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and

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ASSOCIATION
OF GREAT BRITAIN

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UNUSUAL GEMS IN JEWELLERY

By P. HINKS

Amongst the fascinating miscellany of jewels sent for sale at Sotheby's during the past season was included a small antique bracelet set with a gay assortment of coloured stones. It was a pretty thing in black champlevé enamel daintily traced with gold feather scrolls. Rapid examination with the lens disclosed that two of the more luridly tinted stones were pastes. Less commonplace, however, was a pale blue stone, its interior wrinkled with cracks and fissures in a curious but not entirely unfamiliar fashion. As I turned it in the field of the loupe, the agreeable violet blue faded to a nondescript capey colour. The refractometer gave the expected reading of 1·54—it was, of course, iolite. I had encountered this stone commercially before, on the last occasion cut as a sphere and supporting the splendidly enamelled figurine of a Pope.

The other problematic stone was of yet more exotic identity. Its deep molasses brown shade seemed to indicate tourmaline, but a more critical examination revealed a reddish twinkle in the heart of the stone suggesting andalusite. The refractometer read 1·675-1·685, and the dichroscope showed two browns, one darker than the other and with a purplish suffusion. The stone was axinite.

It is pleasant to be reminded from time to time that rare stones do occur in the normal course of business, far from the rarified atmosphere of the geological museum, and finding two such species in one ornament must be answer enough to the cry that these things are a waste of the gemmology student's time.

A VARIATION OF THE BECKE LINE EFFECT

By R. K. MITCHELL

I SUPPOSE gemmologists the world over must have examined countless thousands of faceted gems immersed in highly refracting liquids. In most cases they will have peered earnestly through the instrument while racking up and down and watched facet edges change from blurred shadows to clear-cut lines as sharp focus is reached. I am puzzled to know why a certain significant fact of this procedure has only once appeared in print as far as I am able to ascertain, and then in German*. I am even more amazed that the significance of the phenomenon described below should have escaped my own notice until a short while ago. It is an observation of the simplest kind, yet other gemmologists I have mentioned it to seem to have been as unaware of it as I was.

Friedrich Becke, the eminent Austrian petrologist, contributed a great deal to the science of petrology and in the field of thin section rock microscopy his name will always be linked with the so-called " white-line " effect. Briefly, he observed that when two transparent minerals (or mineral and balsam) are side by side in a rock section, if the microscope objective is raised out of exact focus a line or edge of light will be seen to move towards the optically denser of the two media.

This Becke line effect is known to most gemmologists, but somehow it is not an easy test to apply to cut gems, probably because a girdle edge is far less sharp than the edges existing in thin rock sections. The observation described below must be regarded as a supplementary effect due to the same cause as the Becke phenomenon and closely connected in this respect with the Anderson immersion contact method of R.I. comparison.

Earlier this year I was examining two red stones by microscope. The stones, both of which looked like fine Burma rubies, were immersed in methylene iodide (R.I. 1·742) and were remarkably clean. The first one examined yielded no obvious inclusions but there were signs of the treacly colour distribution of the Burma ruby. To make this more obvious I lowered the substage condenser and closed its diaphragm to a very small aperture—a trick which often helps to throw into prominence such things as curved colour

*The phenomenon is described by Prof. K. Schlossmacher in his book "*Edelsteine und Perlen*", published in 1954, and among German-reading students it is known as the Schlossmacher effect.

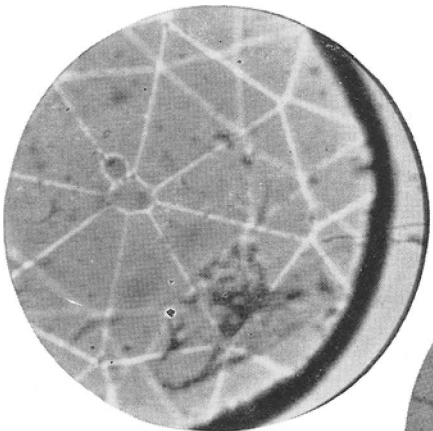


FIG. 1. *Ruby in methylene iodide. Focus is in the liquid.*

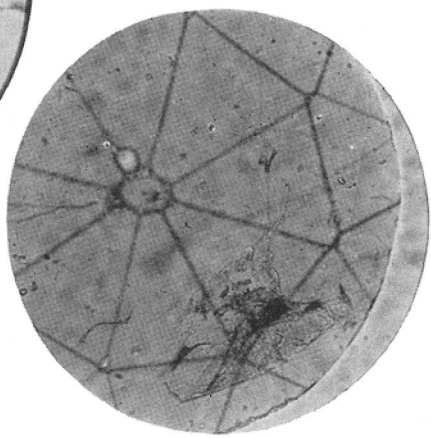


FIG. 2. *The same ruby when focus is lowered into the stone. Note how inclusion shows up under these lighting conditions.*

zoning in synthetics and so on. This brought the " treacle " into clear relief and proved the stone a genuine ruby without further test.

Another feature of this stone was the presence of " chatter " or " fire " marks, fine wavy cracks running roughly at right-angles to the facet edges. These were formerly considered to be signs of a synthetic corundum since they are thought to be due to the " pull " of rapid polishing with fine diamond powder. However, to-day many lapidaries use diamond on natural ruby and, unless care is exercised, the real stone may also show " chatter " marks.

Examining these cracks and racking the focus of the microscope up and down I noted quite subconsciously that the out-of-focus facet edges appeared as blurred white lines when the focus was above them, fig. 1, and then focused to black satisfying edges which remained black, blurring more and more as the focus travelled down into the stone, fig. 2. (The stone used for these two

pictures is a Siam ruby, not the Burma stone mentioned in the text.)

Turning to the second stone I racked down to focus and realized at once that something different was happening. The facet edges now appeared black before the focus reached them and became white as it travelled into the stone. A refractometer reading showed at once that this second stone was in fact a red spinel of unusually good colour. In other words its R.I. was *below* that of the liquid.

Further experiment showed that here indeed was a sensitive test which was much easier to apply to cut gems than was the normal version of the Becke-line test. The only rule to remember is that the out-of-focus facet edges appear *black* when the focus of the microscope is in material of *higher* R.I. Thus in ruby (R.I. 1·76-1·77) they were dark when I focused into the stone, while with spinel (R.I. 1·72) the edges were black when the focus was still in the liquid (R.I. 1·742). Just to clarify this—I am speaking of the point of actual focus, not of the nose of the objective.

The effect is much less noticeable when the substage condenser is high or when the iris diaphragm is wide open. Further work showed that the substage condenser could be removed and that best results were obtained when the diaphragm allowed only a thin pencil of rays to reach the stone.

An immediate parallel with Anderson's immersion contact technique occurred to me, and I was delighted to find that the well-known reversal effect is present in this " new " version. Thus when facet edges appear dark, the outline of the stone is bright, and vice versa.

As in the case of the Anderson method, and of the Becke test, the phenomenon appears to take no account of birefringence (which can be detected simply enough by other means). The effective R.I. in a birefringent stone seems to be the upper one, as might be expected. When a peridot (R.I. 1·65-1·69) was immersed in a liquid of R.I. 1·67 it reacted as having the higher optical density.

An indication of the sensitivity of the test was obtained by preparing a liquid with R.I. 1·565. This successfully separated synthetic emeralds from natural ones. The former showing light facet edges when the focus was in the stone and the latter showing dark edges in the same position.

There is some variation in the intensity of the effect, as conditions vary. It is generally more pronounced when the R.I.'s of liquid and stone are widely different. The sharpness of the angle between the facets also has some effect and of course the width and intensity of the blurred edges varies with the degree to which they are out of focus.

Stones are best examined table downwards and it is necessary to be sure that the facet edges examined are in fact those of the pavilion. If the crown facets are examined through the stone the whole effect is reversed—with confusing results.

The parallel with the Anderson effect, seen in immersion contact photographs, has been mentioned. The present method is obviously another version of the same phenomenon and is perhaps easier to observe. It is, however, reversible as shown in figs. 1 and 2.

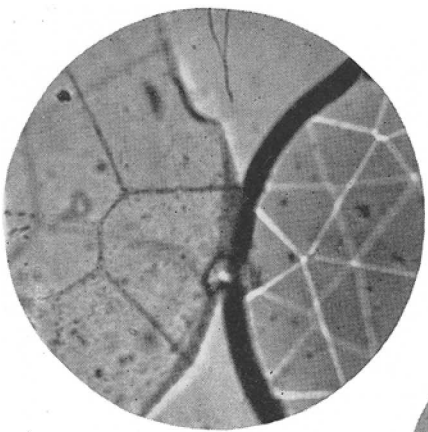


FIG. 3. *Spinel and ruby in methylene iodide. Focus is in the liquid above the stones.*

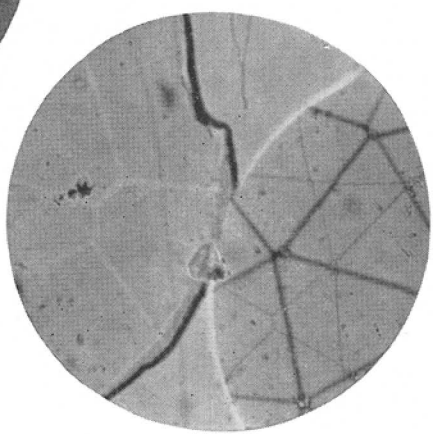


FIG. 4. *The same stones when focus is lowered.*

Figs. 3 and 4 show the effect as I first saw it. A spinel and ruby are side by side in methylene iodide. In fig. 3 the focus is in the liquid (1·742) and the ruby (right) has light facet edges and dark outline, while the spinel has dark facet edges and bright outline. In fig. 4 the focus is now inside the stones, with complete reversal of the effects. In both cases the *dark* facet edges are seen when the *focus* is in the medium with the higher refractive index. It is thus shown that the liquid R.I. is lower than that of ruby and higher than that of spinel.

