each contributed to carry to oblivion visual knowledge of these arts. Of the jewels of gold sent to Europe by Cortes and others . . . no specimens are extant . . . "

Among the ornamental jades of Mexico and Central America, it will be noticed that carved plaques and carved figurines, and of course beads, were perhaps the commonest forms, though ear-plugs (as they were called, though in no sense did they plug the ear) were also common. These ear-plugs were used, almost exclusively, by men. Since many of the carved pieces were pierced, it is obvious that they were intended for suspension as pendants. There were also wristlets,[5] earrings, called by the Maya *orejeras*, and nose ornaments. Labrets or lip ornaments were sometimes so enormous that the distorted lip must have been as painful as the distorted ear lobe that had to be stretched to maintain the ear-plug. Finger rings were far less common and have been established mainly as a result of burial excavations. Cortés wrote of the market place where the jeweller displayed his wares of gold jewellery side by side with precious stones and *chalchihuitl*. Thomas Gann writing of *Mystery Cities* (p. 56), gives us a fascinating picture of a mound he excavated:

" The objects found on the summit of this mound are singularly suggestive: nodules of flint of various colours, nodules of jade, cores of obsidian, and the shells from which were derived the material for making beads, earrings, gorgets, and other ornaments, together with hammer stones, chisels, and a grinding stone for working these materials; in fact what amounts to the entire outfit of an Old Maya jeweller and lapidary, together with a number of his finished products in flint, obsidian, and ivory . . . We learn from Landa, a bishop of Yucatan, writing about the middle of the 16th century . . . that the Maya was accustomed to bury his dead with objects associated with the deceased in life . . . Now here we have what can be nothing else than the stock in trade of an ancient jeweller and I think the inference fairly obvious that the individual buried beneath, whether on the summit, or, as we shall ascertain later, in a chamber at the base, was a jeweller and worker in flints, ivory and precious stones. That he was a person of the first importance, is indicated by the size of the monument erected over him . . ." Gann continues: " . . . constructing a path from Succots to Benque Velgo along the western branch of the Mopan river, two very crude figurines of greenstone were discovered buried in the sand and gravel along what had originally been the bed of the river. Both these were typical specimens of archaic figurines, the prominent eyes surrounded by a ridge . . . But the archaic was a highland civilization which flourished from Mexico to the Andes some 2,000 years B.C.; how then do these specimens come to be embedded in the river-drift near Xumantunich ? This is one of the many mysteries of Central America . . . the area was also occupied by other branches of the Maya many centuries after that date."

Although jade was undoubtedly the most valuable and popular material for ornamental purposes, turquoise ranked a good second (despite its less enduring qualities). Other gems admired and used were rock-crystal, jasper, serpentine, amber, onyx and agate. S. K. Lothrop wrote[6] in 1936: " . . . Middle American jewellery in aboriginal times was made principally of jade, of softer green stones, as well as jasper, crystal, and other rocks with distinctive



Jade ornaments from Zacualpa. The large tabular bead is 6·25″ long.

(Photo by courtesy of Peabody Museum, Harvard University).

colours. Jade seems to have been manufactured in several centres, of which the most important were in the State of Oaxaca . . . the north coast of Honduras, and the adjacent Bay Islands, and in the Nicoya region in Costa Rica. While artistically the finest individual specimens have been found sporadically, the great bulk of the recorded material comes from these regions. In spite of the importance of jade in the ceremonial life and artistic traditions of Middle America, no complete study of the subject has been made, and only a comparatively small number of specimens have been published . . . The Indian women of Santo Thomas Chichicastenago and other Quiché towns have, until recently, sewn silver coins on their blouses. In ancient times pieces of jade evidently were used for this purpose . . . The explanation for this may be that the Guatemalan highlands flank one of the great aboriginal trade routes of the New World, so that foreign ideas and commodities were more prevalent there than among the relatively isolated but highly specialized communities of Peten and Yucatan."

The accompanying photograph shows a collection of jade ornaments from Zacualpa, Guatemala, illustrating pieces of jade that were almost certainly sewn to garments as Lothrop points out. These ornaments are now in the Peabody Museum at Harvard University, U.S.A.

S. Linné, of the Ethnographical Museum of Sweden, writes: " Both ear-plugs and labrets show great uniformity over a large area of the country. No doubt they were products of the workshops of skilled specialists, and it should be possible to trace them back to certain centres of manufacture . . . Certain ceramic finds as well as objects of jadeite (discovered at Teotihuacan, the Toltec capital) have furnished ample evidence of far-flung trading connections . . ."

