Vol. 10 No. 1 January, 1966

# THE JOURNAL OF GEMMOLOGY

*and*

PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

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# THE JOURNAL OF GEMMOLOGY

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**Vol. 10 No. 1 JANUARY 1966**


## STUDIES ON INCLUSIONS IN SOME INDIAN GEMSTONES*


*By SUDHA PHUKAN*
*Geological Survey of India*



ABSTRACT

DIFFERENT types of inclusions in sapphires from Kashmir and aquamarines from Chitral, Monghyr and Coimbatore have been described. The Kashmir sapphires are often zoned, cornflower blue in colour with a milky or a hazy appearance. Inclusions in Indian sapphires in general, are similar to those from Ceylon, particularly in respect of rutile needles, liquid feathers and colour zoning; they even contain zircon haloes, considered typical of Ceylon sapphires. However, they differ from Ceylon stones in containing euhedral crystals of zircon without haloes, which are said to occur in Burma stones. These are reported for the first time in Kashmir sapphires. Liquid feathers and brown liquid films seem to characterize Indian sapphires. Colourless-tube like inclusions in Chitral and Monghyr aquamarines resemble those from Rhodesia. The brown colour of the tubes in Coimbatore aquamarines is due to iron stains and not due to brown liquid as reported from other localities. The two-phase inclusions, of liquid and gas, and the liquid feathers running at right angles to each other, appear peculiar to Chitral and Monghyr aquamarines only.



* Published with the kind permission of the Director General, Geological Survey of India.

## Introduction

Almost all gemstones, even the best, contain microscopic inclusions. During the past two decades, their study has developed into an important branch of gemmology, particularly because of the detailed work of Gübelin (1952). The study finds many applications, not only in distinguishing natural from synthetic gems, but also in tracing the place of origin of natural stones. Besides, inclusions provide clues on the species of gemstone, and its mode of origin. Since very little is known regarding inclusions in Indian gemstones, their studies are being carried out in the Central Petrological Laboratories of the Geological Survey of India. A comparative study was made of the inclusions of a number of cut and uncut Indian sapphires (9) and aquamarines (12) from the collections of the Geological Survey of India in the Indian Museum. The present studies are based solely on microscopic examination, using high-index immersion liquids wherever necessary.

The studies have established that while the Indian gemstones examined in general are comparable to the gemstones of other countries, they also possess distinctive peculiarities. The results obtained from the studies have been presented in this paper. The inclusions in the gemstones are solid, liquid and gaseous in nature. Among the different types of inclusions described by Gübelin (1948), rutile needles, zircon crystals, liquid feathers, fingerprint inclusions, healing feathers, flat films of liquid, feathers with dark opaque crystals in centre, negative crystals, tube-like inclusions, and colour-zoning have been distinguished.

## Inclusions in Kashmir Sapphire

The Kashmir sapphires are cornflower blue in colour, often zoned with a slight milky or hazy appearance. Both solid and liquid inclusions are common in them.

### *Solid inclusions*

*Rutile.*—Long and fine needles of rutile are common. The needles are widely spaced and oriented in three sets meeting at 60°. They traverse the entire stone and appear as criss-crossing canals (Fig. 1). In some cases the needles have decomposed leaving canal-like cavities, which give the stone a shining white sheen, popularly known as "Silk".

*Fine dust.*—Dust-like particles are either scattered in between the rutile needles, or are concentrated into a cloudy patch of extremely fine particles.

*Zircon.*—Inclusions of zircons are rare. Zircon crystals are often found with dark brown halo of fractures round it, giving it a "winged" appearance (Fig. 2). In a few cases euhedral crystals of zircons without haloes, are also observed (Fig. 3).

*Opaque black prismatic crystals.*—Opaque black prismatic and rounded crystals surrounded by liquid feathers are also observed in two cases (Fig. 4).

*Liquid inclusions*

*Liquid feathers.*—Such feathers are found almost in all the stones. Tiny drops of liquid are often arranged in rows or are scattered haphazardly and form a feather-like pattern—whence the name.

*Fingerprint inclusions.*—These are very common. Here the minute drops of liquid are curved like a thumbprint, hence the name, "fingerprint" inclusions.

*Healing feathers.*—They are so called because the liquid has healed the cracks by crystallization. These are less common. The liquid which has entered the cracks is distributed in small drops of bizarre shapes, often producing mesh like patterns.

*Flat liquid films.*—Inclusions of flat irregular liquid films are quite common. The liquid is often brown or yellow in colour (Fig. 5). These are formed of filling up of cavities, due to irregular growth of the crystal—the crystal growing around and enclosing a "cyst" or a pocket of liquid (*cf.* Parsons and Soukup, 1961, p. 670).

Among the inclusions noted above, zircons and opaque black crystals are of special significance. From a study of Ceylon sapphires, Parsons and Soukup (1961, p. 69) and Gübelin (1950, p. 5) opine that zircon haloes are characteristic of the locality, and are due to radioactive disintegration of metamict zircon; however, recently (*cf.* Webster, 1962, p. 652) it has been suggested that these may be formed due to stress generated by thermal expansion. Mitchell has suggested that the expansion may not be thermal, but due to increase in the size of the embedded zircon crystal which has degenerated to metamict type. It is interesting to record that the zircon haloes are also present in Kashmir sapphires (in two out of nine stones examined). In two stones euhedral zircons without haloes have been observed; this contrasts with those of Ceylon where zircon crystals always show haloes. Opaque black prismatic

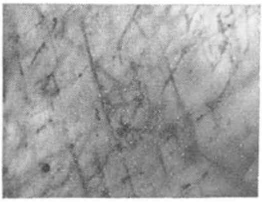

Fig-1 35x

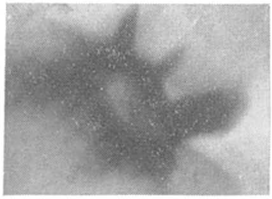

Fig-2 70x

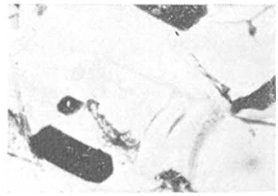

Fig-3 65x

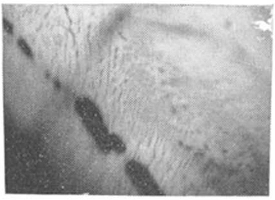

Fig-4 35x

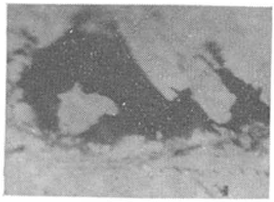

Fig-5 40x

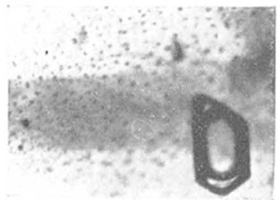

Fig-6 45x

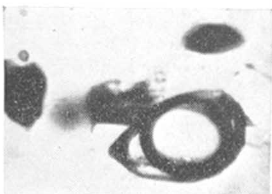

Fig-7 80x

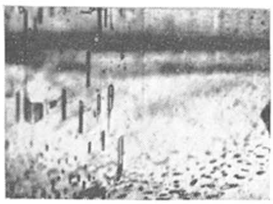

Fig-8 35x

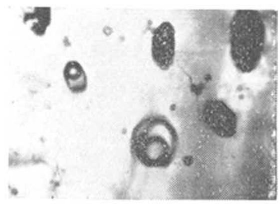

Fig-9 45x

FIG. 1. *Rutile needles in Kashmir sapphire*

FIG. 2. *Zircon haloes in Kashmir sapphire*

FIG. 3. *A zircon crystal without haloes in Kashmir sapphire*

FIG. 4. *Opaque black prismatic and rounded crystals, surrounded by liquid feathers in Kashmir sapphire*

FIG. 5. *Irregular flat liquid films in Kashmir sapphire*

FIG. 6. *Negative crystal with well developed crystal faces in Chitral aquamarine*

FIG. 7. *Two phase inclusions in Chitral aquamarine*

FIG. 8. *Negative crystals and liquid feathers oriented at right angles to each other in Chitral aquamarine*

FIG. 9. *Two phase inclusions in Monghyr aquamarine*

crystals in Kashmir sapphires resemble those from Siam stones. The nature of these prismatic crystals have yet not been determined because of the dark colour of the Siam sapphires which has rendered their study difficult (Gübelin, 1950, p. 6).

### Inclusions in Aquamarines

The Chitral aquamarines are sky blue in colour, and show tube-like inclusions, negative crystal cavities and liquid feathers.

The tube-like inclusions are straight, fine, parallel tubes, oriented parallel to the prism faces. The negative crystals are two-phase inclusions, i.e. they are filled with liquid and bubble of gas. Some of the negative crystals show well developed crystal faces (Fig. 6), whereas some do not (Fig. 7). They are oriented parallel to the C-axis. The liquid feathers are oriented parallel to the basal plane. The negative crystal and the liquid feathers, oriented at right angles to each other (Fig. 8), suggest that there are two generations of inclusions—the negative crystals being primary autogenic in origin, and the liquid feathers being secondary in origin, the liquid apparently made its way along cracks and weaker planes of the basal cleavages (0001).

*Aquamarines of Monghyr, Bihar*

Aquamarines from Monghyr are yellowish-green in colour. They show two-phase (Fig. 9) inclusions, liquid feathers and straight fine tubes. As in the Chitral aquamarines the negative crystals, or the two-phase inclusions, are oriented parallel to the C-axis, and the liquid feathers lie parallel to the basal plane.

The tubes are oriented parallel to prism faces, and some of them are filled with iron stains.

*Aquamarines of Coimbatore, Madras*

The Coimbatore aquamarines are light blue to light green in colour. They are comparatively clear, the only inclusions observed in them are brown-coloured tube-like inclusions. The tube walls are often filled with iron stains giving them a brown colour.

### Comparison with the Inclusions in Gemstones from other Localities

The present studies indicate that most of the inclusions in Indian sapphires and aquamarines are comparable to those of other localities, and some differ slightly, whereas some considered typical of certain countries, are also found to occur in Indian stones; some of the inclusions noted here, do not appear to have been reported in the literature.

The liquid feathers, healing feathers and fingerprint inclusions are comparable to those in Ceylon sapphires. In some cases the feathers differ slightly in colour, the constituent liquid being yellow or brown instead of colourless. The rutile needles are comparable with those of Ceylon in being long and widely spaced, and they differ from Burma stones, where they are short and dense (Webster, 1962, p. 71).

The opaque black prismatic crystals surrounded by shredded drops of liquid (Gübelin, 1950, p. 6) and flat liquid films of brown colour (Webster, 1962, p. 70) are similar to those of Siam stones.