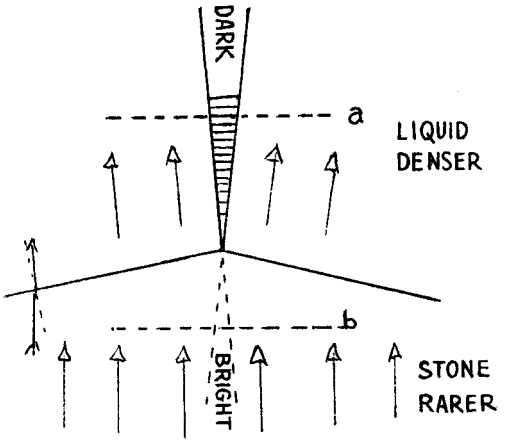


FIG. 5. *Parallel light refracts towards the normal to give two divergent beams.*

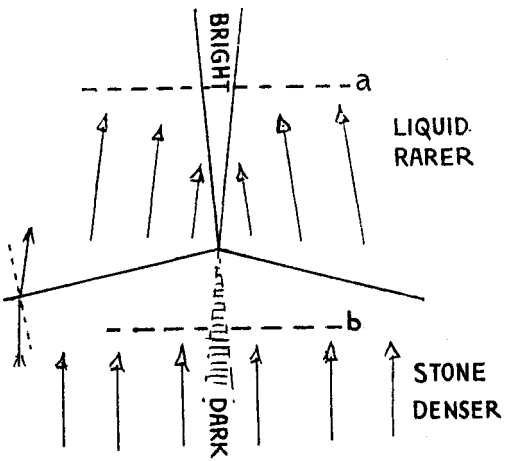


FIG. 6. *Light is refracted into two convergent beams giving rise to a virtual area of darkness within the stone.*

Figs. 5 and 6 explain diagrammatically the reasons for the phenomenon. Light passes up to the stone as a near parallel vertical beam and, refracting out of the stone via two mutually inclined facets, it becomes two beams which converge if the liquid is of lower R.I. than the stone, fig. 5, and diverge if the liquid has the higher R.I., fig. 6. Therefore light reaching the microscope is no longer parallel and focusing on level *a* will show overlapping beams (bright line) in fig. 5, and an area of darkness (dark lines) in fig. 6. Focusing on level *b* within the stones the light reaching the microscope is still in the air and follows either the convergent or the divergent path. Therefore a virtual dark area is seen in fig. 5 and a virtual overlap (light area) in fig. 6.

For me the importance of the test lies in the fact that in examining immersed gems an indication of the R.I. relative to the liquid used is immediately to hand. In large parcels of rubies or sapphires chance spinels or pastes stand out in marked contrast to the rest. Such stones as topaz or citrine can be separated quite easily, even in settings which will not permit the use of the refractometer, by simply observing the effect when they are immersed in bromoform (R.I. 1·59).

Used sensibly I feel that the test adds once again to the great versatility and usefulness of the microscope. But if it serves no more useful purpose than to introduce the reader to the idea of closing the substage diaphragm when he is examining a stone for inclusions (fig. 2 is a good example of its effectiveness) it will have justified its publication.

A NEW TURQUOISE SIMULANT

By R. WEBSTER

A NEW departure in the realm of turquoise imitations is the mineral howlite, which has been stained to a turquoise-blue colour. The pieces examined were baroques fashioned by the tumbling process, and they made a very good imitation of turquoise.

Howlite, sometimes known as silicoborocalcite, is a snow-white mineral which often has black or dark brown veins, but it is little known as a gem material outside the United States of America. The mineral consists of a mass of microscopic flattened crystals having monoclinic symmetry, the whole forming cauliflower-like nodules. The composition is that of a hydrated silico-borate of calcium. However, in the published literature, there seems to be some divergence of opinion as to the true chemical formula of this mineral. That given below is taken from the 6th edition of Dana which gives as the formula: $4CaO\ 5B_2O_3\ 2SiO_2\ 5H_2O$.

Named after Professor H. How, of Nova Scotia, howlite was first found near Windsor, at Brookville and at Winkworth (now known as Wentworth) in Hants County, Nova Scotia. The mineral is found embedded in gypsum and anhydrite, and a mixture of these minerals with howlite has been called winkworthite. The most important sources of howlite are in California where it is found in the borate beds of Calico, San Bernardino County, and near Frazer Mountain, north of Lockwood Valley in the north-east of Ventura County. The source of the gem material is, however, in Tick Canyon, an offshoot of Mint Canyon, in Los Angeles County. The nodules, which are found in a bed of grey clay and shale capped by sandstone, are usually some three to four inches in diameter but can be as large as eight to ten inches across. There is some carbonaceous matter present in the mother-rock, and it is suggested that the delicate black veining shown by much howlite may be caused by this.

The hardness of howlite is given in the literature as about $3\frac{1}{2}$ on Mohs's scale, and the specific gravity as between 2·53 and 2·59. John Sinkankas, in his work "Gemstones of North America", gives the refractive indices as α1·586, β1·598 and γ1·605 on material found at Windsor, Nova Scotia; and on material from Ryan,

California, he gives the following values—α1·583, β1·596 and γ1·605. Thus the birefringence, which is negative biaxial, is 0·019 and 0·022 respectively. In the case of the massive material only a vague shadow-edge about 1·59 would be seen on the refractometer. Sinkankas also states that howlite is easily soluble in dilute acids. The mineral fluoresces a brownish-yellow when irradiated with short-wave ultra-violet light (2537Å), and some Californian material glows with a deep orange light under the long-wave lamp (3650Å) and does not respond to short-wave irradiation.

Examination of specimens of the blue-stained howlite showed that the hardness was about $4\frac{1}{2}$ on Mohs's scale, for this stained material was found to resist scratching by fluorspar but was scratched by apatite. As no specimens of unstained howlite were available for comparison tests, whether this greater hardness is due to the effect of colour staining, or the natural unstained material can be harder than reported, could not be proved.

Determinations of density were made on seven of the specimens, the following results being obtained:—

1.	12·15	carats	2·505
2.	11·96	,,	2·499
3.	13·20	,,	2·555
4.	8·10	,,	2·551
5.	15·71	,,	2·536
6.	20·00	,,	2·571
7.	13·78	,,	2·555

The refractive index, as far as could be measured by the vague shadow edge seen on the refractometer scale, was about 1·59.

The absorption spectrum, observed from light reflected from the surface of the specimens, showed these dyed howlites to exhibit a band in the red which appears to be a fairly sharp line which forms a cut-off to the red end of the spectrum. There is also a weak broad absorption band in the yellow-green centred at about 5650Å. No bands were observed in the blue part of the spectrum, as are seen in true turquoise. The absorption spectrum shown by the dyed howlites is probably due to the dyestuff used in the colouring. What this dyestuff is, is not surely known, but it certainly permeates throughout the material as was seen when a specimen was sawn in two pieces. The colouring, too, does not appear to be subject to fading, for no fading was found to occur to a

dyed specimen of howlite after exposure to a carbon arc for over a hundred hours.

A number of pieces of this blue-stained howlite were examined under the ultra-violet lamp, the long-wave lamp (3650Å) being found to give the best response. Most of the specimens showed glowing patches of brownish or orange-yellow light. These were mainly specimens where the colouring itself was patchy; uniformly coloured material was generally inert. From this it may be assumed that the colouring agent has an adverse effect on the production of luminescence.

Experiment has shown that a specimen of dyed material was easily and apparently (on a small sample) completely soluble in dilute hydrochloric acid. The resulting solution was a " gel ", the dyestuff also having dissolved without decomposition. Thus, a spot of acid placed on the specimen will give an indication, even if not a full test, for these turquoise simulants. However, the test should be made on an inconspicuous place for at best the test will remove the polish, although it does not remove the colour, or do worse damage.

The howlite used for processing into these "simulated turquoises " comes from Tick Canyon in Los Angeles County, California. The treatment is carried out by a firm at Ramona in the same State, and the material is marketed for what it is, no attempt being made to pass it off as true turquoise, of which it makes an excellent imitation.

The writer's thanks are due to Mr. Hugh Leiper, of Del Mar, California, who sent over the specimens from America, and to Mr. Harold Lee who carried out the fading experiments and some of the chemical tests.

Gemmological Abstracts

SCHULKE (A. A.). *Artificial coloration of diamonds.* Gems and Gemology, Vol. X, No. 8, pp. 227-239, Winter 1961/2.