P. Keleman in *Jade and other semi-precious stones* wrote: " . . . Among the stones used in mediaeval America were jade, turquoise, rock-crystal and serpentine, as well as amber, onyx, jasper, and agate. Of these the jade work stands first in quantity and in its artistic quality. The finest carving however, is confined to the Mexican and Maya areas, where the styles are so frequently interrelated that they will be presented here as if from one vast region . . . Besides its rarity and beauty jade had a deep symbolic meaning for the Maya andMexican. The Maya word for it was *TUN*, the *Nahua* (or Aztec) name *CHALCHIHUITL*, " green stone "; an association with grass or herb, emphasizing the colour which is the symbol of life itself . . . In the Tribute Roll towns were assessed for it . . ."

G. C. Vaillant[7] describes Tlalteloco, a communal centre, " as majestic as that of Tenochtitlan . . . The market place of Tlalteloco consisted of a large area of polished pavement, bordered by arcades which sheltered many of the merchants . . . Elsewhere was a row of vendors of implements and tools, such as obsidian blades . . . pottery . . . Jewellers displayed jade ornaments and gold worked into precious rings of filigree or massive beaten gorgets. It was the jade, however, which caught the envious eye and was produced with furtive circumspection as a material of great price."

A further ornamental use for jade (though it is just possible that it could have been a surgical one) was as a filling for teeth. Gann reports that small, round plugs of jade, gold, or obsidian were often let into the front teeth, apparently for aesthetic motives. A Field Expedition to British Honduras,[8] excavating Maya ruins in 1931, came across "remarkable examples of aboriginal dentistry. The most interesting is a set of teeth from the upper jaw of an ancient Maya, showing four incisors and two canines inlaid with jade discs and with their edges filed to form a decorative pattern. The teeth of the lower jaw are undecorated. The owner was in the early thirties at death, and lived about a thousand years ago. The jade discs are set in cavities drilled in the front teeth with hollow bones or bamboo drills and sand, or possibly with points of jade or some equally hard stone. The process must have been extremely painful and we have no means of knowing if any anaesthetic was employed, but it is possible that it was, for it is known that the Aztecs thus assuaged the sufferings of victims sacrified by fire. On the other hand it may be that the drilling was done as an ordeal cheerfully undergone by young warriors to demonstrate their bravery. Other persons of wealth and rank wore such ornaments, for jade was an article of rarity and high value among the Mayas. The second Marshall Field expedition to British Honduras discovered teeth decorated with discs of iron pyrites, which probably adorned persons of less wealth. The discs were held in place by fine cement, faint traces of which were found on one tooth. Inlaid teeth have been found in various parts of the Maya area. Materials employed in addition to jade and iron pyrites are turquoise, obsidian, and hematite. A second upper jaw was found by the expedition at the same ruins of San Jose. The teeth in this one have no inlay, but the incisors and canines have been filed down to points, giving a serrated appearance . . . It is certain that the inlays and filing of teeth do not represent surgical dentistry, although false teeth have been found in Maya skulls in two instances . . . A thick incrustation of tartar showed that it had been inserted in the jaw during the life-time of the owner."

An excavation of the ruins of Copan, in Honduras, revealed that the majority of the skeletons not only were buried with jade beads in their mouths but had jade fillings in their teeth.

To quote Professor Saville[9] again: " Another custom which we have found in Esmeraldas, and which, as far as we are aware, is not present in any other part of South America, is the decoration of the teeth by the insertion of small perforations cut in the enamel of the front incisors. This custom of decorating the teeth was quite common in various parts of Mexico where different settings were used. In the Maya area as far south as Salvador, the object most often used for the inlay was jadeite . . . "

In the second article of this series it seemed wiser to approach the subject of Jade in America from a geographical angle, but by progressing in a southerly direction it is almost impossible to divide these areas, since cultures frequently overlap. Yet, in moving south, one deals mainly with the Maya, whose culture was well passed its prime when the European arrived. In a very primitive form, and in small pockets, this culture still exists. We are told that the Maya region included the states of Chiapas and Tabasco in Mexico itself; the peninsula of Yucatan; Guatemala; Spanish Honduras; British Honduras; Salvador; and part of Nicaragua. The length and breadth of this area was roughly 500 miles each way, with the first Mayan settlement approximately central. T. Gann writes (*History of the Maya*): " Almost every city developed along lines of its own . . . Palenque for its beautiful stucco moulding and engraved jades . . . engraved jades from Palenque are found as far west as Teotihuacan, near Mexico City, and as far north as Chichen-Itza." Dr. Gann speaks of the Mayas as " the least war-like nation ever existing " and writes of their first contact with the Spaniards in Yucatan in 1517.

Writing in *Gems and Gemology* in the Spring of 1952, Raymond Barber said: " The greatest number of authentic jade carvings have been found in the states of Guerrero, Oaxaca, Chiapas, Vera Cruz and Tabasco . . . this jade was held in the highest esteem

Jade Maya disc from British Honduras.