The tube-like inclusions in Chitral aquamarines are comparable with the Rhodesian aquamarines (Webster, 1962, p. 93). The brown-coloured tubes described only in some cases are said to be filled with brown liquid; however the Coimbatore aquamarines do not seem to contain any liquid; their brown colour appears to be due to iron stains. Liquid feathers in aquamarines have not been described earlier, and the negative crystals are reported only in few cases (Webster, 1962, p. 93). These negative crystals and the liquid feathers running at right angles to each other, are not reported from any other locality and are noted for the first time.

## Conclusion

Most of the Indian sapphires are cornflower blue in colour, often zoned with a milky or hazy appearance. The most common inclusions in them are liquid feathers and rutile needles. Liquid feathers and flat liquid films of brownish colour seem to characterize the sapphires from Kashmir. The inclusions in Kashmir sapphires in general, resemble those from Ceylon, particularly in respect of rutile needles, liquid feathers, and colour-zoning. Zircon haloes are not peculiar to Ceylon sapphires only, as they have been found in Indian stones as well. Euhedral crystals of zircons, without haloes, reported for the first time in Kashmir sapphires indicate that zircons are not always accompanied by haloes in Indian stones.

The aquamarines are usually found flawless, but Indian aquamarines, specially from Chitral and Monghyr, are full of inclusions. The arrangement of two-phase inclusions and liquid feathers at right angles to each other seems peculiar to Indian stones only; these inclusions characterize aquamarines from Chitral and Monghyr, whereas the Coimbatore aquamarines show only brown and colourless tube-like inclusions. The brown-coloured tubes in Coimbatore aquamarines are filled with iron stains and not any liquid.

ACKNOWLEDGEMENTS

The author is greatly indebted to Dr. E. J. Gübelin for critical reading of the manuscript and valuable suggestions, to Dr. M. V. N. Murthy, Superintending Geologist, Geological Survey of India, for guidance. The author's thanks are also due to Shri P. R. Sen Gupta, Geologist, Geological Survey of India, for his inestimable help in the preparation of the paper, and Shri S. P. Sanyal, Geologist, Geological Survey of India, for the photomicrographs.

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# "OSMENDA PEARLS"

*By ROBERT WEBSTER, F.G.A.*

Some time ago the writer was asked if he knew of the so-called "Osmenda pearls" and later a specimen of this type of pearl was sent so that it could be examined.

Simple observation gave the impression that it was none other than the "Coque de perle", which has been known in literature for some time. The "coque de perle" is constructed by cutting the central whorl of a nautilus shell, filling it with wax or cement and backing it with a flat piece of mother-of-pearl. An x-ray picture taken some years ago showed the structure to be as described. The "osmenda pearl" now in the writer's possession showed an x-ray picture which is much more revealing, for the inner septa so characteristic of nautilus shells were seen to be present. It is said that in the true "coque de perle" these septa are removed and used for inlay purposes.

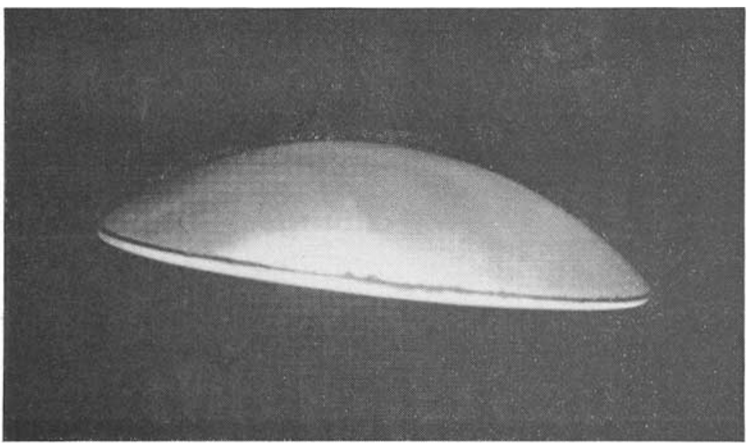

FIG. 1. *Side view of "Osmenda pearl" showing join of backing plate.*

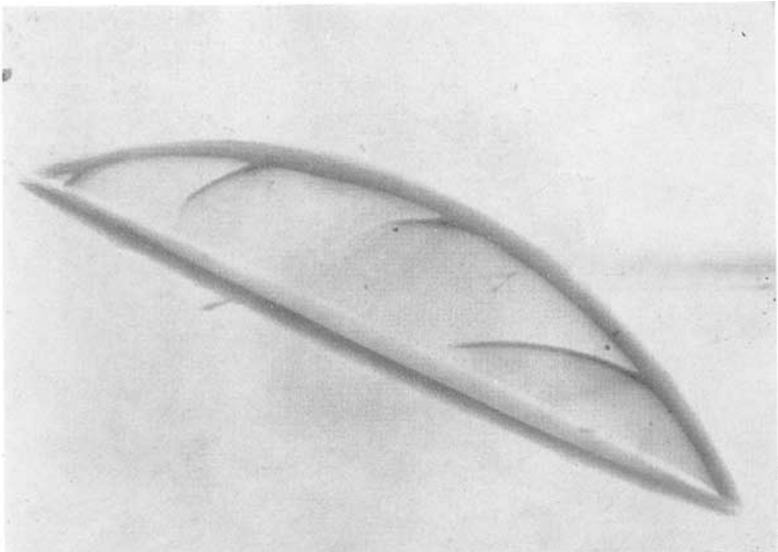

FIG. 2. *X-ray photograph of "Osmenda pearl" showing septa of the nautilus shell.*

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## "MIHAMA PEBBLES"

Seen in a shop in a south-west coast resort was a display of pebbles to which the name "Mihama pebbles" was given. The remarkable description attached to the dish of pebbles reads:—"On the beach of 'Shichiri Mihama' in Kumano (Japan) emitting black lustre, there are mounted with various nice pebbles glittering as though they were 'jewels' and are soaked through the odour of 'Kuroshio' tide. Now, let us trace the origin of the beautiful pebbles. In the mountain range on the basin of the river Kitayama in Kii province, there are many fantastic rocks and stones of various colours. These blue, green, black and white, or red rocks have been broken into pieces by the clear streams of the rivers Kitayama and Kumano carried away by rushing current passing through the Canyons of Torohatto and Kurikyo, polished for fundreds of years by raging waves rolling on the sea of Kumano and scattered on the beach of 'Shichiri Mihama'."

When tested the pieces had a density of about 2·69 and are jasper pebbles.

# NEW CUTTABLE GEM MATERIALS FROM MEXICO

*By FREDERICK H. POUGH, Ph.D.*

DURING the last decade the little known desert which makes up most of Baja California has been invaded by the mineral collectors and amateur lapidaries who have largely exhausted the easy pickings to the immediate north, but who, in the south, have turned up a number of interesting minerals. Geologically Baja California is an extension of the great Coast Batholith which first appears near Riverside, California and continues south through San Diego County into Lower California. San Diego County has long been famous for its pegmatites and for many years was a source of fine tourmaline, topaz, beryl and garnet, and was the place where gemmy spodumene, kunzite, was first found. However, for some reason, until very recently, the national border was regarded as a geological limit, and prospecting for gemstones was not pursued into Mexico. In the past few years investigations have shown that many of the San Diego County minerals do continue right on down into Mexico and that there seems to be an excellent chance of finding additional deposits of typical pegmatite crystals. Some fair tourmalines, at least one of which attained considerable size and wound up in the U.S. National Museum, have been discovered, and it is reasonably certain that additional finds of this sort will be made.

A trip down the peninsula reveals a country somewhat reminiscent of the region of Paraiba, Rio Grande do Norte and Ceará in Brazil. In both places the plateau happens to be eroded to a surface that is approximately the level of the old roof of the batholith. Since it is an uneven surface, there were roof pendants which now form islands of metamorphic rock in a granitic sea, and elsewhere there are truncated cupolas which are homogeneous granodiorite without interesting mineralization. Erosion in northern Brazil has reached about the same level and the relief has been influenced by the mineralization. The improved durability of schistose rocks, into which pegmatite dikes have been injected, combines with the protection from erosion provided by the solid quartz cores. The end result has left most of the pegmatites on hilltops and given the mines in Brazil the name "Alto". The Baja pegmatites seem to have been smaller and have not resulted in the exaggerated relief that marks north-eastern Brazil. They do stand out, however, and are readily prospected.

As in Brazil, metamorphic rock roof pendants are sometimes gneissic or schistose, and elsewhere may be lime rich. Tungsten in the form of scheelite ($CaWO_4$) is found in the lime-rich rocks. The usual associates of scheelite will be grossularite garnet, idocrase and epidote, or clinozoisite (there is much of the latter, some of it gemmy, in Baja California) and, when boron was present, axinite.

For the first time, a new find of axinite has made considerable quantitites of this mineral available for amateur and professional lapidaries. It is particularly unusual in that many of the crystals are thick enough to leave to the lapidary the selection of the orientation, rather than making the stone, by its thinness, the dictator of the location of the table.

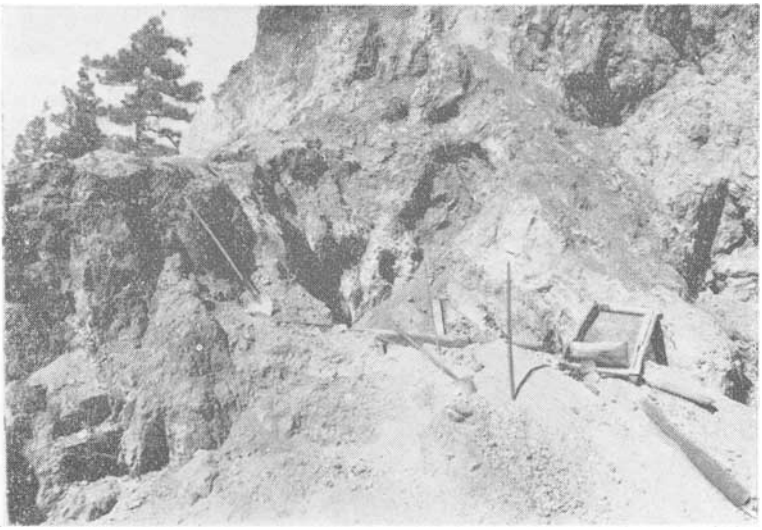
The principal find appears to have been a single pocket of large, loosely intergrown crystals embedded in soil or decomposed rock, and with little merit as mineral specimens. The crystal faces are dull, with many coated with a white skin; it has been said that the gemmiest have such a concealing layer. The few faces they show are typical for the mineral, as is the pleochroism. However, as most gemmologists know, the colour seen through axinite's broadest face is a light yellowish to grayish-brown. The "clove-brown" hue always quoted in mineral texts is a hue observed in the second of the thinner dimensions. There is also a rich purple direction, of which one gets a momentary flash when the angle of viewing is just right. Usually it is the thinnest direction.