Three main groups of radiation are used to colour diamonds. Those in which charged particles (protons, deuterons, alpha particles and electrons) penetrate the stone and remain there, form the first group. The second group consists of those in which uncharged particles (neutrons) penetrate the stone and may or may not remain. Lastly, pure energy, as in the case of X-rays and gamma rays, is used. Cyclotrons are used to produce the first group (with the exception of electrons), nuclear reactors second group; and electrons are produced by an apparatus called a Van de Graaff generator. Cyclotrons, using an energy of about 5 Mev (million electron volts), accelerate the particles to such a speed that they will enter the diamond, but only to a very small depth, a depth depending upon the energy of the particles. A graph shows this. The coloration is confined to the penetration area and is usually less than 20 mils. The colours produced are greens which, by subsequent heat treatment, change to yellow, gold or brown (even red-brown), the final colour being related to the original shade of green. The smaller electron particles from a Van de Graaff machine have an energy of 0·5 to 3 Mev. However, owing to the smaller size of the particles the range of penetration in diamond may be up to 1000 mils. Colours produced are blue to blue-green, depending on the initial energy of the particles. Canary-yellow stones can sometimes be obtained by subsequent heating, and rarely a pink colour is obtained by electron bombardment. A theory that high-energy electrons from lightning discharges may account for the colour of some natural coloured diamonds is propounded. With neutron bombardment the particles displace electrons indirectly by bouncing off carbon atoms energizing electrons, and these displaced electrons cause the coloration, as in the case of cyclotron accelerated particles. In this case the stone is coloured right through, but the green colour produced is said to

be duller than the green produced by cyclotron bombardment, and radiation damage may occur. The various side effects found are mentioned and the heat treatment described. A temperature of about 1600°F is needed. The times necessary to irradiate and the costs of irradiation are discussed. Newer cyclotrons now being built will accelerate the heavier atoms of lithium, beryllium, boron etc. Experiments at the General Electric Research Laboratory have shown that by this process small amounts of boron may be got into natural and synthetic diamonds which then become blue in colour and also become electro-conducting, thus changing them into the rare Type IIb diamonds. X-rays and gamma rays have not been found useful for diamond treatment.
2 illus., 2 graphs. R.W.

SINKANKAS (J.). *World's largest kunzite crystal.* Gems and Gemology, Vol. X, No. 9, pp. 274-277 and 287, Spring 1962.

A large kunzite crystal from Brazil weighed 7,410 grams. Mention is made of the fading of kunzite and the result of heat treatment to improve the colour. There are notes on the examination of quartz crystals to assess their use for piezoelectric purposes, and the heating of smoky quartz to find out whether it will turn to citrine colour for gem purposes.
4 illus. R.W.

CROWNINGSHIELD (R.). *The spectroscopic recognition of natural black pearls.* Gems and Gemology, Vol. X, No. 8, pp. 252-255, Winter 1961/2.

Reports the results of the examination of the absorption spectrum of the shells of pearl-bearing oysters. The conchiolin from the shell of *Pinctada martensii* absorbed light from approximately 5150Å to the end of the violet, and the red above approximately 6700Å. The author found that the absorption spectrum of one type of red-brown conchiolin from a black pearl bearer showed an absorption spectrum similar in essentials to that shown by *Pinctada martensii*, except that in the transmission region of between 6700Å and 5150Å there appeared some four dark bands centered at 6300Å (moderate), 5775Å (strong), 5500Å (strong) and 5350Å (weak). Further experiments were carried out on grey and black coloured pearls and on the conchiolin from many shells. The

article gives a general survey of the identification of stained pearls, of which spectroscopic examination is a part.
6 illus. R.W.

CROWNINGSHIELD (R.). *Developments and Highlights at the Gem Trade Lab. in New York.* Gems and Gemology, Vol. X, Nos. 8 and 9, pp. 242-246; 281-283, Winter 1961/2; Spring 1962.

A number of radium-treated diamonds were examined. Some Burma jade was found to be serpentine which showed, by its absorption spectrum, signs of chromium coloration. A type of jade known as Yunnan jade was examined as well as a Brazilian emerald and a bluish-green chrysoberyl resembling a pale bluish-green aquamarine. " Purpurine " glass is discussed. Reports another diamond found at the Murfreesboro mine. A sapphire with a colour change from green to light violet-red and a foil-backed diamond are mentioned. An imitation star-moonstone was found to be a milky synthetic spinel with a very thin mirror at the back. A rare blue jadeite and an unusual pyrope garnet with a refractive index of 1·731 were other unusual materials. A diamond with an unusual absorption spectrum was encountered.
18 illus. R.W.

CROWNINGSHIELD (R.). *Freshwater cultured pearls.* Gems and Gemology, Vol. X, No. 9, pp. 259-273, Spring 1962.

Cultured pearls without a bead nucleus are produced in the freshwater mussel *Hyriopsis schlegeli.* Cultivation is carried out in Biwa lake in Japan. The mussels are not propagated artificially as yet, native mussels being used. The mussels are procured during October to April and the methods of gathering them are explained. The insertion of a piece of mantle tissue, which forms the pearl sac, is made in the mantle of the animal and not into the body as in bead nucleation. Some ten incisions are made in each half of the mantle, so that a maximum of twenty pearls may be formed at one time. After the insertion operation the mussels are kept in cages suspended in the lake for a period of three years. The life span of these freshwater mussels is some thirteen years, and, if there is no disturbance of the body tissues of the animal, a second " crop " of pearls, and in some cases a third " crop ", will grow from the same mussel. A description of these pearls and their colours is given. There was experimental bead nucleation of such

mussels, and X-ray pictures of such pearls reveal that drilled beads have been used for the nucleus. It seems that such drilled beads are necessary when using a special device for locating the nucleus in a nonvulnerable spot in the animal's body. The complicated twisted intestines make it difficult to place the nucleus without injury. The methods of distinguishing such non-nucleated cultured pearls by X-rays and fluorescence are mentioned. There is a discussion of the terminology to be used for these pearls. There is production of non-nucleated pearls in salt water oysters in Australian and Burmese waters.

15 illus. R.W.

LIDDICOAT (R. T.). *Developments and Highlights at the Gem Trade Lab. in Los Angeles.* Gems and Gemology, Vol. X, Nos. 8 and 9, pp. 274-251; 278-280, Winter 1961/2; Spring 1962.

The fading of dyed jadeite and a " faded " unstained jadeite are mentioned. An insurance claim on a damaged diamond and a diamond which was suggested to have been damaged by ultrasonic cleaning are discussed. Synthetic (alexandrite type) sapphires and the Princess cut are referred to. Data on Australian emerald (per E. Gübelin) are given. "Antique " ear-rings set with synthetic emeralds and a grey opaque sintered synthetic corundum set in cuff links have been encountered. An enstatite-hypersthene, an unusual three-phase inclusion in an emerald, dyed rosé cultured pearls, and abalone pearl, and a black star-sapphire are other items discussed.

2 illus. R.W.

MAYERS (D. E.). *The Curlew amethyst deposit.* Gemmologist, Vol. XXXI, No. 369, p. 62, April 1962.

Reports the occurrence of amethyst in Northern Rhodesia in a mine known as the Curlew Amethyst Deposit. Amethyst was first found in this locality by Alice Sumner Tait and others. The amethyst occurs in the top soil as the result of weathering of amethyst veins in the underlying rock. Production, owing to the inaccessibility of the region and lack of water, is difficult. The tips of the crystals alone are well coloured and are as a rule insufficient to cut into faceted stones, but the material allows the cutting of cabochons.

R.W.

RAMAN (C. V.). *Two kinds of diamonds.* Gemmologist, Vol. XXXI, No. 368, pp. 39-44 and 58, March 1962.

Summarizes the research results carried out at the Raman Research Institute at Bangalore, India. The studies comprised infra-red spectrometry, examination between polaroid plates, ultra-violet fluorescence and transmission. Two fundamentally different types of diamond are postulated one of which can be considered as the perfect diamond. Most diamonds contain both types of crystal architecture. Diamonds fall into three groups. Of the stones tested about 10% are in group A and are considered to be perfect diamonds. 10% are in group B, stones which have very different characters to group A. The remaining 80% of the stones tested were shown to be composite diamonds in which the structural characters of both A and B are present side by side. Group A are truly isotropic and are opaque to near ultra-violet light, and they show a blue luminescence. They have eight different frequencies of free vibration in the infra-red. These are at 1332, 1273, 1219, 1176, 1087, 1010, 746 and 624 Cm^{-1}, and they show first, second and third order spectra. The B group show anomalous birefringence, are transparent to ultra-violet light but do not exhibit luminescence. In this group the first order infra-red spectrum is absent. The composite nature of Group C was deduced from their behaviour under the four forms of testing. Experimental procedures are explained.
5 illus. R.W.

ALTMANN (J. D.). *The opal market.* Australian Gemmologist, No. 11, pp. 13-14, March 1962.

Australia produces nearly all the opal used in the world and the value produced now exceeds £A1,000,000 per annum. Some 80 to 85 per cent of Australian opal comes from the South Australian opal fields at Andamooka (mainly green, orange and blue colours) and from Coober Pedy (red, white and orange colours). Lightning Ridge in New South Wales still produces a limited amount of black opal, and some boulder and matrix opal comes from Queensland. Andamooka opal is much in demand by Japanese buyers, for the green colour is prized by these Oriental people. Some information on mining and mining conditions are given.
R.W.

TUFFLEY (J. R.). *An X-ray examination of synthetic spinel.* Australian Gemmologist, No. 11, pp. 15-16, March 1962.