(British Museum photograph.)

by all the early peoples of Mexico—the Maya, Mixtic, Zapotec, Olmec, Toltec, and Aztec. The great quantities of jade artifacts that have been discovered in Maya ruins . . . probably were brought there from the mountains of Oaxaca in the west, or of Guatemala in the south, to be carved for use in religious ceremonies . . ."

We are indebted to a Spanish friar,[10] who spoke fluent Quiché, for preserving and translating a native MS. known as *The Popol Vuh* (" The book of our people "). In it we learn that when the relatives of the deceased were too poor to put a piece of jade in the mouth of the corpse, they used grains of maize. He tells us too that poor people who could not afford, or were not permitted, jade, had to be content with ear-plugs, and even beads, of pottery. " Nose ornaments of various types were used, the material being jade, amber, and in later times gold."

Maya jade carving

Olmec jade carving

(British Museum photographs).

During 1946 three men[11] were excavating at Kaminaljuyu in Guatemala. " . . . Great value was placed upon jade throughout MesoAmerica," they wrote, " particularly jade of brilliant colour. Nowhere, apparently, were lapidaries so preoccupied with this quality as at Kaminaljuyu. Whether for that reason the local craftsman traded for outstanding raw material, or whether, as we think more probable, ready access to sources of unusually good jade made them, so to speak, colour-conscious, the fact remains that specimens from the Esperaza tombs contain a larger proportion of beautiful stone than any other collection we have seen. Decoration was confined in almost every case to effects which could be produced by straight sawed lines and by circles and arcs of circles made with the hollow drill . . . The shape of any given piece was often dictated by that of the stone, but even more by the distribution of its colour."

In *Maya Jades* T. Gann tells us: " Probably the most spectacular and certainly the largest cache of Maya jades ever found was unearthed quite recently in the ruined city of Copan in the Republic of Honduras, by workmen digging out stone to build a house." He describes a jade pebble found here as: " bi-convex, 8″ long, and carved on one side, the rest of its surface showing distinct attrition by water. The material is of light yellowishgreen jade, and the sculpture is very typically early Maya . . . At the intersection of the limbs of the cross was found a very remarkable cache, containing an anthropomorphic figure in highly polished green jade, 7.5 inches high; eight pendants of highly polished apple-green, almost translucent jade, representing human heads; grotesque animals holding human heads in their mouths; two pairs of jade ear-plugs and two long tubular jade beads pierced through their long diameters for suspension; forty jade beads of various sizes . . . The jades were placed in the centre, around them were arranged the sea-shells, so as to form a covering . . . it is obvious that the anthropomorphic figure . . . though closely resembling that found in the dated vault is more archaic in style. It dates probably from about the middle of the third century A.D. Within this mound was found a human burial accompanied by objects of jade and flint . . ."

A research party[12] in 1945 discovered "the skeletons of six adults with . . . twenty-five complete pottery vessels, a marble bowl, and thirty-four jade specimens . . . Among the jade were tubular beads of fine quality jade, one a brilliant dark green with white streaks, one green with white mottling. Of the jade pendants, one was of a pale blue-green stone. And there were jade ear-plugs."

So many variations in the dates of early American objects exist that the matter has now assumed controversial proportions.

Maya jade carvings (Central Maya region)

(British Museum photograph.)

At first it was thought that the various finds were of extreme antiquity. Later the picture changed, and only a few hundred years separated much of the work with the European invasion. Some years ago a book appeared entitled *The Conquest of the Maya.*[13] A thoughtful reviewer observed: " There is another extraordinary point about this architecture (Mayan). It seems to have been an art which sprang full-fledged into its highest pitch of achievement. There is no development in it, no growth, no life. It is completely static, and always imitative, as if each successive generation copied what had gone before without the faintest notion of why they were piling one stone on another in a particular way. For example, they had unquestionably wonderful mathematicians who ' could calculate to a nicety immense passages of time ' and yet they never discovered the principle of the true arch, in which case each stone is self-supporting, nor could they draw a mathematical right-angle."

Only some four years ago an expedition discovered an Olmec ceremonial centre at La Venta. Here, in a marsh-surrounded island near the Tovala River, were found among the relics several fragments of charcoal, " presumably the remains of ceremonial fires. The carbon 14 content of the charcoal bits taken from La Venta's lowest level gave its average date as 814 B.C., with a maximum possible error of 134 years. Since they lived in a rainy region where only the toughest relics avoid disintegration, almost nothing would be known about the Olmecs if it had not been for their curious custom of carving in jade and hard stone and burying the carvings . . . They also carved monstrous human heads nine feet high with petulant baby faces. They floored their ceremonial rooms with clay tinted red with cinnabar . . . Dr. Robert Heizer, one of the leaders of the La Venta expedition, believes that the Olmecs' radio-carbon dates will ' force a total chronological re-assessment of early American history.' "

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10. Francisco Jimenez. *History of the " Maya " T. Gann.*
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13. J. L. Mitchell.