Some of the recently found crystals are as much as 2 cm through and when they are cut with their tables at right angles to the broad face, the stones come out a rich reddish brown. Large ones are actually a little too dark, a complaint that is unexpected in cut axinites. Unfortunately, none of the crystals is completely free of flaws; they are cobwebbed with streaks of little bubbles, so all of the larger stones that have been cut are more or less flawed. The easily obtained 4 to 6 carat stones may sometimes be practically clean. A brilliant-cut stone of 16½ carats was shown at a recent "Rockhound" show but was almost too dark to be good. Still bigger ones have been promised, but it is likely that they, too, will be so dark as to be lifeless. In any case, the flaws will certainly lessen their brilliance.

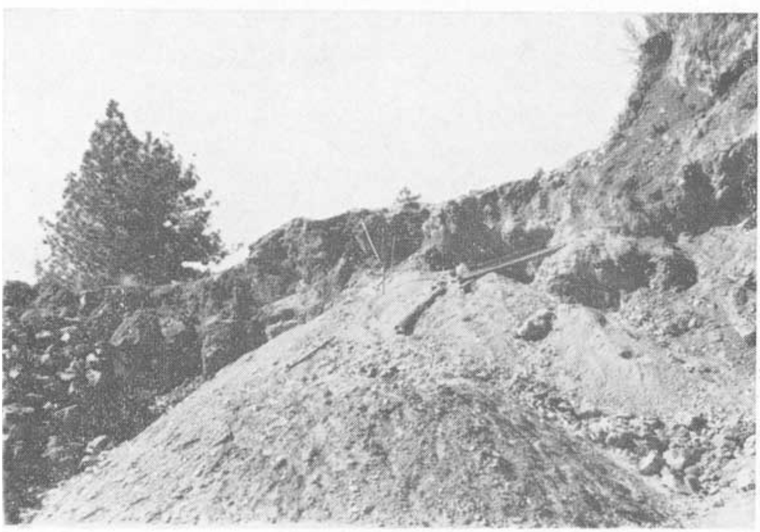
Most cut stones are of the deep red-brown colour that is euphemistically called "red" by cutters. Finishing a stone to bring out the violet colour will be difficult, but with careful orientation it should be possible.

Some of this new rough has found its way to commercial cutters, so some cut stones will probably be offered by Idar cutters of the rarer gemstones. The account of the one large pocket estimates that 550 kilos of axinite were found, though by no means was all of it cuttable. Axinite has since been coming in from other peripatetic suppliers, and it is very possible that more than one good find has been made. If the end of the story turns out to be anything like the experience five years ago with sphene, we can look for the continued offering of a good many grammes of reasonably desirable cuttable material before the supply runs out.

A second important stone from Baja California is that sphene which by now has been found in a great many gem pockets, sometimes in very large crystals. The occurrence seems to be in small pegmatite dikes cutting a dark dioritic rock, and associated with epidote. The first crystals were found at a favourite picnicking spot, very near Baja's main highway, a one-track dirt road that, insignificant as it seems, reaches all the way down the peninsula. It was favoured because it is shaded by a single large pine tree that for miles is the only thing to cast a shadow on the road and, though the region is completely uninhabited, it is a spot designated by frequenters of the route as Solo Pina, "the lonesome pine". A collector, after lunching, was taking a stroll through the brush when he noted some small gemmy sphene fragments in the sand at his feet. Excavation eventually produced a good many grammes of gem sphene, in colours ranging from emerald green and yellow-green to a fairly dark brown. This discovery eventually led to the intensive prospecting of the whole area. First alerted by Californians from the San Diego area, the natives have learned that there was interest in and a sale for the worthless little stones they had not earlier heeded. In time, considerable numbers of crystals were turned up. As with the axinite, none was very attractive as a specimen; the best single crystal is, perhaps, a flat and obviously largely transparent though dull-surfaced twin now in the collection of the U.S. National Museum. It is about 6 inches in its greatest dimension and about an inch through. Even larger ones were found, but this $750 one is about the best individual specimen.



*The scene of the fabulous axinite strike. The miners' tools can be seen in front of the pocket area. The rock exposed is garnet and diopside rock. (Photo courtesy of Lapidary Journal).*



*Close-up of axinite pocket in centre of photo. From a space of about one cubic yard better than 550 kilograms (1210 lbs.) of all grades of axinite was removed. Not all of this is of facetable quality by any means. (Photo courtesy of Lapidary Journal).*

Of course, the immediate effect of the find was to depress the market value of cut sphenes to its all-time low. The connoisseur demand has never been great enough to absorb very much more than the Alps could turn out each year, so any influx of new material was obviously an oversupply. In spite of the large size of some of the specimens, however, the development of the story is not unlike that of the axinite just described. The clear areas in most crystals are not very large, and even though at first we confidently expected to see a number of 50 carat brilliant-cut stones come from such rough, there have been in fact, very few good stones weighing over 10 carats or so. Most are even smaller, and many of them, even, have flaws, and are very dark to boot. The bearish effect on the sphene market of such a large supply was perhaps unduly exaggerated, since it seemed at first as if there would be many more fine stones than the sphene-appreciating market could absorb in years. We know now that this was not to be the case, and that anything over ten carats, combining good colour and fire, with reasonable cleanliness, is still an unusual and valuable gem. Emerald-green crystals are the least common and the smallest, so cut green stones will seldom be over a carat or so. While the brown brilliants show fine red glints that are due as much to dichroism as to dispersion, the brown is commonly too dark to be really attractive. The light greens and green-yellows, much like many of the old Swiss stones, are about the best. Rough is still being found and is still available, but even now very little of it seems to have found its way into the hands of commercial cutters. There is a lot of very sparsely settled land in Baja California, so it may be some time before all of it has been prospected.

Before leaving Baja California to look at one further Mexican mineral with gemmy characteristics, the earlier-mentioned clinozoisite should be discussed a little more fully. Clinozoisite is a lighter-hued, lower-iron variety of epidote, one can say, and it is often difficult to know where to draw the line between the two. Much of the epidote associated with the garnet at the northern Baja California scheelite mines is transparent enough to be called clinozoisite. As specimens the incomplete crystals have little merit, but they are more or less transparent and they do exhibit pleochroism in the lighter greens. No clean gemstones of any size can be cut, but, since cuttable transparent bits of this group of stones are not often encountered, any are worth mentioning. Sooner or later, of course, the once-in-a-lifetime 550 kilo pocket of gemmy clinozoisite might be encountered, but so far that one still eludes the collectors. Present supplies come, as did axinite until recently, as rewards for crawling around on old mine dumps chipping out a bit here and a bit there, normal collector-activity for this region. The Mexican miners, of course, were not interested in anything but the scheelite, so all else wound up in the spoil banks.

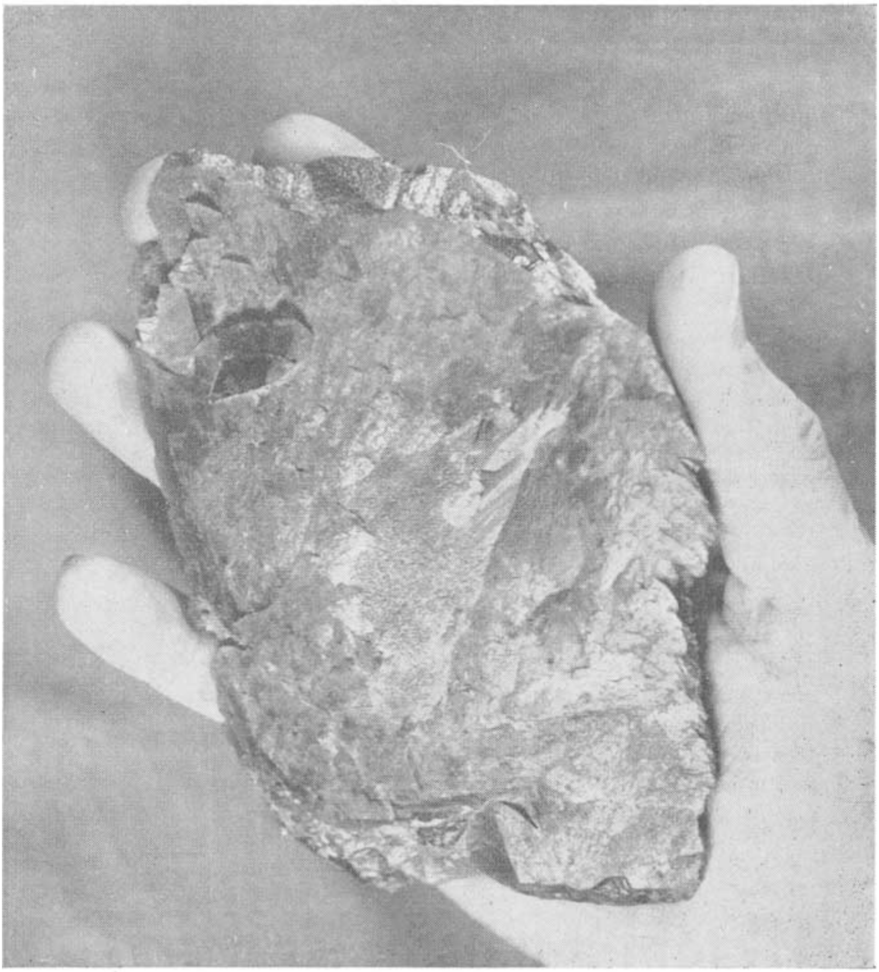
The remaining mineral now coming in notable quantities from Mexico and affording collectors some cutting material, is danburite. The locality is an old, well-known one, the Charcas Mine near San Luis Potosi. However, only in the past few years have the workers reawakened to the worth of the specimens that are found there in considerable abundance and obtained them for sale to various itinerant buyers who have then brought them north and passed them on to U.S. mineral dealers. Danburite is usually considered a rare mineral and until the abundance of the Mexican material was rediscovered, two Japanese occurrences were considered the world's most important. Even now the ordinary gemmologist will not be overly familiar with the mineral. It is a calcium borosilicate that occurs in a variety of conditions; in metamorphic rocks, in veins and even in pegmatites. It was named for a now-lost, Danbury, Conn. occurrence, which seems to have been veins in metamorphics. In Japan it is associated with axinite in vuggy veins, and in Switzerland its very small crystals project into the typical Alpine pockets and seams. Corroded fragments have come from Burma and till now have sold at relatively high prices. A straw-coloured danburite from Burma is still unique, for the mineral does not show this hue in its other appearances though the colour can be temporarily imparted by irradiation of colourless material.

With a history of appearing rather sparsely at a reasonably large number of localities, it could not have been anticipated that it would ever prove as abundant a gangue mineral as it appears to be at the Charcas lead mines. It is associated with sulphide ore, together with a little pyrite and considerable calcite. The calcite is often in basal plates, an indication of fairly high temperature deposition. The danburite has all the appearance of a major gangue mineral; the specimens, which commonly consist of projecting clusters of crystals, can only be compared with the groups of quartz crystals found in so many ore veins. It would almost seem as if danburite had taken the place of the more usual quartz in this deposit.