The nature of spinel and the differences between natural and synthetic spinel are given. The ways in which the excess alumina in synthetic spinel might be accommodated in the lattice are suggested. Confirmation of the possibilities are then deduced from X-ray powder photographs. The results obtained seemed to indicate that the excess alumina, in gamma (cubic) form, may not all be in solid solution and that some remains to form a mixture of compounds. The possible results of subsequent heat treatment is discussed. The author refers to sintered synthetic spinel and states that is is made in a different manner to the normal Verneuil furnace production. The method is said to be as follows. The pure oxides of magnesium and aluminium, plus a small amount of colouring agent, are mixed together, first dry and then wet. The mixture is then formed into briquettes. After the briquettes have been thoroughly dried, they are subjected to a temperature in excess of 1600°C. This is the minimum temperature required for the formation of spinel from MgO and Al_2O_3.

R.W.

TISDALL (F. S. H.). *Tests on Madagascar garnet.* Gemmologist, Vol. XXXI, No. 371, pp. 102-103, June 1962.

A report on the examination of garnets from Madagascar. The colour of the stones was a pleasing shade of purplish-red; the density was found to be 3·84, with an index of refraction of 1·762. These values are borderline figures for pyrope and almandine and are practically the same as for the rhodolite garnet from North Carolina. The absorption spectrum showed the usual almandine bands. Strong anomalous double refraction was observed. A test for magnetism using a long thread suspension and a small magnet showed the stones to oscillate when the magnet was brought near. It was noticed that red spinel does not respond to the magnet and this may provide a test for distinction between red spinel and pyrope garnet. The inclusions seen were crossed rutile needles, transparent crystals, and one stone showed a " radiation halo ".

R.W.

JOHNSON (P. W.). *Organic gem materials of Baja California, Mexico.* Gemmologist, Vol. XXXI, Nos. 370 and 371, pp. 79-83 and 89; 104-110, May and June 1962.

The terrain of Baja California (Lower California) which stretches like a finger southwards from the State of California, is described as being something of a wilderness. Tortoiseshell from the Pacific marine hawksbill turtle (*Eretmochelys imbricata squamata*) has been used for ornamentation for many years. It was exploited by the Spanish in the 18th century. The smallest of the marine turtles, the animal ranges from Baja California to Peru. There are notes on the preparation of tortoiseshell and how it may be distinguished from horn and plastic imitations. The word *carey* is locally used both for the turtle and for its shell; from this the tortoiseshell worker is called a *careyero.* Amber is found in Baja California, but it is too friable to be of use in the arts. Both the shell of and the pearls found in the univalve animals called abalones (earshells) are used for ornamentation. There are several varieties of these abalones, and the highly coloured shells are used for inlay. Circular plates cut from the shells are often wrongly sold as " abalone pearls ". The second part of the article deals with the fisheries and fishing for the many different types of pearl-producing molluscs in the Gulf of California. The diving is usually carried out by nude Yaqui divers. Punta San Francisquito is a renowned pearl locality and this place is well described. The types of mollusc fished and some idea of the value of the pearls found are given. Baja California is noted for the black pearls it produces. These are called " La Paz " or " Panama " pearls. Some data are given on the density of the pearls and shell from this part and of their behaviour under ultra-violet light.

8 illus. R.W.

ANON. *Sorting diamonds by light.*

The well-known methods of diamond recovery are by concentration and grease table and by electrostatic separation. The new light separation method depends on the fact that diamond reflects light not only from its surface but also from its interior and these scattered reflections can be seen from every angle. Other heavy particles from the concentrate being completely opaque only reflect light from their surfaces. A description of the apparatus used is given.

1 illus. R.W.

MATHEWS (C. R.). *The gem market today.* Gemmologist, Vol. XXXI, No. 372, pp. 119-121, July 1962.

A general survey of the present day supply of gemstones from the main localities. Few new sources of gems are found to take the place of the old mining areas of Burma, Ceylon, Thailand (Siam) and Colombia. Kashmir sapphires have not been seen in the raw state for many years. Siam supplies small sapphires and rubies up to a carat in size, while Australia produces sapphires of a similar size but of a dark inky blue colour. Burma is still the best source of rubies and from that country also come sapphires in all sizes and from a bright light blue to a rich blue in colour. Ceylon supplies sizeable sapphires, star-sapphires and pink rubies from the Ratnapura area. Here the native cutters make the stone as heavy as possible and these stones need recutting. Africa is now supplying rubies, sapphires, amethysts and emeralds. Rhodesian emeralds are small but are of good colour, whereas the emerald from the Transvaal is always cloudy or opaque and not of high value. A new source of emerald has been found in Pakistan. Colombia is still the source of the best emeralds. It is envisaged that the demand for fine gems will outstrip production for a long time yet.
3 illus. R.W.

SHREVE (R. N.). *How jade is cut today.* Gemmologist, Vol. XXXI, No. 369, pp 63-70, April 1962.

A comprehensive article on jade cutting in Hong Kong. It is a republication of the article published in Gems and Gemology. (Journ. Gemmology abstracts. Vol. VIII, No. 3, p. 108, July 1961).
11 illus. R.W.

TISDALL (F. S. H.). *Spessartites from Madagascar.* Gemmologist, Vol. XXXI, No. 372, pp. 124-125, July 1962.

The stones examined were a rich orange-red in colour, some dark and some light in tint. The density was found to be 4·17. The absorption spectrum of the stones showed the manganese bands at 4840Å and 4610Å quite strongly, and these were in conjunction with the almandine bands. The stones were found to be inert under ultra-violet light. They showed some magnetism, for when suspended on a long thread they oscillated when a magnet was brought near, and if it was brought close enough

they were found to adhere to the magnet. Most of the stones were " clean " and few inclusions could be seen. Some fine striations were seen in the case of one specimen.

R.W.

MURPHY (M. O.). *The Kelly blue-green gem.* Lapidary Journal, Vol. XVI, No. 2, pp. 224-226, May 1962.

Blue-green smithsonite was obtained from the Kelly mine, New Mexico, and the mineral was named after James L. M. Smithson and is a zinc carbonate. The hardness is 4 to 4½ on Mohs's scale, the density 4·3 to 4·5, and the principal indices of refraction are 1·62 and 1·85. The mineral is found in vugs and has a botryoidal or stalagmitic habit. The blue-green material (Herrerite) is coloured by various copper salts. There are other varieties of smithsonite, such as dry bone ore which is friable and not useable in the arts. Monheimite, a variety containing iron, is pinkish to dull brown. Turkey-fat ore has a yellow colour and this is due to included greenockite, a cadmium mineral; such material has occasionally been cut into small cabochons and faceted stones. Pink smithsonite is coloured by cobalt (cobaltismithsonite), and manganese gives a deep purple to nearly black colour to the mineral. Smithsonite sometimes forms stalactites which, when polished, are spectacularly ringed with alternate bands of yellow and blue-green. It is not uncommon to find smithsonite as pseudomorphs after molluscs and crinoids. Much information is given on the cutting and polishing of the mineral. During 1907 and 1908 the firm of Goodfriend Brothers of New York marketed the blue-green mineral, and they coined the name " Bonamite ", after the French *bon ami* (good friend), for the material. The Kelly mine is now unsafe and entry is barred.

3 illus. R.W.

SINKANKAS (J.). *San Diego's gem-studded tiara.* Lapidary Journal, Vol. XVI, No. 3, pp. 300-314 and 323-324, June 1962.

A comprehensive survey of the gem mines of San Diego County, California. The mining districts are considered in groups and the mines in each group are discussed separately. There is an important list of references.

21 illus. R.W.

WHITE (E. A. D.). *The synthesis and uses of artificial gemstones.* Endeavour, Vol. XXI, No. 82, pp. 73-84, April 1962.

The history of the attempts to make gemstones is a long one. No great success was achieved until 1904. The article tells of the methods used since that time. The syntheses involving ultra-high pressure were first carried out at low temperatures for the equipment used would not withstand the extreme heat as well as the high pressure. This difficulty was overcome by using internal heating and pyrophyllite gaskets. It was by different types of such apparatus that diamond was first synthesized. Two types of such apparatus are discussed—the " belt " type and the tetrahedral ram type. Comments are made on an undisclosed Dutch method of diamond synthesis. The flame fusion method of Verneuil for the production of single crystals, and modern variants of the method, including rapid rotation of a seed crystal, by the use of an arc-image furnace and by plasma-jet furnaces are mentioned. Hydrothermal syntheses using autoclaves and a temperature-gradient method, fluxed-melt growth and other growth techniques are told. The problems of crystal growing are discussed and there are sections on the synthesis of diamond, corundum, spinel, rutile, strontium titanate, quartz, emerald, garnet, blende and some gems of minor importance. The scientific and industrial uses of synthetic gem crystals are considerable.

4 line drawings, 12 coloured illus. R.W.

POUGH (F. H.). *The Brazilian gem market.* Lapidary Journal, Vol. XVI, No. 2, pp. 242-247, May 1962.

The first of a series of articles on the gem markets of Brazil. The author is not optimistic about the economic future of the country, for there are no great resources of mineral fuels and metals and the prospects for agriculture and grazing are not good. The geology of Brazil is favourable for the formation of gem crystals such as beryl, tourmaline and topaz. Owing to the nature of the rocks the recovery of the gem crystals is difficult, and this is further hampered by the local system of taxation. Dealing in gem crystals is always carried out by an agent and not by the miner. Currency problems present other difficulties to the overseas gem buyer. There is much information on the hazards of the country. The article is embellished with excellent coloured plates.