ASSOCIATION NOTICES

GIFTS TO THE ASSOCIATION

The Council of the association has received the following gifts:

Samples of turquoise hardened with polyester synthetic resin and colloidal silica, and samples of the mineral before impregnation, from Harold Maryott, Arizona.

A small parcel of stones from Harold Cropp, London.

A large piece of nephrite, from Monterey County, California, from A. Ramsay, Glasgow.

A collection of Southern Rhodesian gem minerals from K. C. Cole, of Salisbury, S. Rhodesia.

A small parcel of cleaned spessartite garnet from Rutherford No. 2 mine, Keener Farm, near Amelia, Virginia, from Capt. John Sinkankas, U.S.A.

GEMOLOGICAL SOCIETY OF SAN DIEGO

The Gemological Society of San Diego has eight of its members who are Fellows of the Gemmological Association of Great Britain. This is the second largest group of F.G.A.s in any city outside the U.K., Toronto having thirteen. One of the objects of the San Diego group is to train speakers to go before other groups and speak on various aspects of gemmology.

The San Diego Society would welcome correspondence with any similar society and letters should be sent to the President, Edward R. Bohe, G.G., F.G.A., 3145 North Mountain View Drive, San Diego 16, California, U.S.A.

WEST OF SCOTLAND BRANCH

A talk was given by Mr. Robert Webster to the West of Scotland branch of the Gemmological Association at Glasgow last January in which some problems currently confronting the jeweller were discussed.

The difficulty of identifying strontium titanate, known in the gemstone market as FABULITE, when such stones are in a setting was demonstrated. It was pointed out that owing to their pronounced fire, low hardness and the peculiarity of the rounded facet edges (rather like those seen on paste stones), these stones would be obvious to the jeweller once he had seen samples. To this end a series of Fabulites in brilliant- and emerald-cut styles, and varying in weight from 14 carats to as small as 0.16 carat, were exhibited.

The new Australian whole cultured pearls and cultured blister pearls were discussed, and so were the non-nucleated cultured pearls from a freshwater lake in Japan and in the salt waters of north-west Australia.

The effect of wear and greasy cosmetics on cultured pearl necklets was referred to, and it was suggested that a customer should be told that periodical restringing and cleaning should be carried out. It was explained that owing to the discontinuation layer between the core and the outer nacreous layer, greasy skin preparations, which so readily collect dirt, travel up between the core and nacreous outer skin and this dirty grease showing through the translucent layers of nacre impart an unpleasant dark colour to the pearls.

Mr. Webster also discussed the new hydrothermal rubies grown from " seeds " of small water-worn pieces of Burma ruby, which Carroll Chatham of California proposes to place on the market. Some information on the structures of these rubies was given and the question of the correct naming of this type of man-made ruby discussed. Rough Burma rubies used for " seeding " in the hydrothermal process, some hydrothermally grown crystals and stones cut from them were exhibited. The work being carried out investigating these hydrothermal rubies illustrates something of the research work carried out in the London Chamber of Commerce laboratory, an aspect of the laboratory's work which is not so apparent to the jeweller as the routine testing.

The imitation of turquoise and the bonding and hardening of this mineral by impregnation with plastic and colloidal silica were discussed and specimens shown. The coloration of diamond by bombardment with particles of atomic size, the staining of jadeite and jadeite triplets, and imitation hematite were also mentioned.

OBITUARY

Bernard Roulet, Zürich (D. 1955), after a motor accident.

Fred J. Waller, Southend (D.1932).

TALKS BY MEMBERS

WORTH, J. R.: " Diamonds," Leicester Round Table Club No. 39, 24th November 1959.

ATKINSON, J. C.: " Gemstones, synthetics and imitations," Morpeth Soroptimists, 26th January, 1960.

BLYTHE, G. A.: " Gemstones," Rayleigh Round Table, 18th January; Business and Professional Women's Club, Basildon, 2nd February; Rochford Young Farmers' Club, 3rd February, 1960 ; Benfleet Business Luncheon Club, 16th February, Eastwood Teenage Club, 4th April, 1960.

CAFFELL, ERNEST W.: " Gemstones," Hook and Chessington Branch of the Young Conservative Organization, Ace-of-Spades, Kingston-by-Pass, 15th February, 1960.

WARREN, K. (MRS.) : " Gemstones," Women Conservatives and Bromley Parish Church Women's Fellowship, 21st January; Dartford Business and Professional Women's Club, 2nd February; Young People's Fellowship, Christ Church, Bromley; 12th February; Crofton Townswomen's Guild, 25th February; Young Wives' Fellowship, St. George's, Bickley, 5th March; Mothers' Union, St. Augustine's, Bromley, 6th April.

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C O N T E N T S

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