Danburite has formed during at least three different stages of the vein formation, all late and after most of the sulphide mineralization had ceased. Calcite is still later and, in some cases, earlier; coarsely crystallized danburite has been attacked, particularly around the base of the crystals, and replaced by calcite. Many of the danburites are also coated later with more calcite, and attempts to acid-etch them out often result in the detachment of many of the early crystals, as their bases are weakened with the solution of calcite that also replaced the original mineral. The earliest crystals seem to be very large, up to as much as four inches long and an inch and a half or two inches across. Some are very faintly pink; the tips tend to be clearer and more glassy, while the bases, where they are in contact with other crystals, have become cloudy and corroded. Many specimens show two sets of crystals, the earlier ones somewhat milky and opaque, the later clear and gemmy. Terminations are often very complex, the more numerous faces being those on the crystals of middle size, that is about one inch by one-fourth inch gemmy prisms. Lastly we see druses of tiny crystals coating some of the larger ones.

Some fair-sized stones have been cut from the tips of some of the larger crystals. Relatively few are pink enough to give a stone which will retain any colour as a cut stone, so almost all are colourless. The clear areas are not nearly as large as one might hope for with the big crystals. In general, 5 or 6 carats is about all even an optimistic view warrants. Crystals suitable for 1 or 2 carat stones are very common and can cost only a few cents. From the material seen in the dealers' hands, one suspects that many of the crystals are found already loose in pockets, freed from a matrix by the basal alteration to calcite in combination with subsequent natural solution. On occasion we encounter doubly terminated crystals, but it is apparent that the danburite usually formed quartz-like crusts of erect crystals, often crowning a band of ore minerals.

With the addition of this material to the limited market, danburite can no longer be considered a rare stone and, except for the unusual gem, its cost is now nominal. Straw-coloured Burmese stones are still uncommon and probably reasonably valuable, and a cut stone which actually showed some pink should certainly be considered a great rarity. Ordinary colourless danburite, with its refractive index only about 1·63 now has little to recommend it, no longer even the charm of rarity. In recent months the supplies seem to be diminishing a little, but there is still no shortage of specimens, nor of the loose crystals that have been bought by the wholesalers at so much per pound. It is unlikely that the cost of any but an exceptional danburite will be very great in the foreseeable future.



*A large sphene crystal, rich in gem material, from Baja, California. (Photo: courtesy of the Lapidary Journal)*

# GEM-TESTING

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

GEM-testing could well be the title of a book, a lecture, or merely the sum of all that gemmological students imagine is the itinerary of a laboratory gemmologist's day.

Gem-testing, generally speaking, is a mixture of items in infinite variety; and if variety is the spice of life—ours is spicy! We are fortunate in having no strictly routine work (in an orderly sense), but because of gemmological classes, trade associations and earlier retail experience, we are fortunate in having contact with many aspects of the trade.

Gem-testing to the student is usually visualized by stones being tested on the refractometer, or careful wavelength measurement by a spectroscope, crossed-filter work, immersion inspection by microscope, suspension in jars of clerici solution or density work by balance — plus, of course, the mysteries of the endoscope, that unique instrument understood only by a few and capable of use only by the very dextrous, X-rays, fluorescence, phosphorescence, short-wave lamps and electro-conductivity tests on rare and pale shades of diamonds. These together with immersion contact photography, Lauegrams and direct radiographs, all join to add to the importance and interest of gem-testing.

Strangely enough, a good sense of colour, cut and make of stones together with a 10 × lens still remain the most useful versatile and flexible adjuncts to the trained gemmologist.

Gemmology, and by that I really mean "jewellery" testing, is basically a bread-and-butter science revolving chiefly round the stones which matter. Stones such as diamond, emerald, sapphire, ruby, chrysoberyl, peridot, tourmaline, topaz, zircon, quartz, spinel and beryls. These together with opal, pearl, and turquoise, constitute the major importance in the world of gems.

Practically all the money in the gem trade is made by use of these stones in settings of precious metals. The occasional advent of a rare stone in jewellery is interesting to the collectors and non-trade gemmologists. Here lies their skill and expertise. Many non-productive hours may be spent in the pursuit of interference figures, refractive indices, indications of positive or negative signs in uniaxial or biaxial stones. Enjoyable as these results may be, they net no cash and cash spells quite a lot of useful things even to gemmologists non-trade!

However, fortunately for us, there are still a lot of people who want to know what the centre blue stone in a cluster is, or whether the emerald in their Aunt Jane's pendant is real or not. Probate valuation of deceased persons' jewellery, where the beneficiaries cannot agree as to who should have Aunt Maria's pearls, can be a very useful source of gem-testing, for here even the smallest items must be detailed, if only to please the Inland Revenue.

All in all, gem-testing, whilst varied, is mundane and concise—very ordinary jewellery set with usually quite small gemstones or pearls of the well-known varieties and, like many other trades or professions, it always seems more interesting to the non-participants. Like watching a plumber wiping a joint—someone else's job always makes my fingers itch, which brings me to a case in point.

A very good friend of mine, watching with keen interest a test being carried out on a customer's ring said, "You know, you go the wrong way round in your testing. You fly to the most spectacular instead of the more fundamental test in routine matters".

Here was a challenge flung down on our own doorstep. However good an amateur may be (and he may well be ten times as enthusiastic as the professional)—he does testing for love whereas the professional does it for money.

To a professional gemmologist, even though he may be a little jaded, the challenge remains constant. He must be right, backed by incontestable facts. To say his facts must be crystal clear (as the gemmologist punned it) are the remarks of a gemmological pundit.

The stone in question was oval, mixed-cut, set in a gold ring—the stone was about 1¾ carats in size. Viewed through the microscope I could see angular zoning of colour with a small crescent-shaped feather and on the surface of the stone small zig-zag erupted fractures known as shatter or chatter marks (and doubling of the back facets).

So far as I was concerned, the test was complete. Here was a typical natural blue Ceylon sapphire. My good friend, at home in his own (very efficient) set-up, would have taken the refractive index first. Nothing wrong in doing that, of course, provided you only use your refractometer once or twice a week and there is plenty of time to clean and put it away, etc. *But* if you test a dozen different pieces of jewellery of all shapes, sizes and categories in a morning between the opening of the registered post and lunch-time, you may well forget (we are all human) to wipe off the liquid. You may also (and I have) leave the stone on the refractometer when answering the telephone and later search frantically for a lost stone—to find later, as a result, crystallization of sulphur crystals on the soft glass prism of the refractometer. If in business you suffer no interruptions—you are obviously not doing much business. It is the unavoidable interruptions, the imperious note of the telephone bell (someone wanting to know how much it will cost to test a string of pearls is the usual—and the answer can take time). Even shop-keepers who are busy are guilty of time wasting. Witness the retailer who is offered a pearl necklace to value—he hasn't a clue but telephones to find out how much it would cost to test.

In the middle of testing a cluster calibré ruby setting to a brooch—the telephone rings, you lose your place and then the customer starts. Usually they have not counted the pearls, they are not conversant with grain size, they did not realize it would possibly have to be cut if genuine, X-rayed if cultured. They cannot give you a lead and are appalled by the charge because they do not realize till then how much is involved. Having courteously dealt with the customer one returns to the brooch and commences again. None of this matters very much provided that along the line of stones inclusions are seen and continuity of testing takes place and you can say that all of the stones you tested are in fact genuine rubies, or synthetic rubies, as the case may be. But how about that one clean stone which gave away nothing? It was a ruby because one saw doubling of the facets and shatter markings—it looked a slightly different red to the others, but because of the nature of the mounting little else other than a vertical sighting in a stone of total diameter under 2 mms could be obtained. So here you are and the customer is calling back in a quarter of an hour for the brooch and you have had a lovely time answering the telephone to a probably non-productive caller.

This is not the time for one's friends to suggest that your methods are not ideal! These occurrences cause certain delays with which our gemmological enthusiasts do not have to contend. Gemmologists usually deal with loose stones of reasonable size with nice flat facets. Our testing is usually in second-hand jewellery—seldom at its pristine best, with worn facets usually and if the mount is open at the back it is usually clogged up with a fine debris resulting from the onset of talcum powder, cold cream, hand-lotion, soap and all the rest of the lotions, potions and detergent deterrents with which the modern woman's hands are often in contact. I have never had a second-hand piece of jewellery sent in which has been cleaned by the sender for the purpose of testing.

Another *bête noir* can be the customer who is very important (and knows it) and likes immediate attention, and can hardly bear to wait. I have had such persons who bring in, say, a ruby ring for testing. They are usually very shrewd judges of colour and have bought a ring and spent a considerable time testing it in their own office, only to be baffled by a perfectly clean stone. What they see tells them it is real but reluctantly they have to have a laboratory test. They then expect some immediate magic in ten seconds—as soon as it is held under the microscope they ask, "Is it O.K.?" even before one has focused the thing! However, life is not all like that, but most of our customers like to call at least next day for their goods (tested of course).

Having said all this, it now behoves me to settle down to pointing out that despite all the know-how and gadgetry available we cannot always give a definite result while the stone is in a setting. This may seem a little feeble, but in actual fact we seldom ask to have a stone taken from its setting and if we do we usually state our opinion beforehand in order not to appear wise after the event.

Mostly, when we ask for a stone to be taken from a setting, it is a very small synthetic corundum where the curved striae (if any) are running parallel to the girdle and setting. Other difficult cases can be backed baguette colourless stones in a sunken setting precluding refractometer work—these are quite a trial to prove without any doubts lingering.

At one time when we had a colourless cluster surround to a coloured centre in brooch or ring, we could safely say that the colourless stones were not diamond, and usually the customer was not further interested, since money matters.

Nowadays, we usually get asked what the colourless stones are, and surprisingly quite a large number of colourless/white sapphires in Ceylon jewellery are natural sapphires, which rather goes against the usual run of colourless sapphires, which are usually synthetic.