4 coloured plates. R.W.

POUGH (F. H.). *Stones of the Brazilian market.* Lapidary Journal, Vol. XVI, No. 3, pp. 316-323, June 1962.

Through the years Brazil has produced little in the way of new gemstones, except perhaps brazilianite. The types of tourmaline and where they are found are given. Recently a large find of spodumene (kunzite) was made. The colour of the crystals are greyish-green to pale blue-violet and the author suggests that the dark colour may be due to irradiation whilst in the earth. Some kunzite is heated in order to get a pink colour. The amblygonite from Brazil is discussed.

3 illus. Coloured plate. R.W.

WEBSTER (R.). *Salesmen need facts.* Watchmaker, Jeweller & Silversmith, pp. 66-69 and 98 (*Turquoise*); pp. 80-85 (*Jade*); 64-67 and 95 (*Lapis and ornamental stones*), May, June and July 1962.

General articles on the various gemstones written as a guide to the jeweller and his salesman. The simulants in each case are described.

18 illus. P.B.

OSTWALD (J.). *An introduction to the optics of gemstones.* Australian Gemmologist, Nos. 11 and 12, pp. 18-22, 5 to 9, March and June 1962.

Part 2 of this series (Journ. Gemmology Vol. VIII, No. 7, p. 256) gives an outline of the wave theory of light. The relation between wavelength, frequency and velocity is explained. The optics of crystals are comprehensively explained in Part 3.

10 illus. R.W.

ANON. *G.J's. quick course in gemmology.* Goldsmiths' Journal, pp. 158-161 (April 1962); 252-255 (June 1962); pp. 302-303 (July 1962); 350-352 (August 1962).

This series continues with the descriptions of density tests; composite stones; the geology of gem materials; crystal imperfections including chatoyancy and asterism; improving the colour of gems; the colours caused by interference; and anomalous double refraction.

23 illus. R.W.

OBSERVATIONS ON GARNET

By L. C. TRUMPER, B.Sc., N.D.A., F.G.A.

MR. B. W. ANDERSON, writing in the JOURNAL OF GEMMOLOGY[1], pointed out that garnets do not in fact intermix with one another but comprise two distinct groups, intermixing only taking place to any extent between members of the same group. The first group comprises pyrope, almandine and spessartite and the second group comprising grossular, uvarovite and andradite. The article is exceedingly interesting and when my copy of the Journal came back from the binders a few months ago, I read this article again and resolved to devote my spare time during the winter months to putting the facts therein set out to the test as detailed below.

In building up my collection of garnets over the years my first aim was to obtain representative specimens both of rough and cut of each variety, secondly to expand each variety into representative specimens exhibiting all typical colour variations. Whilst four or five spessartites, demantoids and hessonites met these requirements, in the case of pyrope and almandine, colour variations ran into twenty or thirty, from pale pink to deep red, orange to violet, rose red to purple and Imperial purple. Only true yellow and blue seem to be missing.

Some years later, a third selection was made from over two thousand garnets sent to me for the purpose. Examination with a binocular microscope led to some extremely interesting specimens ranging from completely clean stones of several different colours, to stones with large well formed crystals, long fine needles, short rods, specks only, few needles and small well shaped prismatic crystals, myriads of fine long needles characteristically intersecting at 110°, rounded crystals, dendritic inclusions not orientated, feathers or finger print inclusions in several planes, shred-like inclusions and so on.

Inevitably, my first step was to examine my already extensive records and check up that I had all the refractive index readings and that all the specific gravity determinations had been made using toluol and further that in the case of small stones, the smallest possible suspension had been used. This meant many fresh determinations followed by re-checks of the spectrum examinations

all of which kept me very busy and very interested through most of the winter months.

My next step, which I commend to fellow gemmologists because it is so simple to do, was to set up the co-ordinates for a large scale graph on thick white paper on a drawing board, scaling off refractive index on the vertical co-ordinate from 1·7 to 1·90 in steps of ·01 and of specific gravity on the horizontal co-ordinate from 3·38 to 4·4 in steps of ·025.

Then the positions of the constants were marked for the " calculated " constants of the species, namely:—

Garnet	*Composition*	*Density*	*Ref. Index*
Uvarovite	$Ca_3Cr_2Si_3O_{12}$	3·78	1·86
Grossular	$Ca_3Al_2Si_3O_{12}$	3·53	1·735
Andradite	$Ca_3Fe_2Si_3O_{12}$	3·83	1·895
Pyrope	$Mg_3Al_2Si_3O_{12}$	3·51	1·705
Almandine	$Fe_3Al_2Si_3O_{12}$	4·32	1·83
Spessartite	$Mn_3Al_2Si_3O_{12}$	4·18	1·80

As explained in B. W. Anderson's article, it will be readily seen that the first three can be joined to form a straight line and similarly that the last three can also be joined to form a quite differently placed straight line.

I next inserted on the graph the figures for actual stones quoted by Anderson, including an additional one which he kindly provided me with for an actual garnet as near as possible to a colourless garnet. To these I then added the positions of the fifty eight stones listed in the accompanying table. Had the two distinct groups of garnets been capable of mixing to any extent, this would have been shown presumably by the position on the chart being midway or some appreciable way towards the second line. As will be seen, some stones are on this side of the line, but no more than are of similar distances to the other side. There is therefore no evidence of intermixing on these grounds at all. As to the divergences on one side of the standard line or the other, this may be due to impurities, or indeed to experimental error for of course the scale is very large indeed on the original chart some nine times the size of the reproduction. It may possibly be significant that hessonites do group themselves between the two graphs. This may be due to a greater readiness to intermix when the constants are closer together.

As was to be expected, the several species in general segregate themselves into moderately distinct groups as indicated on the chart, which was carefully examined to see if any other characteristics stood out.

Colour did not seem to have any bearing. The colour of some hessonites is almost identical to that of spessartite. The green of demantoid can rarely be almost matched by some grossular. Blood red occurs in both almandine and pyrope as does purple and pink and orange red.

Spectroscopic examination merely confirmed what was already known. Traces of the Almandine spectrum were detectable almost throughout the Almandine/Pyrope Graph range.

Deep purple almandines did appear to have the 5750 and 6200Å bands more strongly pronounced. Superb purple garnets ranged in specific gravity from 3·91 to 4·12.

Finally, could the groups be differentiated by their inclusions? Much work has already been done on this most interesting subject by Dr. E. Gübelin, Mr. B. W. Anderson and many others and numerous examples have already been published and it is generally agreed that the following characteristics are to be found in the different garnets.

GROSSULAR—Usually green, pinkish or white and translucent with black specks.

HESSONITE—Very characteristic rounded crystal inclusions on an oily background of swirls.

DEMANTOID—Emerald green to yellowish green, transparent sometimes clean but usually containing one or more radiating tufts of asbestos fibres.

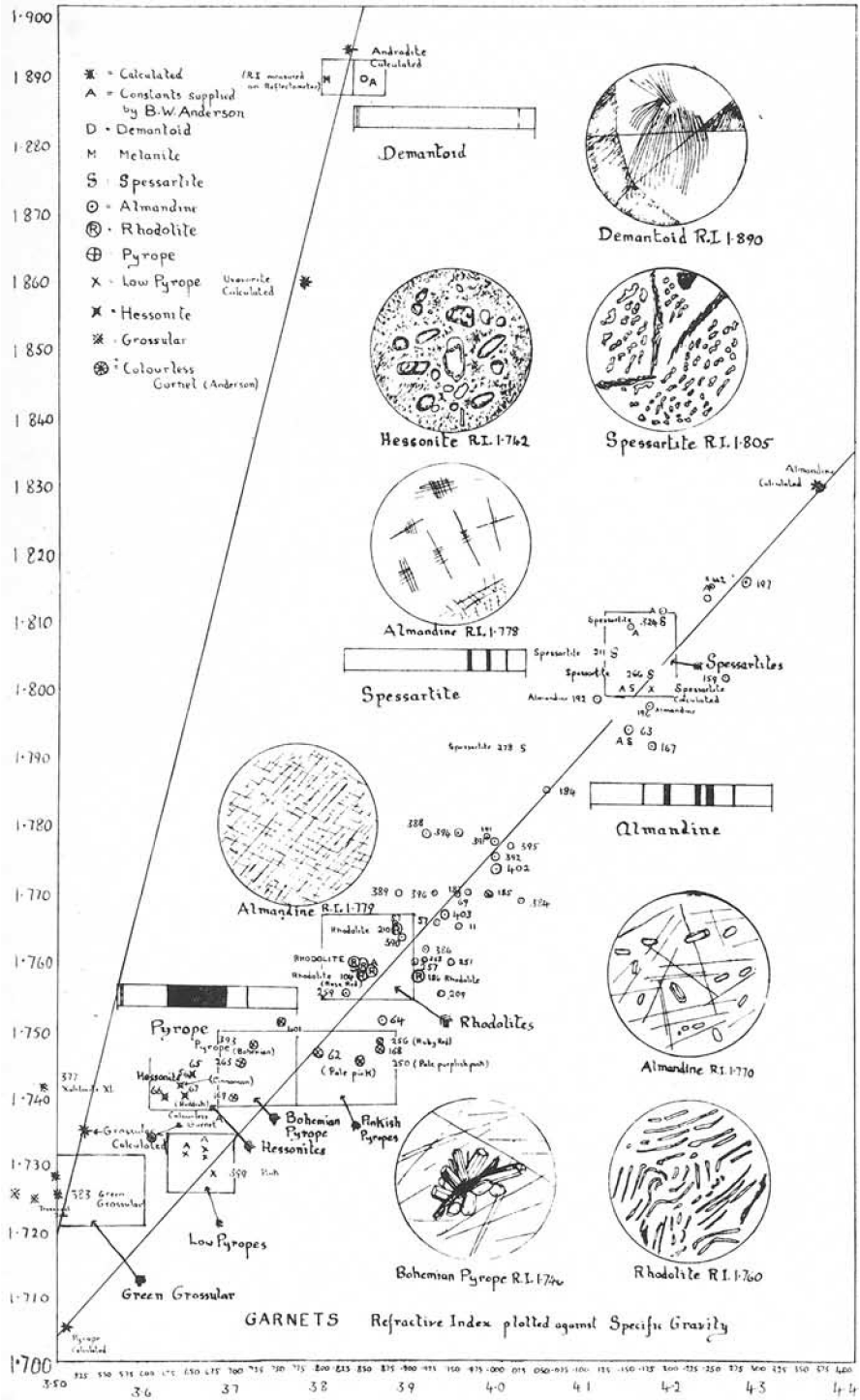
ALMANDINE—Frequently fine needle-like inclusions orientated so as to appear at an angle of 110° (similar needles in corundum are orientated at 60°).