Quite recently we had a pale-pink stone set in a very ordinary

4-claw gold ring. No shoulder stones—just a straight-forward native-cut, slightly lumpy, rounded, cushion-shaped stone. At first glance it could be a fancy spinel, a tourmaline or perhaps a pink topaz. Doing the job the wrong way round, according to my learned friend, I looked at the stone through the microscope. Except for doubling of the back facets—a suggestion of a D R of about ·009—that was all. It could not be topaz, since topaz does not easily or readily show D R. It was not tourmaline, because the bi-refringence was too small, and it did not quite have the typical colour of synthetic or natural pink sapphire. A horrid thought crossed my mind—Taafeite. Fortunately for the peace of the laboratory, it did in fact yield a very positive D R for sapphire. My friend, who did not like my method of approach, would have been vindicated by this since he would have put it on a refractometer first of all. Unfortunately, I have a fetish for trying to pin things down by look, colour, heft, and then microscope to find D R, inclusions, dichroism, shatter-marks, etc. This pink stone ring set me back a few minutes in probing, but now I had to get started and do the obvious, test for synthetic or genuine. Back to the microscope and a dish of methylene iodide. The stone was very clean; in fact, after quite a lengthy session of turning and turning the stone in the ring, lowering the condenser, closing the diaphragm and doing all kinds of useful manoeuvres, I came to a full stop. The stone was a clean pink sapphire with not a sign of curves or bubbles, or any feature whatsoever appertaining to natural. After half an hour of concentrated study under ideal conditions, refiltered liquid, cleaned eye-pieces, objectives and mirror, I changed my mind several times and then gave it up from a microscopic point of view.

One test we often use as a subsidiary is the well known phosphorescence after fluorescence under X-ray of synthetic ruby and pink sapphire. Here, at least, we would get a lead—but no, the stone was completely inert. So it could be genuine. Unfortunately the phosphorescence was only useful to confirm a synthetic whereas the reverse was not so. Our other refinement is to take an immersion contact photograph, hoping, as is so often the case, that structure-lines not readily visible to the naked eye would be revealed by the sensitivity of the film. Once again the result was negative. Somewhat reluctantly we telephoned the customer to ask him to take the stone out.

After the stone was taken out, we found a slight indication of "treacle" and, I think, if my memory serves me, a few lines of silk. This was not a stone suitable for the diploma examination. We returned it to our customer finally certified as genuine.

Trouble seldom comes in small doses, for a short while after we had a succession of small insignificant rings with microscopic stones in the centre of clusters or as cluster surrounds, and suddenly it seemed as if we were continually asking for stones to be taken out of their settings. However, when one considers we tackle hundreds of items a month of mounted stones, our record is very good.

Recently, a rather rubbed brown cabochon stone in a ring with a reasonable ray to the stone came in for test. At first glance the stone looked a quartz cat's-eye, by the coarse nature of the ray. However, as the stone was worn by bad usage, it could be partially the reason for a poor chrysoberyl looking like quartz. The stone was backed; this prevented one looking at the back of the stone for a hint of quality.

However, the very useful distant vision reading method of taking a refractive index soon solves the question of quartz or chrysoberyl cat's-eye. Maybe I am going a long way round to bring the point home, but the telephone rang whilst I was looking at the stone in question, and having dealt with that matter I returned to the stone, put a spot of liquid on the refractometer and took a spot reading. I saw quite a reasonable changeover light bar at 1·74 which seemed reasonable enough—completely divorcing it from quartz. Automatically, I turned the spot intensity lamp on and tried to see the chrysoberyl absorption spectrum and could not. I was not surprised; there was a lot of glare from a reflected light (the stone was backed). Something did not seem quite right, so I took the distant vision again and got a good quartz reading!

Then the penny dropped—after answering the telephone I pulled the refractometer towards me and put on methylene iodide as a contact liquid (I have two dropping bottles and two refractometers). The methylene iodide gave a good spot pattern for itself and the quartz being rubbed it did not react as strongly as it should.

There seems to be some sort of moral here about keeping bottles separate, but actually at the moment of writing we are threatened with a telephone strike at night. Well, all I say is, let us have it by day and get our testing done without interruptions.

# Gemmological Abstracts

HARRISON (E. R.) and TOLANKSY (S.). *Growth history of a natural octahedral diamond.* Proc. Roy. Soc. London, Ser. A, 1964, 279, pp. 490-496.

The pressure and temperature conditions under which natural diamonds grow is still largely unknown. Crystal growth appears to have taken place in layers which often do not lie in crystallographic planes with simple indices. R.A.H.

STEVENSON (P. C.). *Diamond and its origin—new approaches* (Presidential address). Mercian Geologist, 1965, 1, No. 2, pp. 79-88.

The properties of diamond are reviewed and its terrestrial and meteoritic occurrences are described. The conditions for the production of synthetic diamond are considered, and are related to the temperature and pressure postulated for the Earth's upper mantle and to the global distribution of diamonds.

3 figs. R.A.H.

STEINERT (R.). *Suesswasserperlen und Zuchtperlen in Mitteleuropa.* Fresh water and cultured pearls in central Europe. Zeitschr. d. deutsch. Gessel. f. Edelsteinkunde, 1965, 52, pp. 28-30.

During the Middle Ages many pearls were found in Central European rivers, especially in Saxony and Northern Germany on the Lueneburg Heath. Nuns used pearls for precious embroidery and the squires were plagued by pearl thieves. Many pearls were found. It is known that in one year, in 1706, in two rivers only in the Lueneburg Heath area, 295 "ripe" pearls were found. Just as many were found in Saxony and Bavaria, but during the 17th and 18th centuries the industry decreased and it was supposed that the pearl oysters had died, although there are still some pearls found in a few rivers. In the twenties Riedel started to produce cultured pearls in Austria in the "Doblbach" (Dobl river) according to the then Japanese method. He operated on about 150 oysters per year. After his death in 1935 the plant was auctioned. Only 80 pearls were found, but also 400 pearls which were not grown sufficiently yet and would have reached their full beauty a few years later.

E.S.

BANK (H.). *Zur Diagnostik der Edelsteine.* Diagnosing gems. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1965, 52, pp. 17-28.

The author suggests testing gems using mainly their refractive index and specific gravity and preparing a diagram from these two physical properties of each stone. The method is explained with two examples, a tourmaline and a beryl. There are eight diagrams shown and there is also a bibliography.

E.S.

KLING (W.). *Die chemische Zusammensetzung der Glasimitationen.* The chemical composition of glass imitations. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1965, 52, pp. 13-17.

The author shows the relation between the chemical composition of glasses and their properties as gem imitations. As the atomic weight of the oxides of the elements used is increased, so the density and the refractive index of the imitation glass also increases. Colouring substances are then added.

E.S.

SCHLOSSMACHER (K.). *Naturbernstein und Pressbernstein.* Natural and pressed amber. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1965, 52, pp. 10-13.

Pressed amber is produced from very small carefully cleaned pieces of amber, usually sorted according to colour, which are heated under hydraulic pressure to about 200°-250°C in vacuo. The material produced has about the same homogeneity as natural amber. A useful method of differentiating between the two is to polish the stones with an oily woollen cloth and some polishing material like chalk till it is fairly hot. Natural amber becomes smoother and shinier while pressed amber will become matt in places. There is some difficulty about the nomenclature, as according to German law it must be clearly stated whether the amber is pressed or natural. E.S.

BANK (H.). *Systematik der Edelsteine auf kristallchemischer Grundlage.* Systematic classification of gems based on their crystal chemistry. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1965, 51, pp. 23-33.

The article starts with a historical survey of classification. In

1802 gems were classified as gems for jewellery, gems used in medicine and gems used in ornaments. In 1860 gems were subdivided into precious and semi-precious gems, each category again subdivided according mainly to value. There were various other suggestions, mainly classification according to the chemical composition. The author proposes the following main categories, which can then be sub-divided: (1) elements, (2) sulphides, (3) halogenides, (4) oxides, (5) (a) carbonates, (b) borates, (6) (a) wolframates, (b) sulphates, (7) phosphates, (8) silicates, (9) organic compositions. A bibliography is given.

E.S.

THURM (R.). *Ein neues Polariskop und Konoskop.* A new polariscope and conoscope. Zeitsch. d. deutsch. Gesell. f. Edelsteinkunde, 1965, 51, pp. 38-42.

A 40-watt lamp is used as a light source. Above this lies the polarizex, which is a polaroid filter, and above this is the lens on a rod; then comes the analyser and a lens, both of which can be rotated and adjusted in height to suit the size of the stone examined. Bibliography.

E.S.

BANK (H.). *Die Smaragdsynthese von Hermann Wild* 1912. The emerald synthesis by Hermann Wild in 1912. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1965, 51, pp. 43-47.

Wild synthesised emerald in 1912. This synthesis was described a year later by Brauns and in 1914 by Michel. The crystals produced were only 1 mm long, some were transparent, some had tiny inclusions, the specific gravity was 2·654. Photographs of these synthetic emeralds are reproduced.

E.S.

DENNING (R. M.). *Directions of no-image doubling in crystals.* Gems and Gemology, 1965, 10, XI, pp. 299-301.

Discusses the "doubling of the facet edges" seen in doubly refractive stones, and mentions the difficulty of this effect being seen in topaz. It is explained that no doubling will be seen when the view is taken along an optic axis nor when viewed through any facet which is parallel to an optic axis in uniaxial stones or when viewed along either $\alpha$, $\beta$ or $\gamma$ in biaxial stones. R.W.

GÜBELIN (E. J.). *Maw-Sit-Sit proves to be jade-albite.* Gems and Gemology, 1965, 10, XI, pp. 302-308.

Further experiments on the composition of this stone are recorded. Use is made of an electron micro-probe analyser, which is described, on the green mineral which forms the colouring of Maw-Sit-Sit. The results imply that this mineral has a chemical formula corresponding to Na (Fe,Cr,Al) $Si_2O_6$, and that it has 10% of $Cr_2O_3$, and may be said to be a chrome jadeite. From these experiments Maw-Sit-Sit may be logically called a jade-albite.
4 illus. R.W.

GÜBELIN (E. J.). *Maw-Sit-Sit.* Gems and Gemology, 1964/5, 8, XI, pp. 227-238 and 255.

A similar version of the article published in the Journ. Gemmology (No. 10, Vol. IX, April 1965), but with different half-tone illustrations.
17 black and white and 1 coloured illus. R.W.

POUGH (F. H.). *Mallorca and imitation pearls.* Gems and Gemology, 1965, 9, XI, pp. 273-280.

Describes a visit to an imitation pearl factory in Mallorca (Majorca). Various qualities of imitation pearls are produced. The better types, which have a glass core, are coated with a number of "coats" of essence, one of which is fish-scale essence (essence d'orient), the others being synthetic essences. A new method of making the glass beads involves the use of a slurry coated wire which allows the glass beads after forming to be easily slipped off the wire. This avoids the dissolving out of the wire by acid.
10 illus. R.W.

DARRAGH (P. J.); SANDERS (J. V.). *The origin of the colour in opal based on electron microscopy.* Gems and Gemology, 1965, 10, XI, pp. 291-298.

A similar report to that published in the Australian Gemmologist. (Abst. Journ. Gemmology, pp. 402/3, No. 11, Vol. IX, July 1965).
7 illus. R.W.

CROWNINGSHIELD (R.). *Developments and highlights at the Gem Trade Lab. in New York*, Gems and Gemology, 1964; 1964/5; 1965, 7, 8, 9 and 10, pp. 214-218; 242-246; 265-272; 309-312.

Descriptions are given of a number of stones tested in this laboratory. Outstanding items mentioned are a change-colour tourmaline, a green topaz, a chromeless (?) emerald, odontolite, a carved psilomelane, flame-fusion synthetic rubies, a grey-blue kornerupine and a yellow apatite cat's-eye. A "piggy-back" diamond ring in which two stones are mounted on one another is mentioned and there are notes on the examination of a number of "painted" diamonds. Brief details are given on the examination of a synthetic alexandrite and on other specimens of synthetic stones of garnet type.

45 illus. R.W.

LIDDICOAT (R. T.). *Developments and highlights at the Gem Trade Lab. in Los Angeles.* Gems and Gemology, 1964; 1964/5; 1965, 7, 8, 9 and 10, XI, pp. 219-221; 247-253; 281-286; 313-317.

The laboratory reports on a dyed alabaster and fluorite pink and green bead necklet, a brooch with a frame of tortoiseshell which had a carved limestone figure mounted on it, a drop-shaped pink pearl which had been divided into two to give two half pearls, a chatoyant nephrite called "pigeon's-eye", macro-curved structure lines seen in both a ruby and a sapphire, black serpentine simulating jade and an unusual "painted" jade cabochon mounted in a ring. A periclase was submitted with the request as to whether it was natural or synthetic. This could not be determined but the customer implied that it was synthetically produced.

38 illus. R.W.

POUGH (F.). *New Brazilian source for a well-known gemstone.* Lapid. Journ., 1965, 19, 6, p. 688.

Reasonably clean crystals of alexandrite, which were exhibited in California in the summer of 1965, came from Brazil. The locality, presumably in the Minais Gerais district, is given as Agua Vermehla, with the mine name as Mina de Cristolite. Other crystals of alexandrite from Brazil have also been reported.

S.P.

White (L.). *New beauty in petrified Wood.* Lapidary Journal, 1965, 19, 8, p. 870.

A short account of petrified wood with remarkable examples by the author of colour photography made by using a process described as "reflective light". The areas of petrified wood photographed were about the size of a pin-head. The technique of photographing the small cells found in petrified wood, which give rise to a wonderful play of colour, took a long time, including a year and a half to construct a special camera and find the right lens.

S.P.

Zaveri (C. K.). *The gemstone industry of India.* Lapidary Journ., 1965, 19, 8, p.938.

An interesting account of the less expensive gemstone business in India. It is unfortunate that the author uses the meaningless term "semi-precious" to describe several of the lovely gem materials which India can provide.

S.P.

Neys (A. de). *Diamond cutting through the ages.* Diamant, 1965, 8, p. 49.

A short account in English, Flemish and French.

Herrmann (R. C.). *New discovery of gem quality rhodonite in British Columbia.* Lapidary Journ., 1965, 19, 7, p. 792.

A deposit of gem quality "Inca rose" rhodonite has been discovered near Fulford Harbour, Salt Spring Island, British Columbia.

S.P.

Agee (L. M.). *Asterism in garnets.* Lapidary Journ., 1965, 19, 8, p. 910.

A short account of the largest known placer deposit of garnet in the world, in Idaho, in a small range of mountains between Fernwood and Clarkia. Notes on the cabochon cutting of garnet, in order best to display the phenomenon of asterism, are given.

S.P.

## BOOK REVIEW

BRAGG (L.) and CLARINGBULL (G. F.). *Crystal structure of minerals* G. Bell and Sons Ltd., London, 1965. 70s.

This is volume four of a series "*The Crystalline State*", which Sir Lawrence Bragg is editing. To gemmologists Sir Lawrence, who is director of the Davy Faraday Laboratory at the Royal Institution, is better known as the President of the Gemmological Association and Dr. Claringbull is Keeper of Minerals at the British Museum (Natural History) and senior examiner of the association.

This is an erudite treatise intended partly for present-day degree courses mineralogy and is beyond the scope of most gemmologists. The book brings up to date the work "*The Atomic Structure of Minerals*", written by Sir Lawrence in 1937. A chapter on feldspar has been added by Dr. W. H. Taylor of Cambridge University. In order to keep the book within reasonable bounds, selection had to be made of the crystal structures described and illustrated. It will be essential reading for many mineralogists.

S.P.

# ASSOCIATION NOTICES

## OBITUARY

FRANK HENRY KNOWLES-BROWN

The Council has recorded, with deep sorrow, the death of Mr. F. H. Knowles-Brown, on 30th November 1965 at the age of 68.

Mr. Knowles-Brown, or 'K.B.' as he was affectionately known to his many friends in the jewellery trade, gained his diploma with distinction in 1930, whilst in business with his brother in a retail jeweller's in Hampstead. Upon qualifying as an optician he was elected a Fellow of the Spectacle Makers' Company.

In 1939 he became Vice-Chairman of the National Association of Goldsmiths and was Chairman of that organization from 1941 until 1944. In 1944 he was elected as Treasurer and served in that capacity until 1961.

The Gemmological Association was honoured when he became Chairman in 1946. In 1955 he was succeeded by Sir James Walton, but when Sir James died a few months after his election, the Council of the Association invited K.B. to serve again as Chairman. This he did until May of 1965, when ill health compelled him to give up all his activities. K.B. was a founder member of the Antiquarian Horological Society, and became its first Chairman in 1953, an office he held until 1961.

K.B. thrived upon hard work and endeared himself to many members of the jewellery trade, gemmologists and horologists, by his enthusiasm and dedication to the causes in which he believed. He held strong views on the dignity of the jewellery trade being maintained by high standards. K.B. had a remarkable way of making people feel at their ease — a trait which was greatly appreciated by the many jewellery trade candidates who came before him when he was an examiner to the National Association of Goldsmiths. Above all he had a wonderful sense of humour and it is perhaps this that caused him to be regarded with affection by those whom he inspired to do hard work. He had leadership, the ability to inspire, and a great sense of fun. Although a competent optician and jeweller, he was more of a philosopher than a man of business, and this made him all the more lovable. K.B. was a distinguished person who will be sadly missed.

## GIFTS TO THE ASSOCIATION

An example of the Juliana cut, in white synthetic spinal, from Don Hartley of E. Detroit, Michigan.

## COUNCIL MEETINGS

A meeting of the Council of the Association was held at Saint Dunstan's House, Carey Lane, London, E.C.2, on Tuesday, 14th September, 1965. Mr. Norman Harper, the Chairman, presided, and welcomed Mr. Maurice Asprey, who was attending his first meeting since being co-opted a member of the Council.

Sixty ordinary members, eight probationary members were elected and thirty-eight diploma holders were elected to Fellowship (as set out below).

The Council discussed the report of the 1965 examinations (details are set out on p. 36) and heard from the examiners, who were also present at the meeting, of the care that had been taken in assessing the papers to ensure that no injustice had been done to any candidate. It was decided to examine the conditions under which prizes were awarded in the examinations at the next meeting of the Council.

At the meeting held on Tuesday, 14th September 1965, the following were elected:—

TO FELLOWSHIP:

Jones, Robert J., Ross-on-Wye, Hertfordshire. D.1965
Smith, Stephen S., Hull, Yorks. D.1965

TO PROBATIONARY MEMBERSHIP:

Banks, David F., Lawrence, Kansas, U.S.A.
Forman, Stephen Michael, Manchester, 8, Lancs.
Hartmann, Carolus J., Eindhoven, Holland
Hill, Raymond J., Burlington, Ont., Canada
Major, Peter Wm. E., Horsted Keynes, Sussex
Mure, Patrick, Geneva, Switzerland
Wetton, Roy Nevil, Alrewas, Staffs.
Wright, Rodney B., Maurewa, Auckland, New Zealand

TO ORDINARY MEMBERSHIP:

Arends, Henri, Amsterdam, Holland
Bass, Paul, Purley, Surrey
Baxter, James, Edinburgh 9, Scotland
Bhavnani, K. J., Bombay 1, India
Bowley, Malcolm A., Bukuru, N. Nigeria
Boyd, Arthur F., Christchurch, New Zealand
Brown, Judith A. (Miss), London, N.W.8
Buchanan, Kenneth R., Tulsa, Oklahoma, U.S.A.
Bull, Rudolf, Lucerne, Switzerland
Cherns, Jack J., London, N.W.3
Cooper, Revd. S. B. Nikon, Staines, Middx.
Craft, Herscu R., Caracas, Venezuela
Culver-James, Frederick W., London, S.W.17
Cutting, Derrick C. A., Montreal, Quebec, Canada
Dam, Kristian F. J., Watford, Herts.
Dani, M. N., Bombay 4, India
Delplace, Claire (Mrs.), Brussels 15, Belgium
Devries, Jacob, Curacao, Neth. Antilles
Dodd, Albert V., Elko, Nevada, U.S.A.
Dudek, Clelan F., Pendleton, Oregon, U.S.A.
Eales, Adrian H., Lusaka, Zambia

Farringer, Dale E., Annandale, Va., U.S.A.
Firth, Roy, Ambleside, Westm.
Fleming, Clifford Jack, Southsea, Hants.
Gaal, Robert, Los Angeles, Calif, U.S.A.
Gerboth, Niles R., Los Angeles, Calif., U.S.A.
Goldsby, Reginald H., Bradford 9, Yorks.
Haenni, Heinz, Zurich, Switzerland
Hartley, Donald W., Detroit, Michigan, U.S.A.
Hutchinson, Ronald F., Akwatia, Ghana
Jemison, Edward T., Tokyo, Japan
Johnson, Terence R., Salisbury, Rhodesia
King, A. I., Jersey, C.I.
Klaassen, Ferdinand, 's Hertogenbosch, Holland
Kotani, Toshiji, Osaka, Japan
Levy, Marion D., Atlanta, Georgia, U.S.A.
Lewis, Curtis W., Raleigh, N. Carolina, U.S.A.
Loung, George R., Georgetown, Demerara, British Guiana
Luder, Johan G., The Hague, Holland
Lunsford, David W., Huntsville, Alabama, U.S.A.
Mano, Koichi, Osaka, Japan
Moyse, Edith (Miss), Toronto, Ont., Canada
Mumford, Ronald B., Kuala Lumpur, Malaysia
Myer, Lewis L., Huntington Beach, Calif., U.S.A.
Nussbaum, Eric E., Geneva, Switzerland
Owen, Robert E. L., Portmadoc, Caerns.
Prieler, Willy, Vienna, Austria
Radcliffe, William A., Johannesburg, Transvaal, S.A.
Saunders, Gordon N., Kitchener, Ont., Canada
Saxe, John R., (Green Bay), Wisconsin, U.S.A.
Sitzer, Danial H., New York, U.S.A.
Smith, Roger, Keynsham, Somerset
Smith, Wilbur E., Washington, U.S.A.
Stoll, F., Florida, Transvaal, S. Africa
Thornton, Timothy M., Cranbrook, Kent
Treece, Walter E., Pittsfield, Mass., U.S.A.
Watney, B. M., (Dr.), London, N.W.3
Weisler, Joseph, New York, U.S.A.
West, Lionel W., Hatfield, Herts.
Westall, Erica (Miss), Cape Province, S. Africa