SPESSARTITE—Characteristic inclusions of a shred-like nature of irregular outline, sometimes scattered about or twisted around.

PYROPE—(*a*) Bohemian—characteristic deep fiery or crimson red colour and frequently containing well formed crystals of quartz in groups.

(*b*) Pale pink—often clean, sometimes with irregular small crystals, rarely a few fine needles.

(*c*) South African—more orange red colour, fine or coarse orientated needle like inclusions.


1·900
1 890
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1·710
1·700
3·50
3·6
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3·8
3·9
4·0
4·1
4·2
4·3
4·4
* = Calculated
A = Constants supplied by B.W. Anderson
D = Demantoid
M Melanite
S Spessartite
⊙ = Almandine
Ⓡ = Rhodolite
⊕ Pyrope
X = Low Pyrope
* = Hessonite
* = Grossular
⊛ = Colourless Garnet (Anderson)
RI measured on Refractometer
Andradite Calculated
Demantoid
Demantoid R.I. 1·890
Uvarovite Calculated
Hessonite R.I. 1·742
Spessartite R.I. 1·805
Almandine Calculated
Almandine R.I. 1·778
Spessartite
Spessartites
Spessartite Calculated
Almandine
Almandine R.I. 1·779
Rhodolite
Rhodolites
Pyrope
Almandine R.I. 1·770
Bohemian Pyrope
Hessonites
Pinkish Pyropes
Low Pyropes
Green Grossular
Bohemian Pyrope R.I. 1·74n
Rhodolite R.I. 1·760
GARNETS Refractive Index plotted against Specific Gravity

RHODOLITE—This is not strictly a separate garnet species, consisting as it does of two thirds pyrope and one third almandine, and I cannot recollect seeing any published details of inclusions. I was therefore interested to observe in the garnets to hand that as the rhodolite position was reached on the graph from either direction, the typical garnet inclusions became less pronounced with instead small irregular colourless crystal inclusions, and two garnets that were " spot on " for rhodolite contained liquid filled finger-print patterns or feathers in different planes, quite unlike inclusions found in any other garnet and much more like similar types of inclusions so frequently found in Ceylon sapphires.

The only other observation of interest that I was able to make concerned a pale pink garnet kindly given to me by Mr. A. E. Farn with the very low constants of S.G. 3·679 and R.I. 1·729 and which contained no typical garnet inclusions but, instead, wavy dendritic hair-like feathers not in any way orientated.

In conclusion, I would again emphasize the value to be secured by charting garnets in the way explained above, as the visual picture thus presented conveys far more than the mere possession of the constants would lead one to expect.

SCHEDULE OF GARNETS EXAMINED AND CHARTED

No.	*Gemstone*	*Colour*	*S.G.*	*R.I.*	*Inclusions, etc.*
	Demantoid	green	3·856	1·89	Asbestos tufts
378	Melanite	black	3·802	1·89	—
197	Almandine	greyish purple	4·290	1·815	Numerous small prisms and some red-coloured XLs
159	Almandine	wine red	4·268	1·802	Many unusual XLs
324	Spessartite	reddish orange	4·193	1·81	Shred-like liquid-filled
167	Almandine	deep red	4·182	1·792	Fine round needles
196	Almandine	blood red	4·180	1·797	Fine round needles
63	Almandine	pale purple	4·155	1·794	None
266	Spessartite	coppery yellow	4·178	1·803	Shred-like and feathers
211	Spessartite	orange	4·136	1·806	Shred-like and feathers
397	Almandine	purple	4·134	over 1·81	Needles and radioactive zircons
192	Almandine	imperial purple	4·120	1·798	Needles
184	Almandine	deep red	4·060	1·785	Fine round needles
395	Almandine	deep red	4·017	1·778	Few fine needles
278	Spessartite	orange	4·030	1·792	Feathers and shreds
384	Almandine	blood red	4·030	1·769	Short rods
392	Almandine	deep red	4·000	1·776	Long fine needles
402	Almandine	red	4·004	1·775	Long fine needles
195	Almandine	very deep red	4·000	1·779	Rounded XLs with XLs radiating from them like a sea mine
391	Almandine	purple	4·000	1·778	Minute specks
191	Almandine	purple	3·990	1·778	Short needles
185	Almandine	deep red	3·990	1·770	XLs and fine needles
69	Almandine	purple	3·959	1·770	Short rods
11	Almandine	blood red	3·960	1·765	None
187	Almandine	imperial purple	3·970	1·770	Fine needles
394	Almandine	wine red	3·957	1·779	Large number of fine needles
251	Almandine	deep red	3·950	1·760	Very few needles
403	Almandine	deep red	3·943	1·767	Rounded XLs and fine needles

209	Almandine	blood red	3·940	1·756	XLs and fine silk
396	Almandine	deep red	3·930	1·770	None
386	Almandine	blood red	3·923	1·762	short rods and specks
258	Almandine	rose red	3·920	1·760	Fine needles
257	Almandine	imperial purple	3·910	1·760	Almost clean
388	Almandine	wine red	3·923	1·779	Large number of fine needles
57	Almandine	blood red	3·887	1·766	Short rods
389	Almandine	blood red	3·890	1·770	Lond needles, small well defined XLs
186	Almandine/Rhodolite	rose red	3·890	1·758	None
210	Almandine/Rhodolite	rose red	3·890	1·765	Silk
390	Rhodolite	rose red	3·894	1·766	Rods and feathers in different planes
64	Rhodolite	rose red	3·874	1·752	Feathers and XLs
168	Pyrope	blood red	3·870	1·748	XLs and short needles
256	Pyrope	blood red	3·870	1·747	XLs and short needles
250	Pyrope	pale red	3·845	1·745	Small streamers
400	Rhodolite	rose red	3·852	1·759	Feathers
104	Rhodolite	rose red	3·850	1·758	Feathers
259	Pyrope	pale rose red	3·830	1·756	Short rods
62	Pyrope	pale purple	3·794	1·748	Very few needles
401	Bohemian Pyrope	crimson	3·754	1·752	Rounded XLs
393	Bohemian Pyrope	crimson	3·697	1·748	Large well defined prismatic XLs
169	Pyrope	crimson	3·700	1·740	Large XLs and silk
399	Pyrope	pink	3·679	1·729	Dendritic feathers
65	Hessonite	reddish brown	3·653	1·744	Rounded XLs on oily background
67	Hessonite	reddish brown	3·646	1·740	Rounded XLs on oily background
56	Hessonite	coppery yellow	3·642	1·741	Rounded XLs on oily background
66	Hessonite	orange	3·622	1·740	Rounded XLs on oily background
377	Xalstocite	white	3·475	1·742	(An opaque XL)
383	Grossular	emerald green	3·448	1·728	Small black specks
385	Grossular	pink	3·388	1·720	(Translucent only)

REFERENCE

1. Anderson, B. W. *Properties and classification of individual garnets.* Journ. Gemmology 1959, **7**, 1-7.

BOOK REVIEW

WEBSTER (R.). *Gems: their sources, descriptions and identification.* £9 10s. Butterworth, London, 1962.

About five years ago a series of papers in *The Gemmologist* was prefaced by a statement that they were extracts from an entirely new and comprehensive book on gem materials being written by Mr. Webster, and since then gemmologists have been eagerly looking forward to the publication of the promised work. It has now made its long awaited appearance and they will not be disappointed.

This is a book of nearly 800 pages with over 500 black-and-white illustrations in the text, printed on highly calendered and, therefore, heavy paper. It was a wise decision to avoid unwieldiness and to divide it into two reasonably handy volumes weighing a little over 3 and a little under 2 lbs respectively. It invites comparison with Prof. Cavenago-Bignami's *Gemmologia*, which, with 1110 pages in one volume, weighs nearly 6 lbs. The two books are on the same ambitious and all-embracing scale and both cost £9 10s. in this country; but Mr. Webster's has the advantage—at least for this reviewer—of being written in English, and, being published five years later, is of course more up to date. In addition to the black-and-white illustrations, there are 20 colour plates; it is impossible to do justice to a gemstone in a picture, but the 16 plates taken from Dr. Gübelin's *Edelsteine* give as good an idea of the stones illustrated as any I have seen; two plates shewing cabochons of ornamental stones and crystals respectively are exceptionally pleasing, and the remaining two are the colour plates of absorption spectra already made familiar in the *Gemmologists Compendium* but with their colouring somewhat improved.