TRANSFERS FROM ORDINARY AND PROBATIONARY MEMBERSHIP TO FELLOWSHIP:

Bana, Homi R., Bombay, India
Brimelow, William, Southport, Lancs.
Carr, Philip W., Blackburn, Lancs.
Clough, M. B., Bolton, Lancs.
Cole, Kenneth C., Salisbury, Rhodesia
Cook, Murray E., Vancouver, Canada
Cooper, S. B. Nikon, (Rev.) Staines, Middx.
Drew, William H., Wellington, New Zealand
Franke, Lois E. (Miss), Hollywood, U.S.A.
Gadebusch, Dedo A., Koln, Germany
Gauntlett, Gillian (Miss), Haslemere, Surrey
Hanebach, Stanley, Scarborough, Canada
Hanna, Joe D., St. Louis, U.S.A.
Holmes, Milton J., Owen Sound, Canada
Imai, Taichiro, Tokyo, Japan
Inkersole, Denis, London

Jones, Robert J., Ross-on-Wye
Kerez, Christoph J., Baden, Switzerland
Lee, Joseph I., Raleigh, U.S.A.
Lewis, Leslie John, London
Millar, Maurice A., Dannevirke, New Zealand
Moore, Henry, Solihull, Warwicks.
Myers, Leah M. (Miss), Sydney, Australia
O'Donnell, Arthur L., London
Oesterlin, Wilhelmina P. (Mrs.), Mosman, Australia
O'Grady, Royston J., Stafford
O'Shea, John P., Worthing, Sussex
O'Sullivan, Timothy, Dublin, Eire
Riding, Frank, Preston, Lancs.
Simmonds, Stephen M. J., London
Smith, Stephen S., Hull, Yorks.
Taylor, Allan M., Melbourne, Australia
Taylor, Andrew Wm., Exeter, Devon
Thomas, Graham A., Mold, Flints.
Ungar, Michael S., Ruislip, Middx.
Wetton, Roy Nevil, Burton on Trent, Staffs.

* * * *

A meeting of the Council of the Association was held at Saint Dunstan's House, Carey Lane, London, E.C.2. on Tuesday 9th November, 1965. The chairman, Mr. Norman Harper, presided.

The following were elected:—

FELLOWSHIP

Allan, Christine M. (Miss), Stanway, Essex
Allan, Ian E., Birmingham 28, Warwicks.
Armour, Anthony J., Beckenham, Kent
Bailey, Ronald, Dudley, Worcs.
Barratt, Susan M. (Miss), Birmingham. 11, Warwicks
Baxendale, Paul D., Birmingham 16, Warwicks.
Beaumont, Gordon, Huddersfield, York.
Bethel, George C., Hiaeah, Florida, U.S.A.
Bird, Albert J., Liverpool, Lancs.
Cannawurf, Christa (Miss), Frankfurt, Germany
Clarkson, Roland N., Shepperton, Middx.
Cross, William G. (Dr.), Moor Park, Middx.
Edmunds, Ronald C., Wembury, Devon
Farley, Peter F., Bath, Somerset
Frost, Allan R., Llanblethian, Glam.
Gasser, Josef, Lucerne, Switzerland
Goode, Alastair R., Solihull, Warwicks.
Heaven, John P., Birmingham, Warwicks.
Hesse, Kenneth R., Fallbrook, Calif., U.S.A.
Hogervorst, Lia Angelique (Miss), Gouda, Holland
Jackson, Christopher D., Chipperfield, Herts.
Jones, Alfred, Coventry, Warwicks.
Laing, John, London, S.W.12.
Lewis, Kenneth C., Rainham, Essex
Mole, Christopher J., Birmingham
Morley, George K., Wymondham, Norfolk
Nicolau, Jose G., Madrid, Spain
Ogden, Glendower M., Harrogate, Yorks.
Parker, Lovell W., Dublin, Eire
Podhorodecki, Josef, Sherwood, Notts
Randle, Rodney C., Birmingham, Warwicks.
Sher, Morris M., Glasgow S.3, Scotland
Stern, Marion J. (Miss), Wembley Park, Middx.
Thomson, Harry, Lichfield, Staffs.

Toole, John Lewis, Stouffville, Ont., Canada
Wheeler, Jennifer M. (Miss), Melbourne, Australia
Bridges, Reginald J., Chigwell, Essex

PROBATIONARY MEMBERSHIP

Arbeid, Martin J., London, S.W.1.
Bates, Denis Wm., London, S.W.9.
Berwick, Keith J., Portsmouth, Hants.
Blowfield, Ian S., Pinner, Middx.
Boers, Leonie, Naarden, Holland
Chalfen, Brian J. L., London, N.W.10.
Chamberlain, David Alan V., Wallasey, Cheshire
Cohen, Raymond, London, N.14.
Cutts, Michael J., Surbiton, Surrey
Dando, Nigel J., Bath, Somerset
Davies, Derrick K., Harlington, Middx.
Lazarus, John S., Edgware, Middx.
Lowe, Peter J., Chester
McBryde, Michael G., West Harrow, Middx.
Miller, Elizabeth A. (Miss), Wolverhampton, Staffs.
Miller, Fanny (Mrs.), Toronto, Ont., Canada
Newham, Frank Edward, London, E.10.
Pryke, Christine M. (Miss), Colchester, Essex
Rees, David, Hounslow, Middx.
Russell, Madeleine (Miss), Ilford, Essex
Sanitt, Neil, London, N.W.10.
Spicer, Malcolm F., Gerrards Cross, Bucks.
Ward, Michael I., Enfield, Middx.
Halls, Norman E., London, E.6.

ORDINARY MEMBERSHIP

Abubaker, Haji, Karachi, Pakistan
Bradbery, Jean I. (Mrs.), London, N.W.3.
Burnstein, Burton A., Los Angeles, Calif., U.S.A.
Caspart, Peter, Mainz/Bretzenheim, Germany
Chan, George K., Kowloon, Hong Kong
Chartier, H. P., Esher, Surrey.
Cramer, Marvyn H., San Francisco, Calif., U.S.A.
Cunningham, J. Lester, Chicago, Illinois, U.S.A.
Dittrich, Marion, Toronto, Canada
Dunkley, Peter J., Coventry, Warwicks.
Forman, Evelyn M. (Mrs.), Buckingham
Gani, Usman H., Karachi, Pakistan
Gillon, Mary (Mrs.), Glasgow, Scotland
Hammond, Dudley E., Vancouver, Ont., Canada
Huddlestone, Roy V., Melton Mowbray, Leics.
Hunter, Wilfred, Ambleside, Westm.
Imai, Kiichi, Tokyo, Japan
Jayasundera, A. B., Badulla, Ceylon
Karpovitch, Stefanie S. (Miss), New York, U.S.A.
Klassen, Ferdinand, 's Hertogenbosch, Holland
de Leon, Anthony, London, W.6.
Mendis, Cynthia M. (Mrs.), Kingston on Thames, Surrey
Miller, William H., Wolverhampton, Staffs.
Mitchell, Kenneth G., London, S.E.15.
Nixon, Rolf, Washington, U.S.A.
Pearce, David M., Colchester, Essex
Piguet, John A., Le Sentier, Switzerland
Regan, James P., London, N.17.
Stoll, Kurt P., Hong Kong
Sun, Loo Chin, Penang, Malayasia
Wright, Dorothy Willow (Mrs.), Marville, France
Osmond, Leslie P., Akwatia, Ghana

The Council considered the conditions governing the award of the Tully Memorial Medal and instruments prizes presented by Messrs. Rayner & Keeler, Ltd. It was decided that the medal should be awarded to the candidate in the diploma examination who submitted the best papers, which were of sufficiently high standard to merit the award, and that the Rayner Preliminary prize and the Rayner Diploma prize of gem-testing instruments (made by Rayner or Carl Zeiss (W. Germany)) should be awarded to the candidates submitting the best papers of sufficiently high standard in both examinations who, in the opinion of the Council, are members of the jewellery industry. The Council's decision in all matters appertaining to examination results and the award of prizes would continue to be final.

It was reaffirmed that because of the great care taken in assessing and re-assessing the examination papers any subsequent reconsideration of scripts after the results had been announced was not necessary.

The Council also decided not to depart from the long standing practice of not publishing suggested examination answers or of the marks obtained in the examinations.

Appreciation of the generosity of Messrs. Rayner & Keeler, Ltd., for continuing the award of instrument prizes and the work of the Honorary Branch secretaries was recorded.

## TALKS BY MEMBERS

Blythe, G. A. "Gemstones"; Basildon Inner Wheel Inter-Club, Southend-on-Sea, 21st October 1965.

Coop, N. (Miss): "Gemstones", Townswomen's Guild, Luton Ichnield, 6th September, St. Paul's Girls School, League Social Club, 21st October, Barnes Club for the Blind, 1st November, Senior Wives' Fellowship, London Branch, 1st December, 1965

Hudson, F. "Gemstones"; Electrical Association for Women, Dunfermline, 5th October, 1965; Women's Guild, Holy Trinity Church, Dunfermline, 11th October, 1965; Trefoil Club, Dunfermline, 4th November, 1965; Scottish Gliding Union, Scotlandwell, 13th November, 1965; Ladies' Circle, Dunfermline, 19th January, 1966.

Jones, T. "Gemmology"; Abingdon Rotary Club, Abingdon Inner Wheel, Bicester Inner Wheel, October and November.

Langton, E. W. "Diamonds"; Highgate Young Conservatives, London, 15th October 1965.

## PRESENTATION OF AWARDS

Sir Cyril Dyson, President of the National Association of Goldsmiths, the retail jewellers' organization, presented the Diplomas and prizes to the successful students who sat for the Gemmological Association's 1965 examinations. Ten students had qualified with distinction in the Diploma examinations, and two Tully medals were given. This is only the fourth time in the Association's history that two of the medals have been given in one year. One of the winners was

Miss Christa Cannawurf of Frankfurt, who came from Germany to receive the medal. The other winner was Mr. Andrew W. Taylor of Exeter.

Introducing Sir Cyril Dyson, Mr. Norman Harper, the Association Chairman, said that there were successful students present in the hall from Japan, Germany, Holland and Eire, as well as the successful British students. The Chairman commented "1965 has been a record year. The Association has had the greatest number of course enrolments, the biggest ever examination entry and the most enrolment from overseas. More new members have been elected than ever before and tonight is the biggest gathering we have ever had at Goldsmiths' Hall".