The first volume consists principally of " descriptive " gemmology. After a brief chapter on the origin and recovery of gemstones—covering the essential elements of geology—some 200 pages are devoted to describing the better known gemstones (diamond, corundum, beryl, chrysoberyl, spinel, zircon, peridot, spodumene, garnets, feldspars, quartz, opal, turquoise, lapis, jade), some 80 pages to marcasite, natural glasses, marble and lesser known ornamental and gem materials, some 50 pages to synthetic,

imitation, composite and artificially coloured stones, some 50 pages to pearl (natural, cultured and imitation), followed by 36 pages on the other organic gem materials; and a chapter on the fashioning of gemstones is sandwiched somewhat incongruously between the composite stones and the pearls. The descriptions include rather brief sections on lore and legend and extensive details of occurrences as well as particulars of crystallization, chemical and physical properties, refraction, absorption spectrum, luminescence, inclusions, cutting, synthesis and simulation.

The second volume is devoted mainly to " determinative " gemmology—to setting out the methods used in identifying gemstones, explaining the scientific principles on which these methods are based and describing the instruments used. Some 60 pages are devoted to crystallography, hardness and specific gravity, followed by over 80 pages on the effect of light on gemstones (or vice versa), including refractive index testing, absorption spectra and much discussion of the causes of colour. The microscope has a chapter of 50 pages to itself and there are separate chapters on inclusions, luminescence, X-rays, and electrical and magnetic phenomena. Finally there are nearly 40 pages of identification tables and some appendices. The identification tables include 6 black-and-white plates shewing 54 absorption spectra and the appendices include a lengthy list of unusual names for gemstones (misnomers, trade names, and all) as well as a brief bibliography and a list of individually named diamonds.

It is a critic's job to criticize, and if I list a number of minor faults it is in no spirit of denigration of what by any standard is a remarkable and valuable piece of work.

As readers of this *Journal* well know, Mr. Webster's style is straightforward and conversational. Its usual clarity is, however, occasionally obscured by inadequate or misplaced punctuation and by a curious habit of ending a sentence in apparent forgetfulness of how it began (e.g., ' This hardness may be due more to the variation of grain . . . than to an actual greater hardness ").

The absence of footnotes and of references to authorities will probably be welcome to the majority of readers, but it can sometimes be frustrating. Is it worthwhile, for instance, referring to " the Chhatrapati Manick so charmingly described by V. Clarke " without indicating who V. Clarke may be or where the charming description may be found?

Nor is the author always sufficiently exact in his use of words. " A galaxy of lovely colours " is a misuse of language, whatever exciting visions it may conjure up of the night sky in Technicolor! Although the gem gravels of Ceylon may be prolific of zircon, zircon itself cannot be said to be prolific there. And it is regrettable to find that he has repeated the inaccurate description of the monoclinic crystallographic axes from his *Practical Gemmology*.

A book of this calibre deserves a first class index, and perhaps the most serious criticism is inadequacy in this respect. The index runs to 25 pages and must contain some 3,000 headings, but several minerals and occurrences referred to in the text find no place in it, some items indexed have less page references than they are entitled to, and the alphabetical order is not impeccable—some items being out of order because they are misspelt and some for no apparent reason at all. Misprints are rather frequent, but most of them are not significant.

It will be observed, however, that none of these weaknesses in this indefatigable worker's *magnum opus* has much to do with gemmology. Mr. Webster has recorded within the covers of these two volumes an enormous amount of accurate information relating to gems and gem materials, the results of a lifetime of practical study, patient research and laborious record-keeping. Although it will also have an appeal to a wider public, this is essentially a gemmologist's book—on gemmology, for gemmologists, by a gemmologist. To the serious gemmologist it will be—like his microscope, his spectroscope and his refractometer—a useful tool and a valued possession.

J.R.H.C.

ASSOCIATION NOTICES

COUNCIL MEETING

Mr. F. H. Knowles-Brown presided at a meeting of the Council of the Association held at Saint Dunstan's House on 29th June, 1962.

The following were elected:—

ORDINARY MEMBERSHIP

Fraleigh, Jack P., Toronto, Canada
Herring, John T., Radcliffe-on-Trent, Notts.
Zanowitz, Herbert, Willowdale, Ont., Canada
Kidger, John D., Sheffield
Loupekine, Igor S., Nairobi, Kenya
Manning, Edward P., Calcutta, India
Massey, William J., Jr., Birmingham, Michigan, U.S.A.
Miles, Richard S., Nottingham
Sommerfreund, Henry, Panama, R.P.
Tyler, Charles R., London
His Grace The Duke of Wellington, K.G., Reading

PROBATIONARY MEMBERSHIP

Julie Gaydon, Surbiton

Arrangements were made for the 1962 presentation of awards to be held at Goldsmiths' Hall, London (by kind permission of the Wardens) on 5th November. The Council invited Mr. Robert Webster to present the awards and congratulated him upon the publication of his book *Gems*.

MIDLANDS BRANCH

For their annual outing this year, members of the Midlands Branch of the Gemmological Association visited Woburn Abbey, at the beginning of July. The chairman, Mr. W. W. Bowen, had made arrangements with the comptroller of the household for members to view the Abbey in a private party. Members had tea at the Abbey and dinner at Ryton-on-Dunsmore.

EXAMINATIONS IN GEMMOLOGY, 1962

In the 1962 examinations 213 candidates sat for the preliminary examination and 135 for the diploma. Centres for the examinations were established in Malaya, Spain, Norway, Holland, Germany, Hong Kong, Ceylon, Switzerland, Canada, Finland, Sweden, South Africa and United States of America, apart from the United Kingdom.

Upon the recommendation of the examiners the Tully Memorial Medal has been awarded to Mr. P. A. Waters of Manchester. The Rayner prize has been awarded to Mr. A. Cooper of Swinton.

The following is a list of successful candidates, arranged alphabetically:—

TULLY MEMORIAL MEDAL

Waters, Peter Aloysius, Manchester

Qualified with Distinction

Allnutt, Anthony John, London
Bradley, Robert Charles, Didcot
Davidson, Terence Malcolm John, London
Fine, Jay, Orillia, Canada
Fraleigh, Jack, Toronto, Canada
Heidelberger, Martin, Zurich, Switzerland
Hinton, Bernard, Toronto, Canada
Humphreys, Alan Lewis, Andover
Kan, Noah, Hong Kong
Johne, Thor Aksel, Oslo, Norway
Kern, Edward, West Hartford, U.S.A.
Lappalainen, Ritva, Helsinki, Finland
Moi, Gerd, Oslo, Norway
Morgan, Ralph John Alfred, Torquay
Nickolds, Ann Margaret, London
Penner, Ernest, Islington, Canada
Waters, Peter Aloysius, Manchester
Williams, Geoffrey Francis, Esher

Qualified

Aho, Risto Aleksanteri, Laaksolahti, Finland
Asprey, Maurice, London
Bacon, Stephen Jasper, London
Berkel, J. V. M. v., Utrecht, Holland
Blanshard, Philip John Anthony, Croydon
Blyth, Elizabeth Rhoda, Nanaimo, Canada
Borgen, Annemarta, Oslo, Norway
Borgen, Per Otto, Sarpsborg, Norway
Bound, Una Marion, Sidcup
Burke, Frieda, Philadelphia, U.S.A.
Charles, Russell, Camp Hill, U.S.A.
Chesebrough, Rosser, Sherman Oaks, U.S.A.
Crank, Susan Elizabeth, Bolton
Cropp, Alan Reginald, Lucerne, Switzerland
Dowse, John Edward, Birmingham
Egli, Ernest, Geneva, Switzerland
Erichsen, Björn Thorstein Nygärd, Horten, Norway
Evans, Rennie, Toronto, Canada
Farrant, Eric Raymond, London
Fleming, John Alan, Auckland, New Zealand
Foulkes, Peter Clarence Albert, London
Freedman, Israel, London
Gillougley, James Hugh, Glasgow
Gould, Henriette, Johannesburg, S. Africa