Mr. Harper acknowledged the indebtedness of the Gemmological Association to the National Association which, in 1908, had been responsible for setting in train the educational scheme that led to the teaching of gemmology. He felt sure that it was a matter of pride and satisfaction to the N.A.G. to realize that their sister organization had been so successful.

In asking Sir Cyril to present the prizes, Mr. Harper mentioned that Sir Cyril had been to 10 Downing Street as a result of an invitation to see the clocks there that he had received from Mrs. Wilson on the occasion of the opening of the International Watch and Jewellery Trade Fair at Earl's Court.

Sir Cyril, after giving out the certificates and prizes, recalled how in his father's time a stone was either a natural stone or a piece of glass, a pearl was either real or imitation. Today, with all the synthetic stones and cultured pearls about, life was much more difficult for the jeweller, he said, and a trained gemmologist was a tremendous asset to any jeweller. He explained that he was an horologist and an optician and only had a Preliminary certificate for gemmology, but it was impossible to study everything at once. He spoke to the audience about the 300 clocks in Windsor Castle. In concluding, he said he hoped that the Diploma winners would not only continue their work but would derive satisfaction from the very fascinating and absorbing subject.

Thanking Sir Cyril, Mr. B. W. Anderson said it was gratifying that they had someone to present the prizes who had done so much for the retail jewellery trade. Students had been told that after gaining their Diplomas, they were in a position to start learning something about gemmology. There was always something new which needed studying again and the advantage was to know what to do about it. He wondered if it was not possible for some organization to be set up to pass round interesting gemstones, as so many students after they had qualified lacked the opportunity to handle many stones.

At the end of the meeting the Chairman expressed the Association's thanks to the Worshipful Company of Goldsmiths for once again lending their beautiful Hall for the Presentation.

## HERBERT SMITH MEMORIAL LECTURE

The 1965 Herbert Smith Memorial Lecture was given by Mr. Robert Webster, F.G.A., at Goldsmiths' Hall, London, on 9th November. Mr. Norman Harper, chairman, presided, and introducing the lecturer referred to his distinguished work in the cause of gemmology.

Mr. Webster commenced the lecture by referring to the artificial colouration of diamonds by bombardment with particles of atomic size. He recalled that diamonds coloured green by radium emanations had been known since 1912, and that some diamonds so coloured were still occasionally met with. Their residual radioactivity allowed easy distinction and they presented no problem of identification.

Although as early as 1942 reference had been made, he said, in scientific literature to the artificial colouration of diamonds by atomic bombardment, it had not been until well after 1950 that the process became a commercial proposition.

The first of these methods had been by the use of a cyclotron which emitted high speed atomic particles. This treatment had produced a green colour only skin deep. Subsequent heat treatment had produced a golden brown or yellow colour in the greened diamonds. This method seemed now to have been generally superseded by treatment with fast neutrons using an atomic reactor. The colour changes were again similar; green, or after subsequent heat-treatment golden or yellow, the stones in this case being coloured throughout. The third type of colouration was by fast electrons and here the stones, again only coloured skin-deep, were turned to an aquamarine or to a bluish green colour.

Despite the fact that the trade didn't quibble about the colour alteration which produced the sky-blue zircons and the pink topazes, the alteration in the colour of diamonds was considered in a different light and the gemmologist was expected to identify those diamonds which had been artificially coloured. Mr. Webster then went on to describe the tests which revealed this artificial colouration.

Mr. Webster next went on to talk about new sources of gem material. As far as the corundum gems were concerned, he said, there had been some new sources of supply: Finland, Mysore in India, and most important in Tanzania. The ruby crystals in green zoisite from just north of Kilimanjaro, in Tanzania, normally used together in the rock as an ornamental stone, had produced small cut stones. Further south, along the Umbo River, sapphire and ruby had been recovered which produce cut stones; the sapphire often of fancy colour matching the rhodolite garnets found in the same locality. Verneuil's flame fusion method still seemed to be the only commercial method of synthetic corundum production, and the only improvements seemed to be in the automation of furnace feeds and by, in one case, using crushed Montana sapphire as a feed material. The newer techniques such as flux-melt and hydrothermal methods of growing ruby crystals are mostly used for growing maser and laser crystals, and such products had not as yet become a gemmological problem.

It was with the beryl group, particularly the emerald, that a number of new aspects had come up recently. Recent finds of green beryl in Brazil needed comment, he said. Recently some green beryl of pale emerald colour had been examined in this country and in the United States. The material did not seem to show a typical absorption spectrum and was considered chromeless and therefore not emerald. Some people, however, proposed to take it as a borderline case, and on the grounds of the colour suggested that it should be called emerald. To further complicate matters analysis both in the United States and in this country had disclosed a trace of chromium in the composition. This material was said to come from the district of Salininha, in the municipality of Pilao Arcado in Bahia, Brazil. Some similar material seemed to be coming from Brumado in the same State.

What was becoming of increasing importance, he went on, was the synthetic production of emerald. Until last year the synthetic emerald made by Carroll Chatham was the only commercial production. Now we had the French type made by Pierre Gilson and the Zerfass German production, though these did not at the moment seemt to have much commercial significance. Then quite recently the Linde people of America had published details of their hydrothermal production, but did not as yet seem to have marketed them. No specimens of this emerald had been seen in this country as yet.

Later in his lecture he spoke about non-nucleated cultured pearls which he said were unknown before 1953. They were produced from a freshwater mussel by inserting into the edges of the mantle pieces of graft tissue cut from the mantle of another mussel. This acted as an irritant which then initiated the formation of a pearl which was white in colour, but was usually bun-shaped. These pearls were grown in the freshwater lake Biwa Ko in Japan. They usually showed when an X-ray direct picture was taken, peculiar and characteristic cavities and also a strong yellowish fluorescence under X-rays. When such pearls are cut open the peculiarity of the structures was dissimilar from those shown by natural pearls. A characteristic of this culturing process was that a second crop of pearls might form in the places where the original cultured pearls were formed, and had been removed, as in this method of cultivation the mussel was not killed in the process. Some large pearls have been grown in Australian waters by this method. The characters are similar, but as they were sea-water pearls these did not fluoresce under X-rays.

A new type of nacreous natural pearl was the pink pearl, he said, found in East Pakistan, which had recently been shown in America and London. These were river pearls and were quite pretty and might make a good addition tothe pearl range.

Another innovation was the use of mother-of-pearl beads as the cores of imitation pearls. These had been advertised as "shell-base imitation cultured pearls". The fact that when such pearls are held before a light the "stripes" of the layers of the mothr-of-pearl showed through might give an impression that the beads were thin-skinned cultured pearls.

After question time the chairman thanked Mr. Webster for what had been an outstanding talk and invited the audience to inspect the collection of recent gemmological developments which Mr. Webster had arranged.

Before the lecture, early arrivals had the opportunity of a pre-view, by courtesy of the Goldsmiths' Company, of an exhibition of jewellery by the well-known Swiss designer, Mr. Gilbert Albert.

The chairman expressed the appreciation of the Council of the Association for this facility and for the use of the Livery Hall for the lecture.

## MIDLANDS BRANCH

A meeting of the Midlands Branch of the Association was held at the Imperial Hotel, Birmingham, on 22nd September, 1965. Mr. Norman Harper, the

National Chairman who has also taken the chair of the Midlands Branch this year, presided and introduced the speaker, Mr. Trevor Solomon, F.G.A. Mr. Solomon, who has given several interesting talks to the Branch enchanted his audience by speaking about "Biblical and historical stones".

## WEST OF SCOTLAND BRANCH

Mr. A. Monnickendam, of London, was the guest speaker at a meeting of the Branch, which was held in Glasgow on 14th October. The title of Mr. Monnickendam's talk was "Diamonds in a world of unsettled economy" and it provoked numerous questions, enjoyed both by the speaker and his audience.

## WANTED

Wanted to purchase the following issues of the *Journal of Gemmology*:—

| | |
|---|---|
| Vol. I, II, III, | Nos. 1-8 inclusive |
| Vol. IV, | Nos. 1, 2 and 7 |
| Vol. VII, | No. 5 |
| Vol. VIII, | No. 3 |
| Vol. IX, | Nos. 1, 2, 3, 4, 5, 6, 8, 9 and 10. |

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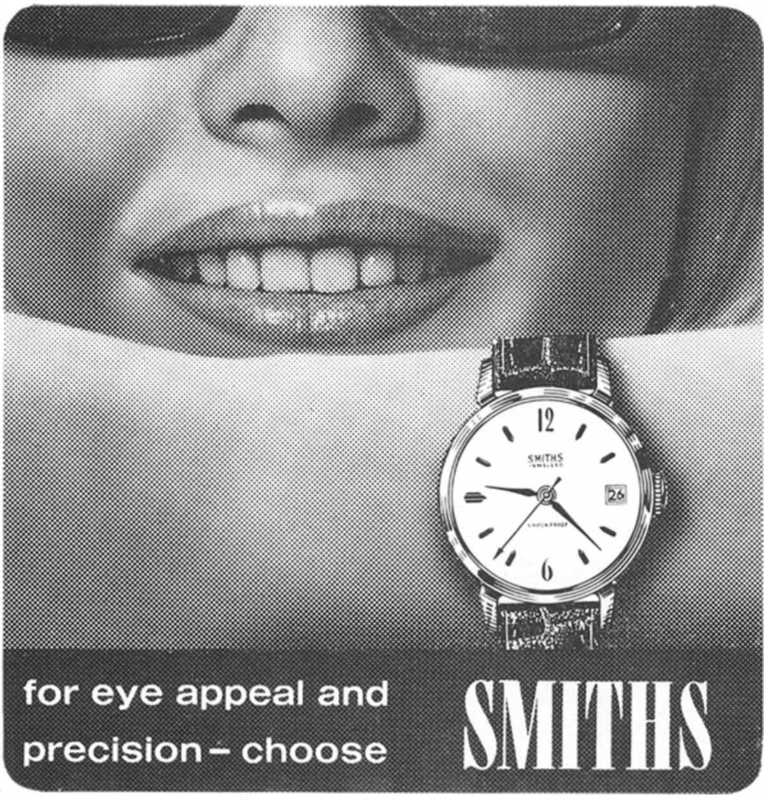


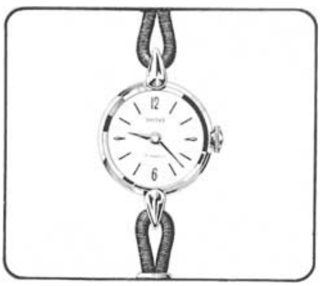

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Vol. 10
No. 1
January 1966

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*Printed by F. J. Milner & Sons Ltd., Brentford & London. 66/18·50*