Green, Edward William, Scarborough, Canada
Griffiths, John Arthur, Kidderminster
Gronqvist, Tarmo, Helsinki,Finland
Gunaratne, Herbert Stanley, Colombo, Ceylon
Harper, David Charles, Welling
Hollens, John Frank, Pinner
Hudson, Douglas Geoffrey, Whitstable
Johne, Vera Asta, Oslo, Norway
Jokinen, Pertti, Helsinki, Finland
Jones, David Colin Barry, Leamington Spa
Jones, David Winzer, Crawley Down
Klerk, A. F. C. de, Oud-Gastel, Holland
Lee, Raymond George, Torquay
Lieberman, Ian Stuart, Ilford
Leimu, Heikki, Hameeneinna, Finland
Lodge, John William, Newcastle upon Tyne
Marno, Raimo Atte Uolevi, Helsinki, Finl and
Marshall, John Frederick, Sutton Coldfield
Marshall, Nigel, Birmingham
Maunton, Frederick John, Bromley
McChlery, George Michael Armstrong, Glasgow
McGoldrick, Bernard, Liverpool
Moller, Jorgen, Copenhagen, Denmark
Otteren, Karl-Jorgen, Trandum, Norway
Parker, David John, Birmingham
Pettersen, Egil, Fredrikstad, Norway
Petzall, Ossi George, London
Potterat, Raymond, Geneva, Switzerland
Ranger, Clive James, Bromley
Robinson, David Michael, Liverpool
Rybom, Lena, Fredrikstad, Norway
Searle, Ian Victor Herbert, Ilford
Selvon, Dennis Ralph, Woodford Green
Sheriff, Hassan, London
Shotton, John Joseph, London
Thompson, Colvin Graham, London
Tivol, Harold, Kansas City, U.S.A.
Travis, Denis John, Esher
Turnbull, Elizabeth, Sunderland
Turton, Phillip John, Solihull
Tyerman, John Thomas, Harrogate
Virkkunen, Marjatta, Helsinki, Finland
Weighell, Stephen Nicholas, Cullompton
Werkhooven, P. J. K. van, Hilversum, Holland
Weston, Raymond William, Solihull
Wilkins, David, Swindon
Woodhouse, Michael Lesley, London

Preliminary Examination

Rayner Prize

Cooper, Alfred, Swinton

Qualified

Abbott, Henry Charles, Liverpool
Addis, Clare Weston, London
Allaby, Frank Edmund, Warrington
Allnutt, Anthony John, London
Andersen, Ragnhild, Oslo, Norway
Barrett, Robert Clive, Southampton
Bell, Raymond Alexander, Liverpool
Berry, William, Kirkcaldy

Bickley, Michael, Birmingham
Bilby, David, London
Björn-Hansen, Eva, Oslo, Norway
Bowers, John William, London
Bromley, Ivan Paul, London
Brown, Diana Mary, London
Bound, Una Marion, Sidcup
Calmus, Michael, Nottingham
Camberg, Michael Ralph
Johannesburg, S. Africa
Campin, Andrew John, Mansfield
Capel, Donald Edward, London
Chiles, Barry Gordon, Warlingham
Church, Derek Arthur, Wallington
Clarkson, Roland Norman,
Chessington
Cooper, Alfred, Swinton
Coupar, Florence, London
Dambrink, Karel, Apeldoorn,
Holland
Davies, J., Sutton Coldfield
Davies, James Meredith, Worthing
Demaline, John Thomas, Dundas,
Canada
Earnshaw, James Albert,
Middlesbrough
Edmunds, Ronald Charles, Strood
Einari, Virtanen Pentti, Helsinki,
Finland
Engelbert, Peter Harry, Sweden
Evans, Rennie, Toronto, Canada
Fairbotham, Alen Geoffrey,
Middlesbrough
Fleming, John Alan, Auckland,
New Zealand
Fraley, Lawrence, Wheelersburg,
U.S.A.
Fuller, Robert George, Ruislip
Gann, David Alexander, London
Gatrell, Michael Leonard, London
Gatward, Robert Bradley, Caterham
Gaydon, Julie Hazel, Surbiton
George, Stanley William, London
Giblin, Michael, Bury
Hall, Lilian Rosemary, London
Hall, William Hardwick, London
Hamp-Gopsill, Garth,
Burton-on-Trent
Herring, John Thomas,
Radcliffe-on-Trent
Hopkins, Peter James, Derby
Horton, Joanna Percival, Plympton
Houghton, Michael John, London
Huddy, William John, Newton
Abbott
Hudson, Felix, Dundermline
Humphreys, Alan Lewis, Andover
Hutchings, Peter Frank, Birmingham
Kallioniemi, Eero, Tampero, Finland
Kan, Noah, Hong Kong
Kari, Raija, Lahti, Finland
Kenney ,Francis Joseph, Hockley
Kudlatz, Harold, Glasgow
Kiuas, Eljas-Jussi, Pukinmäki,
Finland
Krzempek, Evelyn, Nottingham
Lamb, Michael, West Bromwich
Lampert, Ronald John, Plymouth
Lammond, Joseph, Liverpool
Lewis, Sylvia, London
Lugtigheid, Gerharda, Oosterbeek,
Holland
Manning, David, London
Major, Keith Roy, East Grinstead
Meddings, Ann Elizabeth,
Burton-on-Trent
Miles, Richard Stanley George,
Nottingham
Moller, Jorgen, Copenhagen,
Denmark
Morgale, David Alex, London
Morton, Ian, London
Mundie, Ian, Falkirk
Nickolds, Ann Margaret, London
Olswang, Kenneth Joseph,
Manchester
O'Toole, John, Liverpool
Otteren, Karl-Jorgen, Trandum,
Norway
Paine, Alan, Glasgow
Panjabi, Hero, Hong Kong
Porter, Hamish Robb, Carnoustie
Quartermaine, Helen Laurie,
Kuala Lumpur, Malaya
Reekie, Robert, Kirkcaldy

Ripatti, Ida Maire Lrene, Tapiola, Finland
Roca Salamanca, Rogelio, Barcelona, Spain
Rooke, Kenneth Turner, Aylesbury
Rudman, Philip, Oldham
Sanz, Miguel Angel, Barcelona, Spain
Saunders, Robert, London
Scholl, Werner, Zollikerberg, Switzerland
Schwartz, Raymond Noah, London
Searle, Ian Victor Herbert, Ilford
Sher, Morris Michael, Glasgow
Sheriff, Hassan, London
Silva, S. P. Ranjee de, Hong Kong
Smith, Benjamin Henry Jr., Wilmington, U.S.A.
Snell, Richard Geoffrey Fox, Bournemouth
Spacey, Peter William, Sutton Coldfield
Storgmeir, Inkeri, Orapihlajatie, Finland
Straiton, Timothy, Hove
Szejko, Anna-Liisa de, Linnaistentie, Finland
Szejko, Wiktor Ingolf de, Linnaistentie, Finland
Talbot-Ponsonby, Peter William, London
Tarkiainen, Paavo Akseli, Helsinki, Finland
Tarratt, Christopher David, London
Taylor, John Livsey, Blackpool
Teisala, Hannu Herkko, Helsinki, Finland
Thorne, Anthony Reginald, Devonport
Tivol, Harold, Kansas City, U.S.A.
Trotter, Michael Duncan, Birmingham
Vogel, Georg, Lucerne, Switzerland
Walton, Edward Bryan, Chester
Weighell, Stephen Nicholas, Cullompton
Wesselingh, Ank, Zoeterwoude, Holland
Wight, Peter Martin, Wallasey
Wilson, William David, Liverpool
Wood, Mary Bayne Haddow, Sidmouth
Wyer, Philip George, Birmingham
Yates, Paul, London

OBITUARY

The Council has recorded with regret the death of Ing. Johannes Hammes, of Zeist, Holland. Mr. Hammes was the foundation President of the Netherlands Gemmological Association and a former President of the Examining Committee of the Netherlands Goldsmiths' & Silversmiths' Federation, an organization with which he was associated for many years. A pioneer gemmologist in the Netherlands he became a Fellow of the Gemmological Association in 1948. He wrote an important work *Goud, Zilver, Edelstenen.*

SPECIALIST COURSE ON GEM DIAMONDS

A specialist course on gem diamonds was commenced at the School of Jewellery and Silversmithing, Vittoria Street, Birmingham, at the end of September with Norman Harper, F.R.G.S., F.G.A., as lecturer and demonstrator.

This Course is the first of its kind to be established in Europe, and admission is restricted to qualified Fellows of the Gemmological Association of Great Britain. The Course was heavily oversubscribed. The Syllabus is comprehensive and practical, and diamonds in their cut and polished form have been made available for practical work.

GIFTS TO THE ASSOCIATION

The Council of the Association acknowledges with gratitude the following gifts:—

Samples of howlite, stained blue to imitate turquoise, from Mr. R. Webster.

An anonymous donation of £50 for the Association's library.

An opal doublet and pieces of rough opal from Wilson & Gill Ltd., London.

Six demantoid garnets and a pink tourmaline from Mr. Dean Field, Toronto.

LETTER TO THE EDITOR

DEAR SIR,

In your Vol. VIII, No. 7, July 1962, Letter to the Editor, F. S. H. Tisdall asks about sapphires and short-wave ultra-violet light.

Perhaps the answer is given in the chapter " Fluorescent Gem Stones and Lapidary Material" in the book "Ultraviolet Guide to Minerals" by Sterling Gleason (Van Nostrand, 1960). The following is an extract of his remarks on sapphire:

" Titanium, often present, is credited with producing the typical sapphire blue and probably modifies the fluorescent color in many sapphires. Iron, frequently found, accounts for the number of stones that are nonfluorescent.

"Blue natural sapphires are often nonfluorescent, but a good many, particularly those from Ceylon, fluoresce red to orange or salmon, long wave. Some stones fluoresce blue, short wave.

"Synthetic blue sapphires also are often, but not always, nonfluorescent. Experts are able to pick out the natural from the synthetic stones in a tray of mixed stones by the different shades of greenish-blue fluorescence under the short waves".

Yours sincerely,

New York. GORDON V. AXON.

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Names of authors are printed in small capitals, subjects in lower case and abstracts are indicated in italics

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